

Informatica 2

collegehandleiding

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september 1999

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Introductie

Het ontwerpen en vormgeven van interactieve producten en diensten, zoals bedrijfspresentaties, informatiekiosken, CD-ROM titels, front-ends voor multimedia databases en websites, begint een steeds belangrijker onderdeel te worden van de (mogelijke) praktijk van een industrieel ontwerp(st)er. Daarnaast groeit het aantal producten dat multimedia informatie bevat of toegang daartoe biedt explosief. Steeds meer producten worden uitgerust met visuele interfaces, die de gebruiker informatie over het functioneren van het product geven. Denk hierbij aan afstandsbedieningen, zaktelefoons, game-boys, faxmachines etc. Tenslotte zorgt de stormachtige ontwikkeling van het Internet ervoor dat steeds meer informatie in een dynamische, interactieve context gepresenteerd en tot zich genomen moet worden.

Voor de industrieel ontwerper heeft dit een aantal belangrijke gevolgen:

- Het product als tastbaar, materieel object verdwijnt steeds meer naar de achtergrond ten koste van de informatie of de dienst, waartoe het toegang moet bieden. Natuurlijk is het voor een mobiele telefoon nog steeds belangrijk dat hij prettig in de hand ligt, dat de knoppen groot genoeg zijn etc. De functionaliteit van een dergelijke telefoon wordt echter veel meer bepaald door het soort abonnement dat de consument bij aankoop heeft afgesloten. Het product dat wordt gekocht is niet de telefoon zelf, maar de diensten waartoe de telefoon toegang biedt. Het is dan ook niet ongebruikelijk dat men bij het afsluiten van een abonnement de telefoon gratis erbij krijgt, waarmee het object een aanzienlijk deel van zijn materiële waarde verliest.
- Door de voortdurende minituarisering dringen steeds meer producten binnen in iemands persoonlijke, fysieke ruimte. Hing een telefoontoestel 25 jaar geleden nog in de gang, nu dragen steeds meer mensen een mobiele telefoon op hun lichaam. Hierop is echter slechts plek voor een beperkt aantal producten, die bovendien, net als kleding, sieraden e.d., een onderdeel gaan vormen van het imago dat de gebruiker wil uitdragen. Een ontwikkeling als embedded technology, waarbij technologie wordt geïntegreerd in kleding, probeert hierop in te spelen.
- Het accent verschuift van het uitvoeren van taken, handelingen met een duidelijk, vooropgesteld doelen met vaak bovendien en beperkte tijdsduur, naar het ondergaan van ervaringen, waarbij sprake is van gedragingen zonder een vooraf duidelijk vastgesteld doel, welke zich ontwikkelen gedurende een langere periode. 'Surfen' op het World Wide Web, browsen in een multimedia database en het spelen van een computerspel zoals Quake zijn voorbeelden van dergelijke ervaringen. De interface vormt hierbij niet meer zozeer het middel om een gewenste taak te kunnen uitvoeren, maar meer een omgeving, die de gebruiker in staat stelt tot ondergaan van zo'n ervaring. Het ontwerpen van dit soort omgevingen vereist een andere aanpak dan de traditionele, taakgerichte ontwerpmethodieken.
- Bij het ontwerpen van fysieke producten zijn in de loop der tijd conventies ontstaan tussen de vorm, de functie en het beoogde gebruik van het product. Een stoel heeft in zijn verschijningsvorm een aantal uiterlijke kenmerken die door de gebruiker worden herkend en vervolgens op basis van die conventies met een bepaalde functie (zitten), omgeving (klassiek) of gedrag (statig) in verband worden gebracht. Voor de ontwerper betekent dit dat hij of zij door het bewust aanbrengen van dergelijke kenmerken een bepaalde omgang met het product aan de gebruiker kan uitlokken. Dergelijke conventies hebben zich bij interactieve producten en diensten nog niet of nauwelijks ontwikkeld. Hierdoor wordt de ontwerper gedwongen om veel explicieter te zijn in het aanduiden van de gebruiksmogelijkheden van een product, bijv door het toevoegen van meerdere vormen van terugkoppeling. Bovendien zorgt het ontbreken van conventies er voor dat de gebruiker gedwongen wordt tot exploratief gedrag, iets wat het ontwerp van het product of de dienst zal moeten toestaan.

Wil je als industrieel ontwerper een actieve rol spelen in deze en toekomstige ontwikkelingen, dan zal je je nieuwe kennis, technieken, gereedschappen en vaardigheden eigen moeten maken. Traditionele materialen zoals hout, staal en plastic worden vervangen door of gecombineerd met diverse media, zoals beeld, tekst, geluid, video en animaties. Het maken van schetsen en schuimmodellen zal moeten worden aangevuld met het maken van interactieve prototypen, waarmee ontwerpideeën kunnen worden gepresenteerd en getest. Hiervoor zullen nieuwe computerprogramma's, zoals beeldbewerkingspakketten en authoringtools, moeten worden geleerd. Ook zal de industrieel ontwerper moeten leren om te gaan met abstracte begrippen als 'ruimte', 'tijd', 'actie', 'feedback', 'informatie-architectuur' etc.

Informatica 2 Informatica 2 heeft als onderwerp het vakgebied dat zich bezighoudt met het ontwerpen en vormgeven van dergelijke interactieve producten en diensten wordt aangeduid met de term "Interaction Design" of "Interactie Ontwerpen". In deze nog jonge discipline dient de ontwerper creatieve, analytische, communicatieve en technische kennis en vaardigheden in te zetten met als doel de ontwikkeling van producten en diensten, die de gebruiker in staat stellen tot het beleven van dynamische, (inter)actieve ervaringen, waarin gebruiker en systeem met elkaar communiceren en interacteren.

Het is de taak van de ontwerper om dit soort ervaringen mogelijk te maken door het ontwerpen en vormgeven van betekenisvolle verbanden tussen inhoud, structuur, gedrag en vorm van het systeem. Kennis, methoden, technieken, gereedschappen en vaardigheden uit verschillende discipline zoals grafisch ontwerpen, software-ontwerpen, product ontwerpen, maar ook de cognitieve psychologie, zullen hiervoor moeten worden ingezet. In dit vak zal hiervan een, zij het beknopt, overzicht worden geboden. In colleges zullen verschillende aspecten van Interaction Design worden belicht, gezien vanuit het perspectief van de industrieel ontwerper. In het practicum zal enige vaardigheid worden opgedaan in het ontwerpen en bouwen van interactieve prototypen met behulp van een multimedia authoringtool. (Zie de practicumhandleiding behorende bij dit vak).

Diktaat Omdat Interaction Design een jong vakgebied is, is de hoeveelheid goede literatuur nog niet erg groot. Op onze speurtocht naar een geschikt boek voor dit vak zijn wij helaas geen exemplaar tegen gekomen dat aan al onze eisen voldeed. Daarom is besloten, mede om de kosten te drukken, om een aantal geschikte artikelen te selecteren en die te bundelen tot een diktaat. Een dergelijke opzet heeft echter onvermijdelijk gevolgen voor de samenhang binnen zo'n diktaat, aangezien verschillende bronnen zijn gebruikt. Voordeel is echter wel dat verschillende aspecten vanuit meerdere standpunten worden belicht, waardoor een beter overzicht van het vakgebied wordt verkregen.

Het diktaat is als volgt opgedeeld:

1. *Context* Geeft een overzicht van de technologische en maatschappelijke omgeving waarbinnen de interactie ontwerper te werk zal moeten gaan.
2. *Proces* Hierin wordt inzicht gegeven in het ontwerpproces van interactieve producten en diensten, waarbij met name aandacht wordt besteed aan de denkwijze van de ontwerper.
3. *Tools en technieken* Bevat een tweetal artikelen waarin verschillende manieren waarop de interactie ontwerper zijn ideeën kan presenteren en evalueren worden behandeld, evenals de verschillende (computer)gereedschappen die daarvoor nodig zijn.
4. *Ontwerp* Hierin komen verschillende ontwerpaspecten en -elementen aan de orde die de interactie ontwerper tegen kan komen op de weg van probleem naar oplossing.
5. *Case studies* Bevat een tweetal voorbeelden van projecten uit de praktijk.

1 Context

Het ontwerpen van nieuwe producten en diensten vindt plaats in een spanningsveld dat wordt gevormd door de mogelijkheden en ontwikkelingen op technologisch gebied enerzijds, en de behoeften en trends op sociaal-cultureel gebied anderzijds. Het is de taak van de ontwerper om binnen dit spanningsveld een juiste balans te vinden om zo te komen tot betekenisvolle producten. Het is dan ook essentieel dat de ontwerper zich vooraf een beeld vormt van de technologische en maatschappelijke context waarin het product gebruikt zal gaan worden. Te meer omdat de ontwikkelingen in deze context in een steeds sneller tempo plaatsvinden.

In de eerste twee artikelen in dit hoofdstuk, 'The socio-cultural horizon' en 'Technologies in prospect' wordt een dergelijk beeld geschetst. Beide artikelen zijn afkomstig van het 'Vision of the Future' project van Philips. Doel van dit project was het ontwikkelen van ideeën voor producten en diensten voor het jaar 2005. Om ervoor te zorgen dat deze ideeën werden gevoed vanuit de verwachte behoeften van gebruikers i.p.v. vanuit de verwachte technologische ontwikkelingen, is uitgebreid onderzoek gedaan naar deze behoeften. De trends en ontwikkelingen zoals die worden beschreven in beide artikelen, vormen hier een weerslag van.

Uiteraard zul je als interactie ontwerper slechts zelden in de gelegenheid zijn om een dergelijk uitgebreid vooronderzoek te doen. Van belang blijft echter dat je je de gebruiker en zijn ervaringen niet geïsoleerd beschouwd, maar altijd in relatie tot de context waarin deze ervaringen plaatsvinden, nu en in de toekomst.

Dit belang wordt nog eens onderstreept in het derde artikel 'The future is a direction, not a place'. Hierin wordt gesteld dat de traditionele manieren waarop tegen interactive systemen wordt aangekeken, tekort schieten om de steeds dynamischer en complexer wordende context goed het hoofd te kunnen bieden. Een andere benadering, waarbij de gebruiker en het systeem worden beschouwd als actieve, met elkaar interacterende elementen in een informatie ecologie, wordt daarom geïntroduceerd. Hierbij wordt met name aandacht besteed aan de veranderende rol van de ontwerper, die deze benadering met zich meebrengt.

- Bronnen** *'The socio-cultural horizon', Vision of the Future, V+K Publishing (1996) pp. 29-35*
- 'Technologies in prospect', Vision of the Future, V+K Publishing (1996) pp. 37-43*
- Rijken, D. *'The future is a direction, not a place' SIGCHI Bulletin Vol 26 No 3 (1994) pp. 53-59*

"The trouble with our times," wrote the French poet Paul Valéry, "is that the future is not what it used to be." Once we seemed to be evolving gently towards the future. Now the pace of change is accelerating exponentially and the future seems to be racing towards us. Time itself is becoming compressed. And not only time. Communications networks are squeezing distances and bringing us closer together: space, too, seems to be contracting.

The ubiquitous chip, the integrated circuit, is largely responsible for these dramatic changes in our experience of these two primary dimensions. Many homes now contain more computing power than was available in the whole world fifty years ago. In minutes, we can gather information from almost anywhere in the world that armies of clerks once needed months to find. Each year, real-time video telephony and electronic mail are becoming more widespread.

One psychological result is that we no longer see ourselves as static in relation to time and space: we feel time is accelerating and we must keep up with events occurring in the world around us. Another is that as we become more mobile physically, and more connected 'virtually', space too seems to enlarge, making us 'virtual nomads' with few fixed points of reference.

It is this development that seems to underlie many of the emerging and latent trends in industrialised societies. Based on extensive research on cultural change, and taking the dimen-

model which was then applied to specific real-life situations in order to pinpoint potential trends in society. These were then compared with the views of an international panel of experts. Throughout, we sought points of convergence with the work of respected futurologists such as Toffler, Naisbitt, Gaudin, Popcorn and others. The result was, we believe, a relatively clear picture of socio-cultural attitudes and preoccupations in the year 2005.

time

There are at least two ways in which people perceive time today. One is as an ever-accelerating rate of living. People have a sense that a lot is happening at once, that they are doing many things at the same time, that they never have enough time, that they are constantly struggling to keep up with the demands of modern life. Another contrasting way of perceiving time is as essentially non-existent. Those are the moments when time seems to stand still: moments of rest, meditation or wonder. They are also the moments when we become aware of our relation with the past, our heritage, and when we see ourselves as part of a continuing tradition.

These two modes of perception sometimes appear to be opposed and even incompatible: the pressing demands of the present and the immediate future often prevent us from appreciating the larger picture. The sense of time as rushing along, as frantic activity, seems to be a phenomenon of our present age, whereas an

quality time

Since time can no longer easily be defined in terms of the alternation between periods of activity and rest, people have started to restructure according to new criteria. One of these is the depth of meaning it gives to their lives.

As the present moment becomes crowded with activity, there is a danger that in the relentless rush to be busy we will lose sight of ourselves and become severed from our roots. To try to restore the balance between activity and rest, between being swept along and being anchored, people are starting to seek meaning by looking at their own personal or family histories, trying to bridge the gap between past and future. The current interest in the past, in our roots, and in what, individually and collectively, we have been and will become, is an expression of our need to find that dimension of quality and depth of experience which we fail to find elsewhere, either in the rapidly changing present or in an unpredictable future.

space

As with time, there are two ways of perceiving space. On the one hand, people are defining space in narrow, local terms: on the other hand, they are eliminating as many boundaries as they can.

a sense of place

We, as people, like to have our own clearly defined space. We need to be able to trace its borders, to make it comfortable and recognisable our

become confusingly complex and difficult to control.

This is a development that can be seen on many levels. With the break-up of former Communist states, we have seen the resurgence of many national and ethnic identities which had been suppressed for decades. Religious fundamentalism may be considered a similar assertion of group identity, albeit less geographically defined. On a more personal level, we see a tendency for people to withdraw into the security of their own home and social group, rather than participate in community activities and projects. This trend is often referred to as 'cocooning', the sense of feeling comfortable in one's own territory. Personalising one's own space like this leads naturally on to the personalisation of other possessions as a statement of identity.

no borders

However, while some identities are being reasserted, in other contexts they are being merged. On the political level, we see increasing cooperation, as shown in the gradual integration of Europe and the establishment of large free trade areas in the Americas. On an individual level, cooperation and integration is also increasing. Thanks to telephony, e-mail and remote technologies, we can effectively be present in places far away. We can communicate over vast distances with an immediacy and ease that were unthinkable only a few generations ago. We can also join together in 'virtual' communities while remaining members of our own local physical community. As a result, our

limit our ability to communicate with people in distant places.

socio-cultural trends

These perceptions of time and space are two major parameters which will determine how people act and think in the coming years. However, these perceptions will interact with a number of other, more specific trends to give rise to a wide variety of behaviour patterns. We identified a number of these, to which we gave the following names: Subjectivity, Sociability, Exploration, Connectivity, Ethics and Holism.

subjectivity

In the present age, more than in any previous age perhaps, people are searching for identity. Recent developments in society, a falling-away of certainties and the destabilisation of monolithic power blocs and sources of authority have created in many people a sense of doubt about their own position. In addition, the rapid pace of modern life is leading many people to take time out to reflect more on what the 'true' values of life – specifically their own life – might be.

sociability

In order to truly be ourselves, we need other people. The traditional source of reaffirmation and support has always been the family. However, this unit has been fragmenting steadily over recent decades. As members of the family rush in and out, on their way to and from activities outside the home, occasions such as family meals and even holidays are tending to happen less frequently. Pursuit of employment often leads fam-

the country or world.

Naturally, people have been trying to stay in touch with each other. Traditional means, such as letters, notes and the conventional telephone, are now being supplemented by answering machines, mobile phones and e-mail. As a further development in the near future, families may evolve in two directions: both will lead to a reinforcement of relationships. Firstly, we may witness the reappearance of collective activities within the home. Sing-songs around the piano are not likely to return, but using the computer, for instance, which is generally an individual pursuit, may become more sociable if the functions of television and computer are combined. Secondly, we are likely to see the emergence of products and services which link up people living far apart in much more emotionally satisfying ways than are currently available.

exploration

A sense of curiosity and exploration has always been an important part of the human spirit, but the manner and the extent of its expression may vary from period to period and from culture to culture, depending on the prevailing social, political, economic and technological circumstances. Today, technology is offering us ways of exploring a new world—that of 'cyberspace', the 'virtual' world—as well as finding out more about our 'real', physical world. This new spirit of adventure is most clearly visible in the current interest being shown in the Internet and virtual reality. The idea of 'surfing' around the globe, hopping from one World Wide Web site to another, e-mailing to people you have never met and arranging

meetings in cyberspace, has surely captured the popular imagination in much the same way as talk of the New World of the Americas must have done in the sixteenth century.

Geographical exploration was not the only manifestation of the Renaissance spirit: science, theology and the arts were explored as well. Today we see a whole range of activities which also express a mood of adventure and exploration. Probes and extra-terrestrial telescopes explore space, while microsurgery and genetic engineering investigate micro-environments. On a more everyday level, the quest for 'extreme' experiences such as those provided by dangerous sports and drug-use may all be seen as part of the same trend.

connectivity

People are increasingly viewing the world as a place in which all the various parts are connected with each other. Improvements in satellite links, the advent of digital broadcasting, the emergence of cellular telephony and the rapid growth of computer networks are heightening this sense of connectivity. And, for businesses, global markets are making it necessary to take into account what is going on outside their home territory.

There is an appreciation that getting in touch with someone else is not as difficult as it may once have seemed. Even world political and business leaders are 'accessible' on the World Wide Web. Greater media coverage of celebrities and flatter corporate structures have also meant that the psychological distance between people operating in different spheres has shrunk dramatically.

This development is reflected in a variety of individual behaviour patterns. One of the more obvious of these is the increasing use of telelinks: telephone, pagers, text, fax and on-line computer connections. Many of these provide immediate feedback. This is important in a complex society in which we need to manage the different aspects of our lives. We can do this if we can link up rapidly with all sorts of 'experts' or sources of information. These may be official sources or they may simply be colleagues or members of our family who are in possession of information. This explains why mobile telephony is spreading at a tremendous rate, and it also suggests that new on-line services via Internet or interactive television will proliferate in a similar way.

ethics

The search for new rules and values is becoming apparent in various fields, from politics and business to the environment. In many countries around the world, political and judicial authorities are conducting campaigns against corruption. And many people and companies are responding to appeals made to their personal responsibility to respect the environment and are actively working to conserve energy and minimise waste. The individual and the family are becoming more pro-active in their own ethical codes and values. With developments in the fields of communication and networking, there is a need to stimulate the creation of new rules which support these developments.

holism
Holism deals more specifically with the search for environmental balance, with the trend towards seeing ourselves, the natural world and the man-made environment as constituting a whole. We are increasingly becoming aware that treating the environment carelessly in one country can affect the health and well-being of the inhabitants of another. And the global threat posed by the depletion of the ozone layer and its link with matters as diverse as the use of aerosols in the home, commuting by car and the felling of trees in the Amazonian rain forests has reinforced the feeling that 'we are all in this together'. In addition, the migration of individuals from poorer to richer countries is directly confronting people with the needs and attitudes of others.

This leads some people to be 'green activists' or to work for human rights and civil liberties around the world. Others simply modify their behaviour, avoiding environmentally questionable products in the supermarkets, buying lead-free fuel, or not wasting water. Though eco-awareness may vary from place to place and take many different forms, it will undoubtedly have a far-reaching effect on everyone's lives in the near future.

This holistic attitude is no longer simply reflected in conservation, however. On the contrary, it is developing into a tendency towards the elimination of all boundaries between ourselves and our environment in the widest sense. It even extends to the mind and the body. There is a growing appreciation that health and well-being depend not only on physical

fitness or taking medication. They also require a balanced lifestyle.

emerging sensitivities

By combining the variables of space and time and the socio-cultural trends described above, we were able to develop an idea of how people will behave in the future. Specifically, we identified a number of socio-cultural 'sensitivities' which would serve as useful input to the design process.

These sensitivities are potential or latent trends affecting human behaviour, psychology and culture. They are the outcome of a social 'chemical reaction'. How they develop further will depend on how society in general reacts to them. They may be accepted, rejected or simply ignored. If they are accepted, they may ultimately develop to become well-established trends.

clouds, showers and hailstones

Neither the content of a sensitivity nor the speed or path of its evolution is pre-determined. However, we can distinguish at least three phases through which it may potentially pass. A sensitivity, like a cloud, may disperse, remain nebulous or become heavier. In other words, if a sensitivity is ignored or if circumstances discourage its further development, it will either disappear or remain in embryonic form. However, if it is picked up by society and is sustained, it will begin to spread through the community. Finally, given the right conditions, just as raindrops may solidify and fall to earth as hailstones, so sensitivities can become sufficiently substantial to penetrate society and eventually become the norm.

technologies in prospect

the socio-cultural horizon

technologies in prospect

The fact that society is increasingly unpredictable makes any strictly deterministic approach difficult: the best we can do is indicate the existence of these potential or latent developments. The final stage of development they will reach can only be discerned in hindsight.

The following examples are three of many sensitivities which are used to illustrate the maturity of a trend.

living apart together

A sensitivity which is currently at a very early stage is the tendency for certain people to be willing to enter into a close relationship which, because of a geographical distance or because of a reluctance to be confined in a conventional relationship, is lived out in alternating periods of separation and togetherness. The periods of togetherness may be only sporadic but they are experienced intensely. It is difficult to know at the moment whether this type of 'living apart together' relationship will become more or less widespread or whether it will simply remain the occasional phenomenon it is at present.

virtual communities

A sensitivity that has been absorbed by broad segments of the population in advanced societies but which is not yet entirely reflected in consumer behaviour is the tendency towards 'virtual' communities. This involves establishing relations via computer networks with other people (individuals or small groups) with whom we feel an affinity, wherever they are in the world. In the

locality. Through the widespread use of communications technologies, that limitation can now be removed.

the multi-dimensional consumer

Finally, a good example of how a sensitivity can be sustained and combined with others to produce a well-established trend is the recent rise in industrial societies of the multi-dimensional consumer. Until a few years ago, it was possible to identify clear-cut groups in society whose members could all be expected to show the same behaviour in a variety of respects. However, we now see that the consumer's behaviour is often quite unpredictable. People are adopting a flexible, pick-n-mix approach to their lifestyles and habits, and there is little pattern to the variety that occurs.

Predicting the potential of a technology is difficult because its success depends not only on its intrinsic value as an innovation but also on a wide variety of 'real-world' variables. These include commercial viability, social need, governmental policies, international standards, and often other technologies which may boost its widespread acceptance.

In reviewing technologies which now exist or look extremely promising, we decided to concentrate on those which have the most realistic chance of success and which are most relevant to Philips' field of operations: electronic engineering, software, materials, lighting technology, telecommunications and medical systems. We concluded that the most far-reaching changes in the next decade are not likely to be the result of dramatic new innovation. Rather, they will almost certainly result from the focusing, refining and merging of existing technologies and their extension to more areas of our lives.

computing power

Silicon chips – small pieces of silicon on which large numbers of electrical circuits are integrated – have been doubling in power every eighteen months for the last two decades. Exactly how long this process can continue is uncertain, but many people believe that it will go on at this rate at least until the turn of the century, and probably beyond. Indeed, it is possible that by the year 2000 we will be able to store more information than we currently either want or need. In addition to

physically smaller and more functions can be accommodated on the same surface area.

voice recognition and synthesis

The recognition and synthesis of human speech requires vast amounts of memory and computing capacity because everyone's voice is different and every utterance is acoustically unique. Recognition systems currently available can only cope with either limited vocabularies (as with some telephone information services) or input from a limited number of users (as with computer instruction programs and speech-to-text dictation systems). As chip capacity increases, these limitations will be overcome.

Speech-synthesis chips which turn text into speech will soon be possible and could, for example, be incorporated into fax machines to read messages aloud to blind or partially-sighted recipients.

software agents

Software developments are increasingly enabling systems to 'think for themselves'. Artificial intelligence is now reaching the stage where systems can be programmed to predict situations and outcomes based on previous experience, and then take action accordingly. By using 'fuzzy logic' (reasoning and acting on the basis of approximate data), systems can continue to operate efficiently where accurate data is either not available or not strictly necessary – in much the same 'rough and ready' way we ourselves often work.

mands or instructions from the user. Nothing happens unless these commands are entered by keyboard, mouse, touch screen or button. The device is passive and offers us no help unless we ask for it. However, software companies are currently developing what are called software agents.

These are software programs which 'know' what the user wants to do and can act autonomously on his or her behalf. The user will put a problem to the agent, and the agent will then monitor events and perform tasks which meet the user's goal. It will search for information the user needs regularly. It will monitor changes, and even represent the user where necessary. It will learn from experience, automating regular patterns. At any one time we may have a number of these agents working for us: they will be able to expand their knowledge base by learning about us from each other.

It will be rather like having a small community of personal 'helpers'. This is a development which is almost certain to change the way we interact with other devices around us. We will begin to view them in a more personal way, as devices which work together with us. And this, in turn, will make it increasingly natural for us to communicate with them through human channels, such as speech and gesture.

virtual reality

In combination with sensors which detect our movements and devices which convey the sensation of touch to our bodies, software programs can rapidly generate computer images and

There are many applications in the area of games and amusement. And virtual-reality devices can also be used to allow us to experience dangerous or otherwise difficult activities in a realistic way, such as training people to cope with hazardous situations or perform complex operations.

smart materials

Seemingly inert materials will become intelligent and start interacting with their surroundings. They will develop their own 'senses' and, chameleon-like, change their characteristics depending upon their environment. Old materials will combine their individual strengths to create powerful new materials. But as well as 'improving' on nature, we are also discovering how much we still have to learn from it. Smart materials modify their behaviour under specific circumstances, changing their shape, stiffness, position, natural frequency or other mechanical characteristics in response to changes in temperature or electromagnetic fields. Such materials are already in use in the aerospace and engineering industries.

There are several different types of these materials. Shape-memory alloys, for instance, are metals which, at a certain temperature, will return to their original shape after having been stressed. Piezo-electric materials expand and contract in response to an applied voltage, while magnetostrictive materials expand in particular magnetic fields. There are also liquids which increase in viscosity in response to a stimulus. These materials display a

plastics become active
Once plastic was only used as an insulator. However, by creating a structure made up of several layers of plastics, each with a different electrical charge, it will be possible to simulate the effect of touch. In this way, a robot's hands could be made much more sensitive; or we could develop sensitive prostheses for disabled people.

back to nature
Natural materials change under the influence of use and age. In comparison, plastics change very little. Yet the ageing of natural materials, although detrimental for the functioning of objects made of them, is nonetheless often perceived as imparting a certain beauty – the noble patina of age. Old plastic, on the other hand, is rarely admired. It would be ideal if plastics could be enhanced by giving them certain properties of natural materials. One line of experimentation in this area is to make new 'plastics' from natural materials such as cellulose.

In another development, known as 'biomimicking', scientists are increasingly looking to nature to find new ways of improving artificial materials. They are building into them extra properties or functions, in much the same way that nature builds many functions into a single material. Human skin, for example, incorporates sensation (nerves), cooling (perspiration glands and pores), heating (hair), protection from the sun (melanin formation), and so on.

sensing the world
Important advances are also being made in manufacturing. Using 'nanotechnology', the micro-electronic techniques developed in chip technology, researchers are creating a variety of microscopic devices which go beyond

merely switching electronic circuits. New technologies make it possible to produce what are known as micro-electromechanical systems (or MEMS, for short). These are constructions built on the scale of chips, one-millionth of a millimetre thick. They make it possible to link up micro-electronics (both hard- and software), mechanics and chemistry. One type of micro-electromechanical system consists of a pillar on which a tiny beam is mounted. This beam can move or vibrate in response to some external stimulus. By measuring that microscopic movement, we can 'sense' the presence of the stimulus.

MEMS are already used to detect the degree of deceleration that a car undergoes during a collision to make the airbag inflate at the right moment. The deceleration sets the beam in motion and the extent of the motion is what is 'sensed'. But this application, significant as it is, is only the beginning. MEMS also make it possible to sense smell. Smell consists of molecules, and if a molecule of a particular weight settles on a beam which is continuously vibrating, the rate of vibration will change due to the weight of the extra molecule. Detect the extent of that change and you have detected the smell.

new light technologies
The field of lighting will see exciting new developments in the near future. These include technologies for the transmission of light over considerable distances, along glass fibres or light-reflective tubes. Light will also become flexible, with the introduction of light-emitting polymers.

remote-source lighting
Remote-source lighting allows light to be produced at one location, transmitted along a pipe with minimum loss, and then released at particular points. An entire underground car park, for instance, could be illuminated from a single source using this system. Besides offering the possibility of 'tapping off' light anywhere, it also facilitates maintenance.

light-emitting foils and polymers
A quite different type of lighting currently under development is one which allows thin, flexible 'sheets' of light. These involve the use of phosphorescent layers on polymer foil to which electrical charges are applied. This flexible light 'sheeting' could be used to provide backlighting for control panels and could also be used in emergency contexts, being incorporated into clothing, for instance. It is completely safe and can be touched without danger.

Another development is light-emitting polymers which involve multiple layers of 'doped' plastics (plastics which have been made conductive). Light is created by electrons jumping from one layer to another.

fibre optics
The technique of transmitting light along glass or plastic fibres is known as fibre optics. It can be used for applications as diverse as exploratory surgery and animated billboards. In more familiar realms, we will soon see fibre optics appearing in the car, with lighting generated at a single source and relayed through the entire lighting

system – headlights, rear lights, interior lights, and so on. Not only will this make maintenance easier, it will also save space.

faster data transmission
The principles of fibre optics also allow a highly efficient method of signal transmission using a rapid series of light pulses. Fibre-optic networks are now used to transmit voice, video images and data. They are up to a hundred times faster than traditional copper wiring. The voice, video and data are translated into digital signals (in this case, light signals).

Fibre-optic transmission can be made even faster. Every time a light signal has to be converted into an electronic signal for intermediate switching or processing purposes, the rate of transmission is slowed down. To solve this problem, fully optical networks are currently being developed. These eliminate all such conversion moments, so that the only time light signals are converted into electronic signals is at the very end of their 'journey', when they enter a computer for final processing.

Speeding up the transmission process will create greater capacity for data. But increasing speed will not be enough to cope with all the signals we will want to send. Real-time video with realistic movement, for videoconferencing or video-conferencing for instance, requires a lot of signals to be transmitted in an uninterrupted stream. New ways of compressing data and of sending more at one time will therefore be needed. One method that is currently being investigated involves treating the light signals rather like radio sig-

nals, transmitting them on a particular frequency and then receiving them by tuning in to the same frequency. Non-video data, which does not need to be transmitted in a continuous stream, can be transmitted in 'packets', i.e. messages can be split up into small parts which can then be transmitted separately along whichever route is available and reassembled at the receiving end.

telecommunications
Global telecommunications is big business, and wireless telecommunications is its fastest-growing segment. Analysts' predictions made in 1983 as to how many Americans would be using cellular phones by the turn of the century have already been exceeded twentyfold. Annual growth in North America is now running at 50%, and the figure is even higher in Western Europe, Australia, Asia and parts of South America. This great demand is forcing regulatory bodies to make more spectrum available and service providers to make more efficient use of that spectrum by using digital technology.

digital assistant
The first development beyond the mobile phone is the personal digital assistant. This is a wireless handheld computer which can handle text, graphics and audio. It is essentially an enhanced mobile phone with extensions for video and fax. It is quite possible that within ten years, faxing and videoconferencing from handheld equipment will become commonplace. Such sophisticated operations need not be difficult, since much of the work

will have been incorporated into the network and will be done for us automatically. Calls will be forwarded to us in the car, the office, or wherever we may be. Numbers will be linked to people rather than places, and satellite positioning systems will pinpoint our location.

medicine

New developments in electronics and telecommunications are already having a considerable impact in the medical field, and this trend is likely to accelerate as the technologies are applied more widely.

networks

Medical computer networks will become more sophisticated, so that patient data will be available immediately, not only within the hospital, but also, via local, national or international telelinks, to doctors in other hospitals or paramedics attending the scene of an emergency. Specialists will be able to diagnose, treat and even operate on patients at a distance. Historical data will also be more accessible for analysis, so that medical staff can learn from each other's experience.

imaging systems

Digitalisation of medical imaging systems will become cheaper and more widespread, permitting more accurate analysis and teletransmission of images. By linking imaging to computer systems, surgeons will be able to plan surgery more accurately and then be guided interactively through the operation itself. Miniaturisation will enable

relieve the pressure on expensive full-body scanners. The next step will be portable equipment for use in the field, linked by communications networks to a base hospital.

ethical implications

Many new technological developments will raise ethical questions. Take the smart card, for instance. For people, these are mainly used for identification purposes in banking. But, in the form of electronic tags, they are used to identify cattle and pets. Electronic tagging is also used to keep track of, for example, prisoners on parole. But the next step is implantation of an electronic identification device into the flesh. This is already being done with animals. Could we accept implantation into humans?

The increase in personal computing power, access to the information superhighway, and so on, all have the effect of spreading knowledge much wider than it has been spread before. Until now, those with knowledge have had power. Companies have had hierarchical structures, with those at the top having access to all the information and able to make the decisions. New developments may change all that. Corporate structures are set to become more horizontal and more 'democratic'.

Similarly, the rise of software agents will provide many more people with the equivalent of an extensive support staff, hitherto the prerogative of those in power or with the resources to pay for them. This may lead to a considerable 'democratisation' of power struc-

not come cheap. The question is: How much is the consumer prepared to pay for new developments? Will people be prepared – or even able – to pay the extra to have a fibre-optics line enter their living room for a videophone or hundreds of channels on their cable TV? Will manufacturers, for their part, be prepared to put vast sums of money into research, development and production if they cannot be sure of recovering their investment?

And finally, the issue of the impact particular technologies have on the environment has to be faced. Will we, as producers and consumers, be able to resist the temptation to avail ourselves of benefits provided by technologies which are less than eco-friendly? To what extent will governments take a hand in guiding development? To what extent will well-intentioned companies be supported by the consuming public?

Predicting answers to such questions is every bit as difficult as predicting other social attitudes. Yet these answers will be crucially relevant to the success of any technological innovation: ultimately, it is social acceptability, not technology, that determines what happens.

The future is a direction, not a place

In this contribution, we outline the philosophy behind our Interaction Design curriculum. We argue that change and complexity are two crucial issues that any interaction design curriculum has to address. We propose a perspective on interactive systems that offers a frame of reference for future systems that provide rich experiences and feature large scale connectivity. We present our interpretation of "human-centredness", that focuses on human experience and action.

Complexity, change and us

The past decades have given us a dazzling spectrum of information-based products and services that affect most every part of society. The rate of change around us has taken on giant proportions and this seems only to increase. It has also resulted in new forms and new magnitudes of complexity. A four-year curriculum that is so closely connected to the information age must deal with change and complexity in a way that is inspiring, not frustrating. Consumer electronics, telecommunications, the computing industry, the entertainment industry and the media industry are all entering the digital arena. All information will be digital, all information will be inside computers and computers will be everywhere. But people are still people. Many of them are having a hard time trying to make sense of all the information around them and they are feeling bad about it. While technological innovation contributes to human progress, some people experience the world as a technopolis that causes feelings of alienation and aversion with regard to technological developments. Yet, our ability to function and survive in the future depends on our ability to relate to information. Can we interact with this cybersoup in a meaningful way? Is there an alternative for the technocratic approach?

We aim at meaningful applications of information technology, but we are convinced that new paradigms for thought and practice in information technology are necessary to achieve this on a scale that matters. In order to deal with complexity and change in a positive way, these paradigms will need to emphasise inner values and quality over external values and quantity. Inner values and a sensibility for quality shift with the speed of generations, whereas external values and quantity shift with the speed of fashion. Interaction Design as a discipline will succeed if it can drag interactivity away from technological fascination and wizardry into the realm of human experience and action. What is being designed is no longer a medium or a tool in the traditional sense, but something far more intangible when it is embedded in a continuously changing environment where everything is connected to everything else. Designers of interactive systems need a deep insight into the possibilities of interaction between real people and various kinds of systems.

Traditional perspectives: tools and media

Distinguishing two traditional and influential perspectives on human -- computer interaction ("tools" and "media"), we can use these to think about the nature of interactivity and begin to see why a new approach is needed to accommodate new developments and what the issues are that must be addressed.

tools

Tools (e.g. word processors, drawing programs) allow users to create, inspect and manipulate content (e.g., a text or a drawing).

Information flows mainly *through* the interface *into* something that carries a sense of order (a text document, a drawing).



the tool perspective

This perspective is very common in the computing industry. There is much experience logical and formal organisation of information with a strong technological and utilitarian flavour.

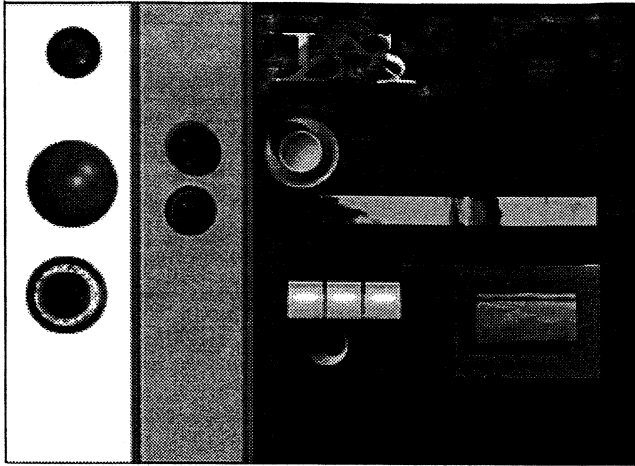
This utilitarian nature of many computer systems fits the tool perspective

"Anybody who tries to talk about change is in trouble from the word go."

(Gregory Bateson in

"A Sacred Unity, further steps to an ecology of mind", p. 284)

We are convinced that new paradigms for thought and practice in information technology are necessary to achieve this on a scale that matters.



Bas Ording ID-2, 3D buttons

well: people (are required to) use them for performing tasks.

Using tools involves processes of creation, choice and action. The user is an active agent. Interactivity is not a new phenomenon, but until this day it has proven hard to make it work. Technological considerations have traditionally had a strong influence on user interfaces, something the HCI community has always opposed. Fields like cognitive ergonomics emphasise the importance of taking human capabilities and limitations into account. But still the efforts are very much embedded in the Western-scientific tradition and rarely take cultural

or emotional issues into account. Users are no longer working with one tool on one computer. Many applications can be active simultaneously on different computers, computer supported collaborative work is supported at the system software level. Increasingly, we are using computer-based tools for communication with other people and interactive systems are becoming gateways to communities and endless information spaces. Users are no longer the only initiators when working in collaborative workspaces or when their software agents prompt them for help.

media

Media (books, movies, television, etc.) generally allow users to access a fixed body of stored information. Information flows mainly *through* the interface *to* the user. Traditionally, media have featured linear data



the media perspective

structures (despite the existence of indexes and tables of contents). The pages in a book are numbered and a movie consists of one fixed sequence of images. Interactivity allows information to be organised and accessed in a non-linear fashion. Also, the

media industry is rooted in the idea of discrete products -- each issue of a magazine is a separate entity, distinct from others. Existing tools, techniques and production processes are not equipped for a future that involves networked multimedia databases that evolve more or less gradually.



Henri Smeets, ID-1, TV

Linearity involves processes of submission, acceptance and adaptation on the side of consumers. The user is relatively passive, with action restricted to appreciation and judgement of someone else's selection. Non-linear information structures result in complex multidimensional representations, where individual users determine their own "paths" through the information. This requires a new attitude that involves active selection and construction, but it also generates problems of meaning. If some unit of information can be reached via multiple paths, its interpretation may vary according to the path followed. Navigation in these semantically ambiguous spaces and the required shift in user

mentality pose exciting challenges for design.

Infinite information spaces and rich experiences

Many interactive systems can still be viewed as being primarily tools (word processors, CAD systems, drawing programs, etc.) or media (CD-interactive Points-Of-Information, Points-of-Sale, etc.). This is changing.

Firstly, hybrids are starting to emerge. The medium television is becoming a shopping tool and multimedia is entering the workplace. Media users

Levels of complexity

1. the person (traditional Human-Computer Interaction)
2. the group (Computer Supported Collaborative Work)
3. the community (the design of enterprise systems for large organisations)
4. the world (the design of information ecologies)

Tight linkage between visual, kinesthetic, and auditory modalities is the key to the sense of immersion that is created by many computer games, simulations, and virtual-reality systems. Brenda Laurel, "Computers as Theatre" (p. 161)

ecology

The word "ecology" is taken from the Greek OIKOS, meaning house, the immediate human environment...

become active navigators, while tool users lose control when interacting or communicating with people or with software agents. Secondly, the complexity of systems increases rapidly. Powerful systems allow us to create artefacts of amazing complexity. In those cases, tool users also need to inspect the manipulated artefact (thus calling for the media perspective) and users of interactive media need powerful tools for navigation through content when that content is multidimensional and spread out over world-wide networks (thus calling for the tool perspective). Thirdly, everything will be connected to everything else. We are moving from the simple one-user-one-device situation to computer supported collaborative work and the design of interfaces for entire organisations. When the environment of an interactive system includes global networking capabilities, it is no longer clear what or where the boundaries of the system are and who or what the user is interacting with. Content simply becomes infinite from a user's point of view.

from information to experience

Television has become a real-time experience. Interactive multimedia offers opportunities for powerful multisensory experiences. Imagine a user, equipped with a number of input devices, moving around freely in a virtual environment. There are a multitude of 2D and 3D shapes, images, sounds, voices, everything moves and has behaviours attached: a rich and dazzling experience. All this is not fully understandable in terms of information and communication. Much more is going on -- there is a shift from information to experience.

Computer games are sometimes seen as supreme examples of full-experience products. Appealing to physical as well as mental skills, they indeed provide interesting examples of a shift from information to experience. A player acts in some environment, engaged in immediate and intuitive loops of control and feedback. However, in many cases, what is left is entertainment in the form of intense experiences and self-centred dexterity.

With computer games, advanced input devices, gesture-based input techniques, etc., the body has entered the arena. Experience in future information environments will be multisensory and multifaceted (physical, cognitive, emotional, motivational, spiritual). There is a danger that these experiences will become hollow -- that they will be roller coaster rides that don't go anywhere. Action and experience are two sides of the same coin and we need to understand them in a fundamental way. It is a challenge for interaction designers to create truly meaningful experiences that communicate as well as entertain.

from users and systems to information ecologies

If we look at users and their interaction with information systems, we can view them as agents that share information spaces where they communicate and co-operate. Good examples of this can be found in Rheingold's book on virtual communities (Rheingold, 1993) that illustrates how people in social contact on the Internet have established communities where rules of conduct have evolved in self-regulating ways. We can view the Internet and other networks (also human-only) as information ecologies with co-dependent communities.

An ecological perspective

Distinctions between tools and media become irrelevant as they merge, grow and everything interconnects. Trying to take the best of both worlds is not enough. We cannot just throw everything we have learnt from media and computing together and expect synergy to deal with the design challenges. We cannot stretch the old metaphors much further. We need non-reductionistic metaphors for interactive systems that allow us to deal with new forms of complexity and rich experiences. The single thing that anchors these developments is interactivity.

Ecology is the study of systems or organisms in relation to their

environment. We propose an ecological perspective, where the individual interacts with, or rather, acts inside an information ecology. Users, system and hybrid forms are seen as active agents that define and influence each other reciprocally. They are significant components of each other's environments. They share information spaces where they communicate and co-operate.

This metaphor motivates us to focus on: self-regulating behavioural patterns instead of rigid procedures, the whole in addition to its parts, continuous change and evolutionary development, local instead of global control, etc.

self-regulating behavioural patterns instead of rigid procedures

In the ecological perspective, interaction can be seen as dynamic patterns of behaviours (potential and actual) that define fluid relationships between systems and users. Information ecologies give rise to patterns of communication with other users or other systems in a way that cannot be controlled or predicted beforehand. Ecologies can maintain their stability despite the fact that information can be inconsistent and delayed and decisions are made based on imperfect knowledge (Huberman, 1988, p. 1). Also, many interactive systems are not used in isolation. It is often uncertain what the effects will be of the introduction of a new product in an existing environment (home, office, school). Information is produced and made available at different locations, transformed or integrated and, again, made available at other locations, etc. These patterns will establish complex, self-regulating patterns of relationships.

the whole

In complex ecological systems, the relationships between species form an intricate web, while every individual organism adapts to the environment. The ecological perspective stimulates us to examine, for instance, how the introduction of any new product (or update) affects the stability of an ecology: will the same information still be available at the same location and in the same form? Also, it stimulates us to think about the ways in which users must adapt to new systems and how this will affect their functioning elsewhere. We no longer ask ourselves what a specific system is for, but apply our quality criteria to attributes of entire information ecologies.

continuous change and evolutionary development

Information ecologies are open systems. Radical change is virtually impossible and small changes can have large-scale effects. The development of many future systems will have a very evolutionary character. E.g., many future database networks will grow and evolve according to how, by whom, and by how many they are used. We can ask ourselves how vulnerable our novel products are: what possible external changes may affect their use in a positive or negative way? We must leave room for accidental as well as intentional interaction and try to anticipate future growth and evolution.

the designer as a (pre)facilitator

Information ecologies feature complex patterns of communication between users and systems in a way that cannot be controlled or predicted beforehand. We cannot design the new situation, but must allow it to grow and evolve. Designers must facilitate processes of growth in existing ecologies and prefacilitate it in the creation of new ecologies. The former requires a sensitivity to recognise these patterns and the latter requires a highly imaginative ability to set up preconditions that stimulate growth and development in specific directions that are beneficial for users.

local action ...

The way we attempt to integrate the ecological perspective into interactive design practice is not to turn to formal cybernetic systems theory, since it tends to feel disembodied once the relationships are carefully modelled :

"In nature, a thing is always born, and developed, as a whole."

(Christopher Alexander,

"The Timeless Way", page 205)

represented in terms of control and feedback loops. This inevitably distorts the living reality. Users shape and are shaped by information ecologies. We focus on the individual experience of users, in relation to other agents (human as well as non-human), because this is where real meaning is born. Local action is local experience is local meaning. The ecological perspective does not conflict with older ones, but broadens our view. Even if what we are designing is "just a tool", we can look at the way the tool will function in an evolving environment. If we design "just another CD ROM title", we can think about how our design concepts and interaction elements and styles may function when the information on the CD is replaced by a world-wide network. We must aim for designs that function well right now, but also carry in them a readiness for the future.

ecology

Today, the term "ecology" also carries a set of "green" values. In the "deep ecology" movement (Devall & Sessions, 1985), "everything is connected to everything else" is interpreted in a very metaphorical and spiritual sense. We stand neutral on possible relationships between information ecologies and our biological environment, but we do appreciate the qualitative ring that the word "ecology" carries in the sense that we are dealing with something that we can never fully understand. It is more than just a model, it also carries an intangible component that refers to a feeling of wholeness. Ecology as such may not help, but inspires us to ask new questions. The ecological perspective provides a promising metaphor for our investigations into a more human-centred view on interactive systems design.

Information ecologies have qualities that cannot be understood or reduced to their individual components. Yet these qualities are real and we can recognise them if we use our intuitions and our personal histories. We complement the ecological perspective with a focus on the individual experience of a user. Aiming for rich user experiences in complex information ecologies, it is our goal to create a balance between knowledge & ratio and skill & intuition in the design process of interactive systems. This is a balance between synthesis and analysis, where analysis always serves synthesis in the design process.

Human-centredness

In our approach, human-centredness applies to the user and the designer as well as to the design teacher: all major design decisions relate to users; students and design teachers are human beings, not knowledge bases.

analysis and synthesis

In general, designers focus on synthesis, and scientists on analysis. Analysis enables us to take things apart in order to understand them. Synthesis enables us to put things together and experience how they function. We need both and aim for the best of both worlds: the aim is synthesis, and analysis (rational as well as more intuitive) plays a crucial, but subservient role.

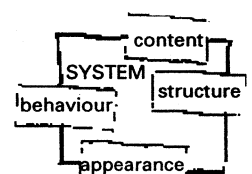
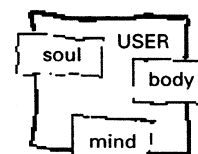
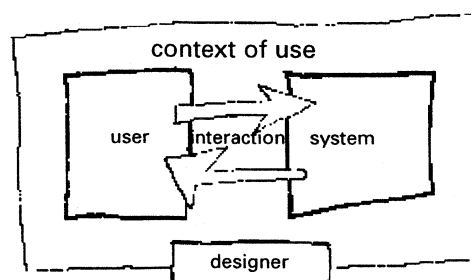
human

Inspired by the European tradition that builds on phenomenology, emphasising personal experience and action, our starting points are:

- The "self" is not just a biological essence, but also a social construct.
- All experience is situated. A situation is a system of relationships, in which people find themselves. People are involved in a continuous dialogue with themselves, with others, with things and with some entity that represents a spiritual dimension (God, for example).
- People and their situations cannot be described objectively.
- People and their situations define each other reciprocally during human experience and action.
- All consciousness is intentional; people are always conscious of something.
- People understand their existence in terms of their experience of themselves and of their situations. They interpret their situation subjectively and base their actions on perceived meaning.
- Experience can be multifaceted: physical, psychological (emotional, cognitive and motivational), and spiritual.

"The mind and the world, jointly make up the mind and the world" [Hillary Putnam]

central model for interaction design



Individual experience and action are two sides of the same coin and the need examination in the richest sense possible: physically, psychological and spiritually. Every system contains an implicit image of its intended users. The interaction designer must attempt to make this image as explicit as possible during the design process, however unknown and unfamiliar users may be in some cases.

designers and design teachers

Good design comes from good designers. Interaction designers need a specific kind of sensitivity for human and cultural values.

Human-centredness is found in our emphasis on the interaction designer's attitude. We believe that it is an attitude, rather than knowledge or skills, characterises the interaction designer. This does not come from books, from a more personal approach. It is in contact with our design teachers that students notice how this attitude feels and how it translates into design practice.

This attitude is supported by relevant knowledge and skills (from disciplines like the social sciences, art and design) that enable the designer to formulate and express views of users.

Complexity and Change: the future is a direction, not a place

In order to deal with complexity, we take a number of actions. Firstly, the ecological perspective stimulates us to **think in terms of evolution and growth** rather than revolution and radical redefinition and to carefully monitor the effects of our designs in their real life situations. For example, when designing large systems that may affect many people or large organisations, we shy away from formulating radically different solutions to be implemented in a short period of time. Rather, we develop a view of the future (that can indeed radically differ from the current situation) and use that as a guiding notion for a migration path that leads in that direction, thus leaving open the possibility of changing our course along the way. During this process, we hold on to our original assumptions and ideals, we adjust our course of action according to unexpected developments. Secondly, we emphasise **the use of intuition** in addition to rational thought in order to **understand the character of the whole** in addition to the parts. Finally, we acknowledge the impossibility of predicting what will happen and **involve users in the design process** as often as possible and put extensive effort in the employment of prototypes and other tools and techniques for user testing.

Complexity and change are internal, as more of our faculties get involved in complex action and experience. They are also external, as everything becomes connected to everything else, and systems connect us to people as well as to information. Human-centred design is not an ideal, it is a necessary strategy for survival in an information society.

*Where is the life we lost living?
Where is the wisdom we lost
in knowledge?
Where is the knowledge we
lost in information?
(T.S. Eliot, "The Rock")*

2 Proces

In de vorige hoofdstuk zijn een aantal ontwikkelingen en trends geschetst, welke van directe invloed zijn op de behoeften en problemen van huidige en toekomstige gebruikers. Het is aan de interactie ontwerper om hiervoor zinvolle oplossingen aan te dragen. Veranderende behoeften brengen echter mee dat dergelijke oplossingen niet meer in de traditionele richting gezocht kunnen worden, maar dat nieuwe methoden en technieken nodig zijn. In dit hoofdstuk wordt hierop in een tweetal artikelen ingegaan.

In 'The process of designing interaction' wordt het ontwerpproces van interactieve producten en diensten beschreven vanuit een methodologisch perspectief. Hierbij is met name aandacht voor de overeenkomsten en verschillen met het traditionele productontwerpproces, zoals dat op de faculteit Industrieel Ontwerpen wordt gedoceerd. Gesteld wordt o.a. dat industrieel ontwerpers, vanwege hun combinatie van analytische en synthetische kennis en vaardigheden, prima geschikt zijn voor het ontwerpen van interactieve producten en diensten. Echter, een wat minder strikt ontwerpproces, met meer ruimte voor eigen intuïtie en ervaringen, zou dit nog kunnen bevorderen.

Deze lijn wordt doorgetrokken in het tweede artikel 'The role of the Artist-Designer', waarin de rol van de interactie ontwerper in het ontwerpen van software wordt beschreven, met name in relatie tot die van de 'engineer-designer'

Bron Crampton Smith, G., Tabor, Ph. *'The role of the Artist-Designer'* in: Winograd, Th. *'Bringing design to software'*, ACM Press, New York (1996) pp. 37-57

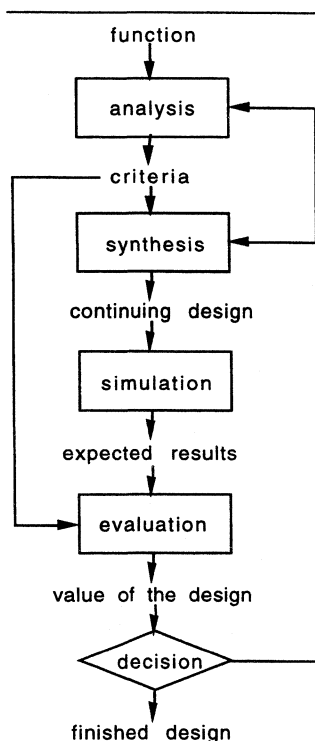
The process of designing interaction

Interaction design methods

When the field of interaction design emerged in the mid 70's, it came about as a logical demand for improved interaction in the wealth of new software programs being developed for the computer. Prior to its recognition as a field of study on its own, interaction design concerned itself mainly with structuring and programming of software products. At first, this was entirely the domain of software developers and programmers. Later, when the end-user was recognised as an important element in the software development process, psychologists were called in for advice. Still later, competition between software products forced a new marketing emphasis (and a new look), graphic designers were added to the interaction design team. For the most part, these three players (programmer, psychologist, designer) still constitute the software development team strategy of companies. Industrial designers didn't actually get involved in the process of interaction design until computers began to be embedded into products thus demanding software interfaces. It seems that industrial designers are well trained to deal with both the product and the computer-interface aspects of interaction design and have been significant, and often leading members of development teams ever since.

For this reason, as Industrial Designers we have a special interest in Interaction Design. The user-directed, product-development-oriented curriculum of our faculty of Industrial Design Engineering would be incomplete without some attention to the growing field of interaction design and with it, the merging of computer and product in a user-centered, humanistic manner.

The product development process



*The Design Process,
Rozenburg and Eekels*

How the design process is taught to IO'ers

In the late sixties, the notion that the act of designing can take place with a set of more-or-less linear steps was well established by design methodologists. Design Methodology books like the *Universal Traveller* by Koberg and Bagnall, were widely adopted in design schools. At our faculty of Industrial Design Engineering, a refined method has been described by N.F.M. Rozenburg and J. Eekels in their book. Most IO students are well-versed in this definition of the design process.

At the first impression, the process of designing computer-interactive products and software is not much different than that of physical products. The design process, as it is taught in the faculty of Industrial Design Engineering is, indeed, a good basis for any kind of product development. The designer always starts with a methodical analysis which points to a clear understanding of the problems to be solved which are then put into a list of requirements. From this list, the designer focuses on a number of important issues which are creatively solved during the idea phase of development. The best ideas are sorted and combined into a final concept which is ultimately modelled and tested.

How interaction design relates to the process

It seems that the basic steps of analysis, definition, concept generation, choice and implementation are common to any type of product whether physical or virtual. Issues such as Engineering (construction) or Formgiving (design) can be raised concerning the development of software products and, in fact, these products exhibit their own forms of engineering and design in the way that they are programmed or graphically displayed. Likewise, Marketing constraints and consumer trends play a role as well as the perceptual and ergonomical requirements of the user.

To better analyse the problem, each of these disciplines require different sets of tools to be used during different phases of the design process. It

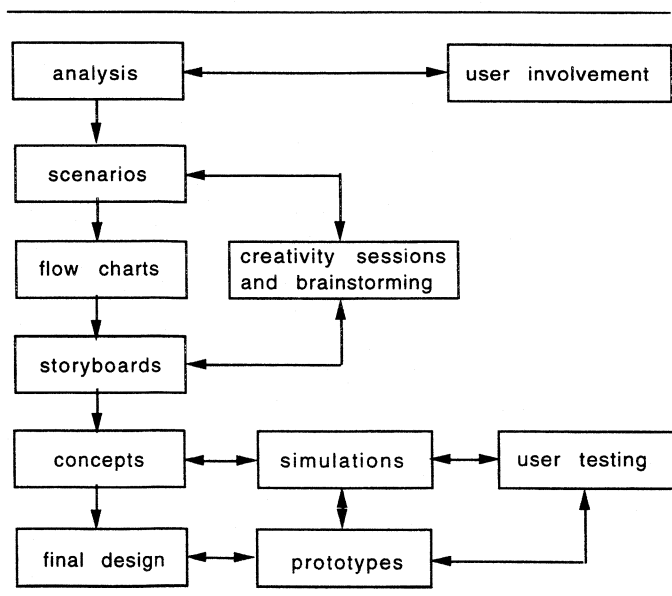
the application of these tools and methods that constitutes a complete design process and it is within this context that differences can be found between physical product development and interaction design. For example, it has been shown that the early concept development phases of the process can be done at a quicker pace and in a much more explorative way in Interaction Design. This is mainly because of the easy to learn prototyping software tools which are available to the designer. With these tools, the designer can quickly explore and suggest many different interface ideas.

Further, these ideas can be easily tested with real users at a much earlier time during the development process, thus insuring a better, more meaningful solution to the problem. In physical product development, prototypes are time-consuming and costly to make. In addition to the easy generation of working prototypes, many of the other tools and methods used to develop software products are different from physical product development.

How interaction design is different

The emphasis of good interaction design is on the end user and the way in which the user interacts with the product. What are the user's needs, interests and expectations? The designer needs to find out by carefully targeting and analysing the user by using a number of techniques that have been introduced for this purpose. For example, analysis techniques and the use of marketing strategies can be introduced. Methods such as scenario-building are suggested as a way to identify with the user and determine user needs during the actual using of the product. These scenarios can be further refined with brainstorming techniques and through the use of group dynamics. The scenarios, once refined, form the basis of a user-function profile which can be interpreted into a flow diagram of the user's activities. Flow diagrams also undergo levels of refinement until the final version represents, in the most detailed way, the step-by-step actions of the user within the new context of the intended product. At that point, the flow chart can be interpreted into a series of storyboards which attempt to put into pictorial terms, the functionality of the product. This is also the time that different designs and graphical layouts are developed and numerous concepts are formulated, either for parts or for the entire product. During this process, many small simulations or prototypes are developed and frequently tested with the user so as to constantly improve the level of understanding and usability of the product.

In fact, another sort of linear design process can be defined based on the tools which come into play during the development of these "virtual" products:



A new look at the interaction design process

The *analysis* of the user or group is always done together with the user in order to determine his/her needs, interests, expectations and working methods. From this, *scenarios* are created to capture the actions of the user. These are shown to the user and verified. The scenarios are converted into *flowcharts* which show the actual interactions. The idea is to generate a complete single flowchart for the entire design which can then be used as a "template" to ensure that all important interactions are not forgotten during the process.

The conversion to *storyboards* is done to add design and humanistic elements. The appearance and the behaviour of the product is identified during this phase. Scenario-building as well as flowchart and storyboard generating can all be enhanced with group creativity and brainstorming sessions which, again, involve users.

Concepts of different parts of the project are made from the storyboard elements and can be quickly simulated using software tools for testing with the user. The best concepts are combined into a *final design*.

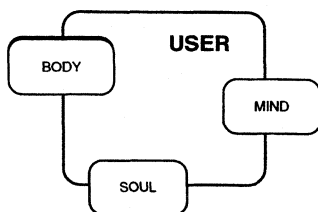
The final design is then either *simulated* or an actual interactive *prototype* created for further user testing and evaluation. Often this first prototype is called an *Alpha prototype*. A detailed and corrected final version, called *Beta prototype* is then made for testing before being produced and distributed.

The final design is a direct reflection of the initial user needs and is evaluated based on the program of requirements which were developed as a result of the user analysis. Thus, the final design is not only oriented to a specific user or group but, in this way, optimised to the highest level of interaction between the user and the product.

Again, it should be noted that this is an intensively iterative process which involves many repeated steps and frequent user testing and participation.

The integration of information

Designer's role (Taken from "The future is a direction not a place")

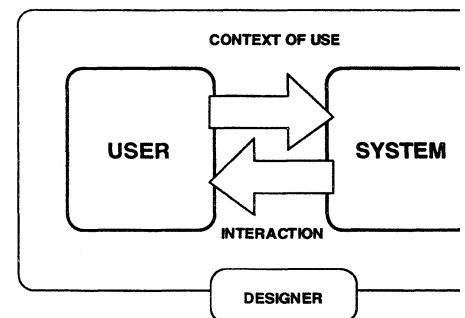


The User (Taken from "The future is a direction not a place")

The designer's role

In this illustration, the designer's role is clear: He must manage the interaction between the user and the system. This is done within a "context of use"; the place, time and situation in which the user and the system come in contact. At first appearances this looks simple enough but there is much more beneath the surface which needs to be explored. This can be done by looking more intently at the user and at the system.

Since interaction design is user-based, the needs, interests and expectations of the user are of the highest priority to the designer. But the user is a complex entity, in fact.



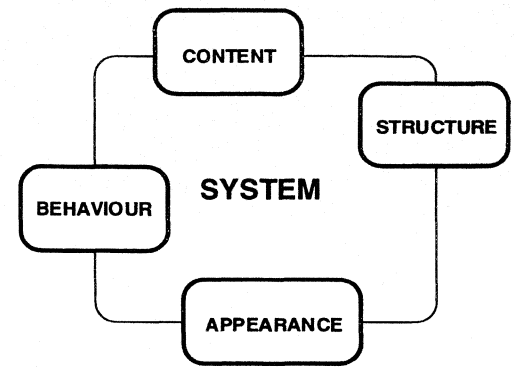
To get to know the user, the designer needs to look at all the parts; the body, the mind and the soul. Ergonomics, for the most part, deals with the needs of the body. These constitute human factor measurements dealing with tactile, visual and other physical needs. Psychological issues such as perception and thought together with Marketing puts the designer into the mind of the user. These help to define the user's motivations and actions. The soul, seen here as something more than just a religious entity, contains the user's beliefs and, therefore, his emotional acceptance and satisfaction with a product or interface. To do a complete process, the designer has to know all these aspects of the user.

*The System (Taken from
"The future is a direction
not a place")*

The system is not a simple entity either.

First there is the actual content which has to be carefully collected and organised. Sometimes the content is already supplied by the client but, for the most part, the designer still has to make it acceptable to the project by formatting and categorising it. The structure is the bond between the elements in the context and

provides the way in which the content is accessed within the system. There are many types of structures which may apply to a design but, in general, it should be based on a logical organisation of the content which is consistent with the user's expectations. The behaviour of the system is the manner in which it responds to its user. For the system to be "user-friendly", it has to behave as the user expects with meaningful questions and logical responses. The behaviour of the system is often based on the user's own working methods and habits.



The appearance of the system is its graphical arrangement and use of color. Not only should this be attractive and pleasing to use, but it should also be a reflection of the content and structure in the interface. No part of the system can be developed without considering the other parts.

It was said earlier that the role of the designer is to manage the interaction between the user and the system within the context of use. One can see from the complexity of these factors that the process is not a simple one.

The need for balance between design and engineering

A harmonious and satisfying interaction design involves the management of both hard, calculable engineering factors as well as soft, artistic and even emotional criterion. Since the interaction design process is human-centered, all of the factors which govern the actions of the user in his working with the product should be conscientiously thought out and carefully designed. We have all experience products which fail to solve all the problems. Typically we have seen "programmer-oriented" products which solve the problem but are incredibly ugly and hard to work with. Likewise, we have also seen beautiful graphical solutions with no real structure or content behind them. The interaction design process demands a balance.

Working in teams

The problem is that very few designers have the training to be both artists and engineers. Often one is asked to specialise in their acquisition of skills such that no single designer can really manage all the aspects of an interaction design. Therefore, in industry the emphasis is now put on teamwork and mixed disciplines. This, in turn, puts a strain on communication since each expert sees the process of designing from their own point of training. Often, lapses in the communication between team members hampers and even ruins the final product. Team leaders, therefore, have to know something about all of the disciplines represented in his/her team and should be able to smooth out communication problems.

This is one reason why Industrial Design Engineers are quite suited for the task of leading interaction design teams. The training given in IO allows them to communicate to both the design as well as the engineering sides of the problem. However, as good as the training may be, other experts will be needed from time to time and good project leaders will recognise weak areas in his team and will augment those areas with consultants.

Inseparability of content and form

Gillian Crampton Smith and Philip Tabor argue in their article "The role of the artist-designer" that content and form are directly related to each other. For example, the content that is provided by, say a software program, is conveyed graphically on the screen. If the content is serious, the way it is displayed should reflect that seriousness. If the content is comical, the representation is also comical. This seems quite obvious but the opposite has been seen in many occasions. Examples have been seen in which important information is so lightly presented that it is not taken seriously, information which is sensitive and personal presented in a comical and insulting way. Likewise, content which is intended to elicit an emotion has missed its mark because of incorrect representation on the screen. Content and form are inseparable.

"How a design conveys a message is an important part of the message itself. Moreover, every piece of design carries an aesthetic charge, whether or not it has been attended to; even inattention will be interpreted by the audience as meaningful.

...We emphasise this point to crush the hope that there exists in graphic user interface design a universal form into which any content may always be poured with optimal effect. The assumption that content and form are separable tends to encourage forms (designs) that, supposedly neutral and content independent, are instead simply bland and spiritless."

This quote is most important now because it can be seen lately that many designers try to force-fit their content into the "convenient" format of WINDOWS 95 without regard for the form which is really required. Too often this has resulted in "bland and spiritless" solutions which can be, in our minds, meaningless and useless to the user. The designer must be cautious in the use of templates, interface guidelines and other "rules of thumb" that may or may not be appropriate to the content of their design.

The indivisibility of function and aesthetics

We have always heard that form and function are related. It is impossible to create a product with functionality that doesn't have some issues of form to resolve. And, conversely, it would be meaningless to construct pure form oriented solutions with no consideration of the functional needs. We used to adhere to the old Bauhaus phrase "Form follows function" which suggests that all form is derived after the functionality is defined.

Unfortunately, in reality it is not such an easy two-step process. Normally form and functionality are developed simultaneously and, in fact, the interplay between these issues usually forms the basis for innovative concept generation. The "What if..." questions that come from playing with form solutions based on certain functions as well as the reverse, functional solutions based purely on intuitive form, provide some of the most unique ideas during the early development phase of the process. The factors of form and function should always be inseparable.

The Component Activities of Interaction Design

The inventive core of the process

Crampton Smith and Tabor also propose their own approach to the process of interaction design which they call the "Component Activities of Interaction Design". They are:

1. Understanding
2. Abstracting
3. Structuring
4. Representing
5. Detailing

Understanding is a bit like the "analysis" phase of the IO process. It is an attempt to gather information (and, hence, knowledge) about all aspects of the problem. The use of photographs, videos, sketches and notes are

encouraged as documentation. The emphasis on user-oriented designing is also made.

Abstracting is closely related to the scenario-building part of the other process. It is oriented to finding the main elements of the problem and the types of information being conveyed. Lists, sketches and diagrams are useful tools here.

Structuring deals with the relationships between the elements, their ordering and usefulness to the user. The method of flowchart-building is one way to achieve a formal structure.

Representing the structure in a visual (and auditory) way is considered here. Whether the representation should be concrete or abstract or whether a metaphor should be used is determined based on the user's "world". The results can be sketches on paper or more refined "interactive sketches" using a software tool like Macromedia Director. Evaluation by users (and design colleagues) is encouraged.

Detailing is done to determine smaller aspects of the design such as the color and form of each element, the style of depiction, and how elements might move. For these details, the designer either sketches out ideas or sometimes works directly on the computer in a paint program such as Adobe Photoshop.

It is stressed that these five processes are not to be done sequentially. During the process, the designer jumps from one activity to another as guided by the results. During the act of circling through these processes, the designer keeps a good record of the requirements, thoughts and ideas that are generated.

Prior to doing this list of processes it is necessary to have discussions with the client and user which determine the client's interests together with the user's needs. These discussions lead to a "performance specification" which establishes the application to be developed.

The article details three projects done by students at the Royal College of Art (London) which had different starting points: one showing the entire process including the user-needs discussions, another starting just after the performance specification was done and a third which adds the interaction details to a finished engineering solution.

Summary

Interaction design is a complicated business. There is probably no single process or method which will work all of time and for all possible applications. Therefore, it is up to the designer to choose the process which is appropriate and to apply it, keeping in mind that it may even be necessary to alter the process if the project demands it.

In general, there are some factors which should always be adhered to:

1. Do user-directed designing which involves the end-user in the process
2. Look at the whole picture of interaction; all the aspects of the user, the system and the context of use.
3. Do as many iterations of the process as time permits
4. Do frequent prototyping followed by user testing
5. Keep a balance between design and engineering - between art and science

Lastly, it is important to stress that step-by-step processes are not entirely suitable to the activities of interaction design. There are many parallel activities which have to be done and the designer will have to remain flexible in his approach and disciplined in his documentation.

GILLIAN CRAMPTON SMITH *and*

PHILIP TABOR

The Role of the Artist-Designer

Interaction design cannot dispense with scientific method and engineering knowledge; indeed, familiarity with computing technology is as essential to an interaction designer as familiarity with building technology is to an architect.... [but] interaction design is more of an art than a science. Its ultimate subject matter—human experience and subjective response—is inherently as changeable and unfathomable as the ocean.

One of the key issues in creating a discipline of software design is determining the scope of concerns—the boundaries within which software design differentiates itself from other areas of design. Gillian Crampton Smith and Philip Tabor bring a particular perspective to the design of software, from their backgrounds in other design fields. Crampton Smith trained as a philosopher and art historian, then worked as a typographer and graphic designer for books, magazines, and newspapers. Philip Tabor trained as an architect and teaches architectural theory at the Bartlett School in London.

They have both been deeply involved in the interactions between their disciplines and computing. Crampton Smith set up the computer studio at St. Martin's School of Art in London, started a postgraduate course for practicing graphic designers to learn about the potential of computers for their work, and, in 1989, initiated the Computer Related Design course at the Royal College of Art (see Profile 9). Tabor did his doctoral research on computer-aided design in architecture. His primary focus is on how the meaning of architecture is shifting in the light of developing electronic media.

Crampton Smith and Tabor view the software-design enterprise from a position on the border—balancing a technological and an artistic perspective, with a focus on how people and designs communicate. In this chapter, they describe the role of the *artist-designer*—a person whose focus is not on *software design* as traditionally conceived, but rather is on *interaction design*. Software is a medium for the actions and experiences of the people who use it. Interaction design, then, has the characteristics of the traditional design areas in which the authors have worked—in which issues of form, function, and communication are inextricably entwined.

—Terry Winograd



THE WORD “DESIGN” is often associated with the visual, affective qualities of objects. Aesthetics certainly play a central role in fields such as fashion, product, interior, and graphic design, and

increasingly in software design as well. But that does not mean that the job of *artist-designers* (graphic designers and so on, as opposed to *engineer-designers*) is primarily decorative.

Of course, artist-designers try to make things look good. Pleasure in the sensuous qualities of surface look is what probably drew them to design in the first place. But the vague shorthand of approbation that they often use (*cool, neat, and so on*) indicates a response that is not purely sensuous. It is mediated through sets of values and meanings currently at large in the world. The artist-designer's skill, developed by training, is to design things that not only fulfill a utilitarian purpose, but that also speak to the user through messages that are implicit as well as explicit. Some implicit messages are social: How do we tell the difference between the *Sun* and the *London Times*, or between a Harrods bag and one from Tesco? (United States readers may wish to substitute the *National Enquirer* and *The New York Times*, Saks Fifth Avenue and K-Mart, respectively). Other messages convey function and operation. Which way is up? Where do I open it? What *is* it?

The focus of this chapter is *interaction design*—designing the way people interact with objects and systems, especially with computer software. The product, therefore, is almost entirely experiential: It creates an alteration in the mind of the user. So the customary (originally Platonic) assumption, that substance—the *real* thing—is separate from, and is privileged over, appearance, is misleading. As far as the user is concerned, WYGIWYS: What you get is what you see. The interface *is* the product.

The permeation of semiotics into psychology and the social sciences has left its mark on everyday common sense and conversation. Although sometimes a cigar is just a cigar, as Freud warned, we have become accustomed to looking behind things for their significance—for the role they play in the economy of signs (see Baudrillard, 1981). It is only recently, however, that this aspect of our mentality has become important to software design. One reason is the increasing affordability of richer visual and auditory displays, and the computing power to support them—and thus, potentially, of more nuanced representations. A second reason is that users have changed: Fifteen years ago, computers were the specialized tools of technological professionals. Today, however, they are used by people in all (well, many) walks of life for work and entertainment.

Information technology is becoming an environment within which people operate, rather than a device that they pick up and use. It is part of everyday culture. People buy products, including software, not only for what those products ostensibly do, but also for what they represent. Consumers buy into a symbolic world that both differentiates them from other people *and* reinforces their sense of belonging. A third reason is that, in an information-rich society, competition for attention is huge and discriminating. Distinctions of iconography and style are increasingly important to retain the attention of an audience.

This chapter argues the following:

- The effectiveness of the structure of a piece of software, and of its interface, depends on how they are interpreted by users.
- This interpretation by users is not independent of context. It depends on the cultural codes, shared sensibilities, emotional responses, and habitual prejudices that users bring to it.
- Recent advances in display technology allow richer and more expressive communication at the human-computer interface.
- Decreasingly useful, therefore, is the idea that the *functionality* of a piece of software is separable from, and takes precedence over, its appearance.
- Decreasingly useful, too, is the idea that the main task of artist-designers is to beautify already-designed products.
- The fundamental training and skills of artist-designers lie in detecting, creating, and controlling cultural and emotional meanings.
- If we are to make full use of these skills, we need to have the input of artist-designers from an early—if not the first—stage in any design project.

Nowadays, in short, the habitual model of software design—engineering first, visual representation later—makes less and less sense.

The Artist-Designer

Software design in today's changing environment increasingly requires the input of designers who can predict and control how users will react to a piece of software. Unfortunately, suitable skills are already

available—in artist-designers whose experience and training are in areas such as graphic design, film making, product design, architecture, painting, and illustration. The graduate program in Computer Related Design at London's Royal College of Art brings together these skills to exploit developing technologies and media (see Profile 9). The training emphasizes

- *Invention*. Divergent thinking; innovation; new forms for new purposes
- *Empathy*. Putting yourself in the users' shoes; imagining what they are like; how they live, love, and have their being
- *Evaluation*. Juggling and balancing incommensurable factors, such as cost versus performance, and timelessness versus fashionability
- *Visualization/representation*. Imagining objects, ideas, processes, structures, scenarios, and so on; thinking them through in spatial or visual form; vividly communicating them to team members, users, and clients

There is no logical reason why the skills of artist-designer and engineer-designer cannot be combined in one person. A few people are totally ambidextrous in this way, and many are partly so. But the time needed to gain education and experience in either domain, not to mention the differences in temperament suited to the two domains, means that most designers specialize in one or the other. It is therefore through teamwork that the domains converge.

The effectiveness of this teamwork is diminished by misunderstandings created by habits of mind that exaggerate the distinctions between content and form, substance and appearance, function and aesthetics. We shall explore these distinctions, first defining more clearly what artist-designers do, using graphic design as our exemplar.

The Example of Graphic Design

The field of human-computer interaction came of age when the monitor replaced the Teletype printer. Since then, and at least for the foreseeable future, the dissemination of information through a two-

been central to software design. For most of the Gutenberg era, however, this task fell to the typographer. Recently—since the invention of offset lithographic printing has allowed cheap reproduction of images as well as of text—it has fallen to the graphic designer as well. So graphic design, which includes typography, is an apt illustration of more general artist-design theory, practice, and procedure.

Graphic designers find structure in information that is useful to the intended audience, and they give that structure form (in text and pictures) to communicate its meaning. Structure and communication are as central to designing a poster for a rock concert as they are to designing a maintenance manual. So graphic design describes the means, not the end. The end of a piece of graphic design is meaning—a rich interplay of implicit and explicit messages, understood by the viewer and transmitted graphically (see Crampton Smith, 1994).

Formally, the graphic designer has remarkably few dimensions of freedom. There is the frame: the perimeter, usually rectangular, of a page, for instance (or, in the case of interaction design, of a screen or window). Within the frame may be disposed blocks of text, abstract objects such as lines and geometrical shapes, and iconic or pictorial images. To this scant trio may be added the space left when these items have been disposed. That is the cast of the play.

The stature and dress of these characters may vary within limits. Text is inflected by size, font, weight, and color, for instance. But the number of possible and distinguishable point sizes is usually small; fonts are basically either with or without serifs; a given typeface usually comes in roman or italic, and two or three weights, and there are only so many basic hues to mix.

Graphic design's relative lack of formal means has three consequences. First, intense attention is focused by both designer and audience on small distinctions, which are delicate and difficult to control—in the case of type design, they are difficult for the untrained eye even to distinguish. Second, each combination of distinctions is recognized as having predecessors—as constituting a style. Third, each style soon accumulates—if it does not already have—a set of associations or conventional meanings (as discussed by Brown and Duguid in Chapter 7). These associations change over time: Asymmetric, sans-serif typography once exuded the uncompromising and unfamiliar aura of the avant-garde; now it advertises bubble-gum.

The Inseparability of Content and Form

There is a commonly held assumption that content is somehow separate from form. (See, for example, the discussion of the *conduct metaphor* by Reddy, 1993.) We think that this assumption is mistaken. Content cannot be perceived without form, and the form of a message affects the content. For instance, an obvious aim of graphic design is explicitly to inform: that the 0905 train to Cambridge goes from platform 3, say. For this purpose, clarity, legibility, predictability, and economy of means are essential. These characteristics, however, are not only useful, but also affective—the timetable shown in Figure 3.1

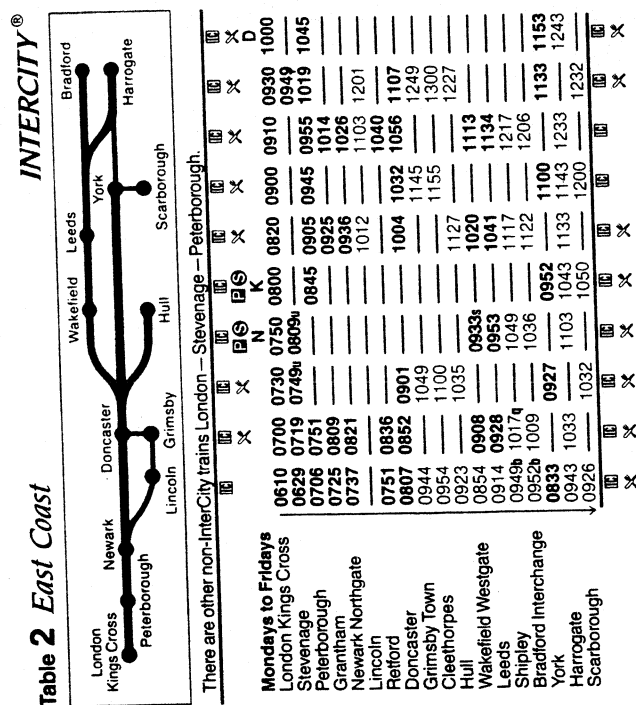


Figure 3.1 Graphic Communication The graphic design of a railway timetable does more than simply inform—its form conveys a message that the rail company is dependable, efficient, and trustworthy. The same words, written in a flowery hand script, would not convey the same message. (Source: British Railways Board, 1995.)

evokes an emotive response—a congenial *feeling* of clarity, predictability, and so on. The graphic design implies, whether or not intentionally and truthfully, that the rail company is dependable, efficient, and trustworthy.

Thus, the form of a design (almost any design of any kind, we claim) is inseparable from the content. How a design conveys a message is an important part of the message itself. Moreover, every piece of design carries an aesthetic charge, whether or not it has been consciously attended to; even inattention will be interpreted by the audience as meaningful. Marshall McLuhan (1964) went further: form and content are identical, the medium is the message.

We emphasize this point to crush the hope that there exists in graphic or interaction design a universal form into which any content may always be poured with optimal effect. The assumption that content and form are separable tends to encourage forms (designs) that, supposedly neutral and content independent, are instead simply bland and spiritless.

We do not mean to deny the utility of templates, interface guidelines (see Profile 4), and all those rules of thumb on, say, text size and line length, which are listed in desktop-publishing how-to books. That is the kind of craft lore that—as Einstein is alleged to have said of Le Corbusier's proportional system—makes the good better and the bad difficult. Nor do we deny the validity of the more general taxonomic strategies and perceptual-psychological principles codified by artists and designers of the Bauhaus (hierarchy, enclosure, unity, contrast, and so on) that appear to have always governed graphic activity.

The difficulty with these taxonomies and rules is that a design that serves well both the particular material and the particular audience cannot be adduced from principles alone: It requires a leap of invention. Moreover, although individual principles may hold good, competition between mutually contradictory requirements must be resolved pragmatically, according to the specific audience, material, and context.

The notion that content and form are separable also encourages the idea that content must be devised and specified completely before it can be dressed in form, or that in some way form emerges naturally from use (form follows function). But the opposite (func-

tion follows form) is often, acceptably, the case. In certain artist-designer tasks, in fact, no precise intention may be specified in advance—it may be recognizable only when it is achieved. A client might ask an architect simply to design a beach house, for example, relying on the designer to create a house that is exhilarating and life enhancing. A detailed performance specification will come later, if at all.

The Indivisibility of Function and Aesthetics

The railway timetable of Figure 3.1—a simple and straightforward information-design problem—demonstrates that any design inevitably carries an affective charge. The fulfillment of function inevitably generates, and is generated by, an aesthetic. Yet, closely related to the notion that content and form are separable is the myth that function and aesthetics are divisible.

This idea has several lamentable aspects. One is that it usually comes bundled with the puritan assumption that function takes precedence over aesthetics—a view we have shown to be illogical. Another is that this precedence tends to be temporal; that is, artist-designers are invited to only the final stages of a design's development, to apply a final coat of spray-on aesthetics. That this perception annoys artist-designers, we stress, cannot be entirely attributed to volatile bohemian temperaments. Marketeers and accountants are equally frustrated by the waste of their wisdom when they are not consulted on a product's design until it is almost launched, and normally mild structural engineers become sullen when architects haul them in at the last minute to make visions stand up.

Aesthetics, moreover, are concerned with more than visual appearance. There is a delight in a program that is rigorously consistent, elegantly clear and lean, where sound and vision are perfectly at one, or where the representation chosen neatly fits the ways that users think about what they are doing. These qualities cannot be added on at the end: They are integral to the design and engineering of the product.

The Component Activities of Interaction Design

Of all the activities necessary for the development of any design, five comprise the inventive core of the process:

1. *Understanding.* What is going on here? What is the underlying problem to be solved? Photographs, videos, sketches, and notes can be used to aid designers in observing and analyzing the information or the problem. Designers talk with people, especially clients and users, and look at the information to be communicated.
2. *Abstracting.* What are the main elements? What kind of information is being conveyed? What do people want to do with it? What is important? What is irrelevant? Lists, sketches, and diagrams are the usual tools here.
3. *Structuring.* What are the relationships among the elements? What different ways can the elements be ordered to be useful for users? What are the users interested in? How much can they take in? The designers' assumptions will be checked with the users and the clients.
4. *Representing.* How can this structure be represented in visual and auditory form? What representations does the material suggest? What representations might the designer glean from thinking about the users' world? Should the representation be concrete or abstract? Is metaphor appropriate? Here, the designer typically uses sketches on paper and interactive sketches in a medium such as Macromedia Director (see Profile 10), which may be evaluated with colleagues or users.
5. *Detailing.* Exactly what color should this element be? What style of depiction should be used? How is the picture plane handled? How do the elements move? Should an illustrator be hired? Some designers work directly in a paint program such as Adobe Photoshop. Others start on paper, and move to the computer later.

These five processes are not executed sequentially. Designers circle among them as activity in one throws light on another. When consid-

ering the structure of the information, for instance, a designer might also be thinking about how much text can be put on the screen, or how this particular audience might most intuitively interact with the information. So the stage at which interaction designers are admitted to the design process determines the extent to which the full range of their skills can contribute to a software product's success.

Three Projects

To illustrate the process of interaction design, we shall describe briefly three occasions at the Royal College of Art in which interaction designers were involved:

1. When the basic engineering design was complete, so only detailed interaction design remained to be done (the accounts project)
2. At an earlier stage, when the performance specification of the application had been established, but not the model that was to represent the purpose of the application and how to interact with it (the Suitcase project)
3. Still earlier, when the users' needs were first discussed, so the purpose and representations could be designed together, each contributing to the other's development (the fashion project)

1. The accounts project

Imagine that an application is almost finished, but performs disappointingly. An experienced engineer is called in to optimize the code, but finds that the problems are more fundamental—they lie in the data structures. Optimizing the code would make superficial improvements, but the basic flaws remain. In the real world, this scenario should be rare, because software engineers are involved from the start. An important part of the product, however, is a coherent model that tells users what the product is and how they operate it—its central organizing model. Yet interaction designers, who have much to contribute to this model's invention and representation, are seldom called in sufficiently early.

3. THE ROLE OF THE ARTIST-DESIGNER

Two of the College faculty (Gillian Crampton Smith and Martin Locker) were involved in the attempted rescue of an accounts package, one month before the project had to be finished. The original designers—an accountant and software engineer—had modeled the code's underlying structure on traditional paper-based work, without sufficiently considering how shifting tasks to the computer would change everyday accounting procedures. When the screens at last came to be designed in detail, it became apparent that the conceptual model—now hard-wired into the structure—was obsolete. By then, the timetable only allowed screens to be designed that were neat and presentable but did little more than list the functions provided. An inventive model, relating better to the users' future world and work, would have required the application to be fundamentally restructured (see Denning and Dargan's discussion of action-centered design in Chapter 6).

2. The Suitcase project

A more productive time for interaction designers to enter stage left, then, is when the application's performance has been specified, but there is not yet a specification of how that performance is to be fulfilled. An example is a project for students to redesign the desk accessory Suitcase, a mini-application that allows Macintosh users to install and de-install fonts in their system folder. The existing interface allows users to access all the functions, but gives little clue about what the application is, what it does, how you use it, or what, after you have used it, has been done. You must either remember or check the manual.

The students started by analyzing the context in which the application would be used and the kinds of tasks that its users would be doing. They found that the basic communication problem was to distinguish easily between fonts available in a library and fonts already installed. Possible solutions used more descriptive phrases such as *available types* versus *loaded types*, or *library* versus *in use*. Other solutions animated the movement of fonts from a list of those available to a list of those installed.

The most successful solutions, by Robert Girling and Sally

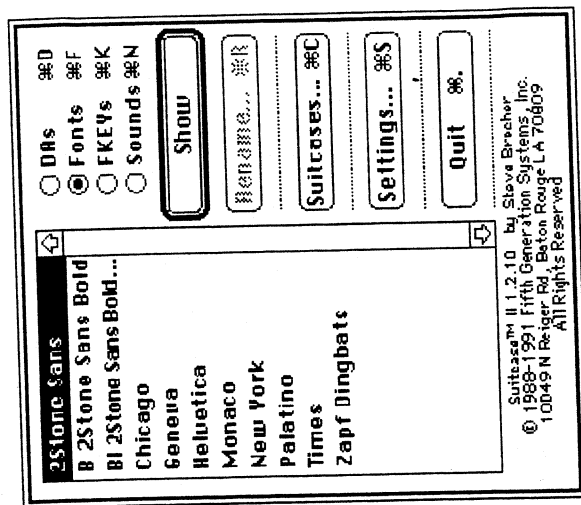


FIGURE 3.2 The Suitcase Problem The desk accessory for moving fonts in older versions of the Macintosh Finder allows users to access all the functions, but gives little clue about what the application is, what it does, how you use it, or what, after you have used it, has been done. The challenge posed in a student project at the Royal College of Art was to improve the interface. (Courtesy of Fifth Generation Systems. Reprinted by permission of Symantec Corporation.)

by abandoning the desk-accessory approach and incorporating the tool into the application's font menu. Through layout, terminology, and animation, the purpose of the application—to install and de-install fonts—was communicated to the user, and the state of the system was shown explicitly (Figure 3.3).

An interaction designer who thinks about information in terms of what users do with it, and the context in which they use it, may imagine approaches different from those suggested by the way that the system is engineered. If interaction design is considered only at the end, software is driven by engineering design, of which users are rightly unaware, rather than by the representations with which they interact.

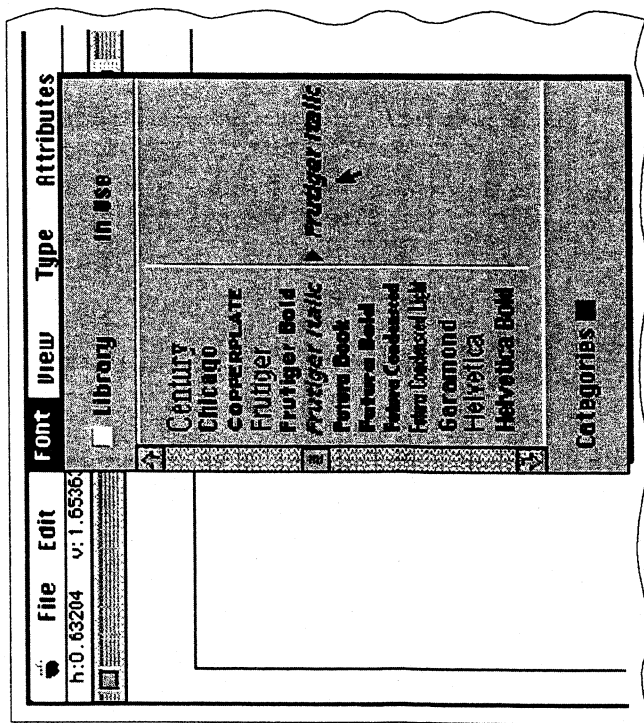


FIGURE 3.3 The Font Mover One solution to the Suitcase problem was to recast the users' conceptual model of the application by abandoning the desk-accessory approach and incorporating the tool into the application's font menu. (© Royal College of Art. Reprinted with permission.)

3. The fashion project

In the fashion project, interaction designers were involved from the beginning. A consortium of clothing manufacturers asked the College to see how computers could help in the fashion-design process. A research and design team was assembled, comprising interaction designers from engineering, product, and graphic-design backgrounds (Gillian Crampton Smith, Charlie Hill, and Philip Joe), as well as cognitive scientists Ellie Curtis and Michael Scaife from Sussex University. We went through the five design stages just described, cycling back through them more than once:

- *Understanding.* One of the cognitive scientists spent several months at the factories and design studios, watching what was done and asking people what their work was and how they viewed it. The team began their design investigation as a graphic designer would: by considering the existing paper file compiled for each garment type. This file, containing some 50 different forms, had evolved to enable the manufacturers to keep track of each stage of the garment's production. The researchers could see from the file the information that already had to be provided, and they hoped to provide additional amenities.
- *Abstracting.* The paper file was used to keep track of every garment type in the production process. It contained information about the garment's geometry, its materials, the trimmings to be used and the company that supplied them, the garment's critical path, and test reports on sample garments. The file's fundamental purposes were to ensure that all the season's garments got to the shops in time, and to avoid costly errors. The file was not active: It did not, for instance, alert the users to emerging problems. It offered no overview of progress—how many garment types were delayed, say, or were ahead of schedule.
- *Understanding.* The researchers discovered that people involved in different parts of the manufacturing process held vastly different views about what the process was and what was important. They concluded that, to make sense to all users, the central organizing idea of the software model should be the garment, rather than the departments, work stages, techniques, or data flow.
- *Structuring.* One of the interaction designers with a graphic-design background looked in detail at the types of information represented and how they might be categorized. One approach that turned out to be productive was to divide the information according to how it could be manipulated: pick from a list, choose from a range, tick off something finished, and so on. The aim was to see whether there were a few underlying regularities that could be represented similarly, to reduce the apparent complexity of the information.

- *Representing.* The team brainstormed with lists and sketches, searching for metaphors to represent the information. Could deadlines be shown as milestones or hurdles? Might the different seasons' designs be represented as clothes rails, with garments hanging on them? Although there were useful metaphors for different elements, none seemed satisfactorily all-encompassing.
 - *Abstracting.* Surveying the range of different representations that they had devised, the researchers were forcibly reminded that each provided a different handle on the process. One of the cognitive scientists mentioned John Searle's (1969) concept of speech acts: Propositions are not simply true or false, but rather have purpose—are exhortations or supplications, for instance. The team realized that the fashion information was useful only if it promoted action. This realization helped them to escape from the mindset associated with the existing data structure—the paper file—and from the assumption that their task was simply to represent the information.
 - *Representing.* One demand, clearly, was that every garment should be ready on time and without problems. Managers had to be alerted to difficulties that arose, so that they could minimize the consequences (a stitch in time). The researchers therefore sought ways to communicate a feel for how schedules were progressing, and whether there were problems ahead. The next need was remedial action. So the team designed a system whereby faults—a wrinkled zip on a sample, say, or an inaccurate dimension—would be flagged on the image of the garment itself, and notified directly to the computer desktop of the staff involved.
 - *Understanding.* The team returned to the factory to check the assumptions so far, and asked people further about the purpose of the information—what they did with it and what they might like to know that the existing systems did not tell them.
 - *Structuring and representing.* To keep in mind all the ideas that had emerged, and to discard those that they did not find useful, the researchers took pages from all the sketchbooks and photocopies, cut them up, and assembled them into a large map of all the different approaches. This map prompted them to make suggestions: "If you represented each garment on the timeline like a bar, you could also show how far ahead of or behind schedule it is." "You could highlight this flag in color, to make the problems jump out." "If you represented problems as Post-It notes, you could see at a glance where there had been problems and whether they were still there; you could use the same representation as a message to the person who had to deal with the problem."
 - *Detailing.* Only now—well over halfway through the design work—did screen and interaction design begin. The work done up to this stage on structure and design strategy is almost invisible to anyone looking at the final result. Indeed, it becomes obvious only if it has not been done well: The more skillfully it is achieved, the more transparent it is.
- The detailed design, done by one interaction designer with the help of a second, involved decisions such as the exact screen layout, the colors and type to be used, a consistent logical and visual style for the representations, the management of transitions between screens, the feedback to be given, the users' means to navigate the information, and the hundreds of other details that make software effortless and pleasurable to use.
- The two designers had decided that each garment type should have two views: a *portfolio* (information about the item itself) and a *timeline* (information about its schedule)—two conceptual models, or central organizing ideas, to make the huge range of information coherent and easy to grasp. This decision came from considering both how this particular information could be represented within the limitations of the medium, and how it could be made to fit the conceptual world of the users. So using the image of a portfolio with tabs for different sections, for instance (Figure 3.4), both suggested the original file and referred to the world of fashion designers. In terms of representation, it had the advantage of encouraging direct manipulation and allowing problems to be shown clearly on the image of the garment.
- As the garments were measured, any deviations from specification would be marked in red. Any problems, such as a wrinkled zip or

poorly finished pocket, would also be flagged. In addition to indicating the faults on the image of the garment, the system would notify the relevant staff directly via their desktop machines. The shelf at the top of the display is for tools: rule book, diary, printer, scanner, auto-dial phone, calculator, and an envelope (for posting changes in the database to other users).

In this kind of design process, few individual design decisions are startlingly innovative; the creative task is to forge a coherent and consistent whole, in terms of logic, representation, and the users' world.

The process of detailing the representation was the most problematic in terms of tradeoffs among competing requirements. For instance, the designers wanted to represent simultaneously the timeline of each of about 30 garments—the responsibility of one department. Time could be represented as a vertical or a horizontal axis. If they used the best-understood—horizontal—orientation, however, they could not get enough garments on screen from top to bottom. They tussled with ways of shrinking, scrolling, and so on, but none seemed successful. They particularly resisted turning the representation through 90 degrees, because the labels would have to read from top to bottom. But they finally accepted the vertical orientation, because nobody referred to a garment by its name: People used only its number. More important than the legibility of the labels was an overall grasp of which garments were slipping behind schedule.

There were also problems of pictorial logic and coherence. Generally, pictorial icons were used to represent objects; a coat hanger, for instance, represented a season's collection of garments. Clicking on the hanger, however, did not reveal further icons representing each garment, but rather revealed just a bar, colored to show whether the garment's production was behind or ahead of schedule. Pictorial consistency was sacrificed for relevance and compactness.

Two people worked full-time for four months on this project, and three worked part-time—roughly one person-year in all. Over this period, the 50 different representations in the original paper file were compacted into two basic views, showing the information in a way that allowed users to grasp it much more intuitively. The look and feel of the tool were designed to avoid the character of computer-controlled bureaucracy and to resonate with the visual sensibilities of fashion designers. An important part of the system's function was that it be stylish and enjoyable to use.

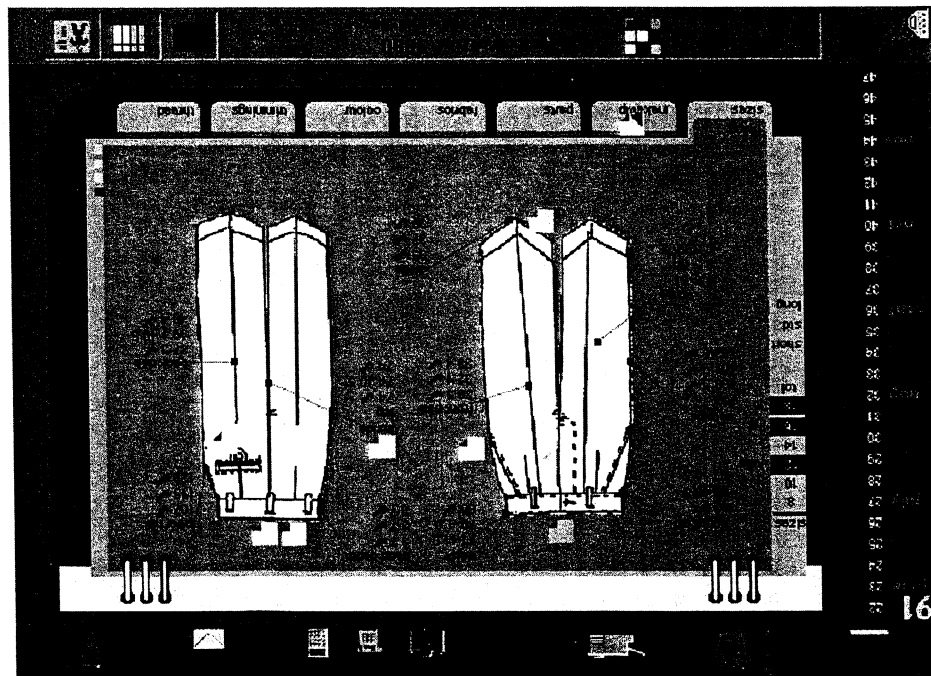


FIGURE 3.4 Visualizations of Action
(© Royal College of Art. Reprinted with permission.)

Interaction Design: More Art Than Science

Interaction design involves three interlocking elements to which the skills of artist-designers are particularly germane:

1. The design of what the software *does*—its purpose for people
2. The design of a model of what the product *is*, and its *representation* to users in the terms of their world, through vision, touch, and sound
3. The detailed design of the software's *look and feel*—the exact number of pixels, their color, how fast or smoothly they move, and so on

Interaction design cannot ignore scientific method and engineering knowledge. Indeed, familiarity with computing technology and psychology is as essential to an interaction designer as familiarity with building technology is to an architect. After all, no science breeds more theories than do the human ones such as psychology and sociology—or than does art itself. But because interaction design deals primarily with values, preferences, and meanings—with, if you like, aesthetics and semantics—it can have neither a universal *predictive* theory nor always-reliable methods to generate solutions. You can say, for instance, that a certain color of type will be legible to most readers, but you cannot say with the same degree of certainty that readers will or will not like it. So informed instinct (hunch) is as important as is principle in interaction-design practice, and osmosis (the largely intuitive absorption of skills and values) is as important in interaction-design education as is factual information transfer.

This level of ambiguity and subjectivity is not a result of interaction design's relative youth. It is intrinsic to all the artist-designer disciplines; it gives them their power, subtlety, and robustness. Interaction design is evolving rapidly. Like all artist-designer disciplines in the industrial and electronic ages, it must constantly reinvent itself to respond to changing situations and sensibilities. The interaction designer needs to break rules and to overturn precedents, as well as be able to follow them.

In the end, interaction design is more of an art than a science. Its ultimate subject matter—human experience and subjective response—

Suggested Readings

Carl Dair. *Design with Type*. Toronto: Toronto University Press, 1952, 1967. Maurice de Saumarez. *The Dynamics of Visual Form*. London: Studio Vista, 1964.

Gyorgy Kepes. *Language of Vision*. Chicago: Paul Theobald, 1969.

Kevin Mullet and Darrell Sano. *Designing Visual Interfaces: Communication Oriented Techniques*. Englewood Cliffs, NJ: Prentice-Hall/SunSoft, 1995.

Emil Ruder. *Typographie*. Teufen, Switzerland: Arthur Niggli, 1967 (text in German, English, and French).

Edward Tufte. *The Visual Display of Quantitative Information*. Cheshire, CT: Graphics Press, 1983.

Edward Tufte. *Envisioning Information*. Cheshire, CT: Graphics Press, 1990.

About the Authors



Gillian Crampton Smith, originally a graphic designer, is the Professor of Computer Related Design at the Royal College of Art in London. She consults on interaction design for companies such as Interval Research, Apple, and Philips.



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3 Tools en Technieken

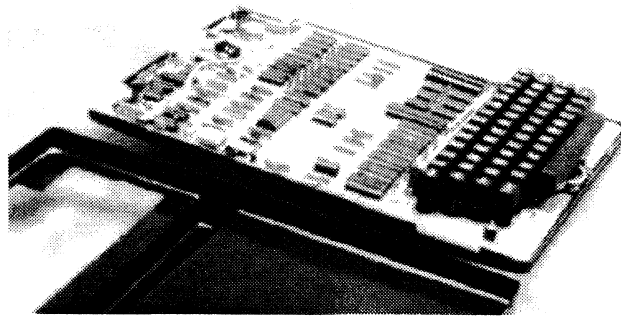
Goed gereedschap is het halve werk, dit geldt ook voor de interactie ontwerper. Dit hoofdstuk bevat daarom een overzicht van tools en technieken, zowel traditioneel als computerondersteund, die ingezet kunnen worden voor het visualiseren, presenteren, simuleren en evalueren van ontwerpideeën.

'Computer tools for designers: visualization, animation and simulation' behandelt de verschillende computertechnieken en softwarepakketten, waarvan de ontwerper gebruik kan maken tijdens het ontwerpproces. In 'Interaction prototyping: tools en technieken' wordt specifiek ingegaan op het ontwerpen en bouwen van (interactieve) prototypen. Behandeld worden o.a. de rol die dergelijke prototypen spelen in het ontwerpproces, de verschillende vormen waarin een prototype gegoten kan worden en de software die hiervoor nodig is.

Computer tools for designers: visualisation, animation and simulation

1.0 Introduction

In the field of Industrial Design, the use of the computer started in the mid 1960's and quickly became an integral part of the process. At first, the room-sized mainframe computers, programmed by punch-cards, were used to calculate complex mathematical models. Graphical output was limited to whatever chart or graph could be printed on a text-only printer. Even then programs like VTCON¹ and GPSS² were used to help organise complex design problems. Later in the early 70's, the advent of smaller-scale computers and the introduction of affordable desk-top equipment made it possible for many more individuals to access and use computing systems. Manufacturers started making and selling computers and the technology was taken from the hands of the home-builder. Products like the OSI Superboard were the first in a step that integrated all of the computing components in the same printed circuit board. The APPLE computer, developed by Wozniak and Jobs in their garage, quickly followed this trend and offered one of the first all-in-one solutions to the public.



*The OSI Superboard
Computer*

As more people used computers, more demands were made on the technology such as increases in screen resolution, screen colours, computing speed and printing technology. The swing of technology, fed the enthusiasm of the new users, went in the direction of graphics. Two areas were heavily exploited at this time: the use of the computer for text generation and editing (word processing) and the use of computer for drawing, in particular, the laborious task of mechanical drawing and layout. Later, as the new computer tools developed, more design disciplines, especially Industrial Design, became attracted to its use. The ways in which the computer has been utilised as a design tool during the process of product development is the subject of this discussion.

¹ Variable Threshold Condensation Program - Developed by Prof. Charles Owen at the Illinois Institute of Design, Chicago, Illinois, USA. VTCON was used to break down large, complex design problems by taking problem elements and creating clusters based on interactions. These clusters formed the basis of a semi-lattice which told the design team which elements needed to be considered together in the solution phase.

² General Program Simulation System - Used by designers to test mathematical models of flow through spaces. This "flow" could be, for example, air over the profile of a new auto design or people walking through an architectural space.

2 2D Visualisation

2.1 Graphics-oriented development

2.1.1 Desk-top publishing

The first design-oriented group to really benefit from the application of computers was Graphic Design. The early text-based manipulators quickly became very sophisticated tools for the layout of books and other publications. A distinction was made between Word Processing and Desk-top Publishing. Word Processing was the generation and editing of text. Together with the field of Typography (the creation of new typefaces and styles) Word Processing allowed the new generation of designers a great deal of flexibility such as the changing of fonts, scales and easy editing of words as well as entire bodies of text. Desk-top Publishing programs allowed for the importation of this text for layout and positioning. Later, the importation of other graphical imagery such as charts, graphs, illustrations and photographs gave full control over the layout of the printed page. The designer could now create an entire page of graphics and see exactly how it would look before it was printed. When the screen fonts of the computer were able to accurately simulate the graphical fonts of the printer, the term WYSIWYG (What you see is what you get) was coined to emphasise this new software capability.

As printing technology improved, the notion of hand-laid metal type was quickly abandoned. The tools and methods of printing shops had to change drastically as the old presses made way for computers and high-resolution laser printers. Large format cameras, used to photograph graphical images for the creation of printing plates, also disappeared. Text could now be transferred to the printing shop via computer diskette or the telephone using a modem. Other images could be captured using high-resolution colour scanners. Eventually, a new format called Postscript would allow for entire documents, including illustrations, to be "downloaded" to a printer. New laser printer technology was designed around this format and it is now a standard for all high-quality printers.

Not all graphic designers readily embraced the new technology. Some saw it as a very dangerous tool since it put into the hands of untrained people the power to produce graphic products. For example, the production of company newsletters, notices, manuals and other printed documents were often done by secretaries who, because they used the computer and had some word processing skills, were logically chosen for the task. However, the sophistication of these graphic products was quite low as seen through the eyes of the professional graphic designer. Hence, the computer as a tool was, in a number of cases, purposefully avoided by designers and educational programs. Avoided, that is, until recently when the realisation was made that knowledge of the computer is an essential part of getting a job in the graphics industry. Now, every program in Graphic Design has extensive computing facilities.

2.1.2 The use of Video in Graphics

The use of video has become another important aspect of graphics production. A number of technologies are coming together in order to provide solutions to this new industry. The technological growth of computing systems leading to improvements in computer speed and screen resolution have allowed video to be imported. Up until now, video has been relegated to a small window on the computer screen. The current challenge, to produce equipment which is fast enough to provide full-frame video running in real-time, is almost upon us. Graphic designers are called upon more and more to incorporate video sequences (converted into digital "Quick-Time Movies") into presentation programs and interactive CD's. Designers are merging with Moviemakers in order to produce these new forms of communication.

2.2 Product-oriented development

2.2.1 The use of Graphics on products

Industrial Designers also became interested in the new graphical tools of the computer. In the mid to late 70's graphics became a part of the product identification and text began to appear on the surface of the product. At first, this effort was a bit overdone and the use of SuperGraphics put large scale, bold text directly on the product. In some cases this text was absolutely unnecessary, e.g. a hairdryer might have the words "HAIR WORKS" in Helvetica Bold silk-screened on the side. Later, as this trend subdued, corporate logos and images became an important part of the product identity thus an accepted part of the product form development. Today there is virtually no product without some sort of graphic identity moulded or silk-screened somewhere on its surface.

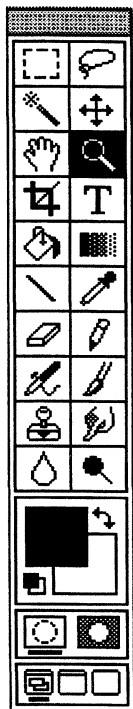
2.2.2 Drawing/Painting Programs

An off-shoot of the text-based graphical tools were the development of software for the creation of illustrations and drawings. These, too, started the domain of Graphic Design but developed into many different forms based on the interests of other users including Industrial Designers. There is a fundamental split between the typical types of drawing programs; those that are Pixel-based and those that are Object-based.

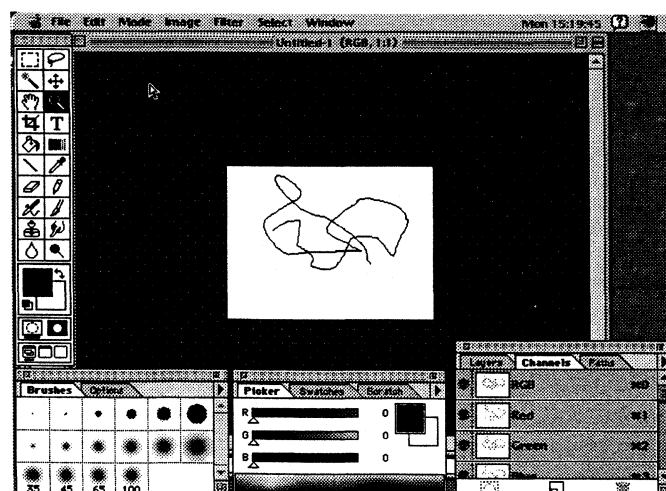
2.2.2.1 Pixel-based drawing programs

Pixel-based programs provide drawing tools that alter each single point on the computer screen. A point, for example, can be placed anywhere on the screen and assigned to any colour. The limitations are based on the screen resolution and the maximum number of colours the computer can represent. Lines are created by drawing all the pixels that are in a row representing the line and clusters of the same colour pixels become areas of colour on the screen. In this manner, a number of simple tools have been created which offer the artist flexible drawing possibilities.

The advantage of pixel-based drawing is that it is the closest method to actual pen-on-paper sketching. The creation and development of images is therefore, quick and easy to learn. The disadvantages are centred around editing and changing of the created images. Editing can only be done by totally erasing the part to be changed and re-drawing it; again, like paper and pencil. Additional problems are related to the resolution of the image when printed. Pixel-based drawings produce bitmaps of the computer screen which are representations of each pixel on the screen. The problem with bitmaps is that they are two-dimensional and are limited to the screen resolution which, in turn, limits the maximum printing quality. However, improvements in computer technology have continued to affect the resolution of both computers and printers to the point where extremely high-definition, colour drawings and, equally, high-quality colour printouts are now possible. This has developed into new software drawing products which closely emulate the tools and methods of the Industrial Designer and can actually be used to generate reasonably high-quality renderings of products.



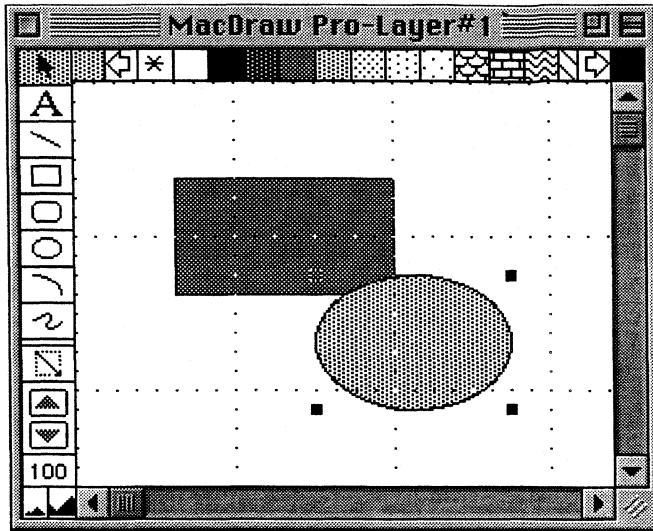
Typical iconic tools for pixel-based drawing programs



Pixel-based drawing programs, Photoshop

2.2.2.2 Object-based drawing programs

A different philosophy for drawing was adopted by graphic designers. Object-based drawing doesn't rely on producing a bitmap. Instead, objects are defined by the coordinates of their points (vertices). These geometrical definitions are then represented on the computer screen by a bitmap interpreter. The tools for object-based drawing also behave differently than pixel-based tools and are not as intuitive to use. Lines, for example, are defined by two points (beginning and end) which can then be positioned anywhere on the screen. The resulting line is then a calculation between these two points. Boxes, circles and other shapes are made the same way.



Object-based drawing program, MacDraw Pro.

Advantages to object-based drawing are twofold. First, the objects themselves are easy to edit and manipulate. The user can select one or more objects and edit them by altering the position of their points. Likewise, objects could be easily erased or stored for later use. But the biggest advantage for the Graphic Designer was that these object-based geometric definitions were not limited to the computer resolution. Printing could be done with a higher quality than could be seen on the computer screen. This led the way to acceptable, high-resolution graphic images and, thus, high-quality printed documents. The disadvantages to object-based drawing is that it is not an intuitive method; the tools and how they behave have to be learned. More importantly, the resulting illustrations are severely limited to the attributes of the drawing tools and are not at all suitable for use as Industrial Design illustrations. Hence, object-based drawing remains mostly in the domain of Graphic Design.

2.2.3 The incorporation of 3D Video and Animation

In the last ten years, the impact of computerised imagery for television has been remarkable. Advertisers discovered that they could better promote products with eye-catching and unusual advertisements. The field of television graphics which started with "Flying Logos" has now progressed to the simulation of products and environments far beyond the imagination of the viewer. This phenomenon has generated an entirely new industry which has grown very rapidly to the point of being almost commonplace in our communication media.

2.2.3.1 Video production

Most video producers are now doing their editing using digital equipment. In this process, analogue video footage, shot at location, is first digitised onto massive hard drives for storage. Then the sequences and transitions are programmed into the computer and assembled into a final version. The computer plays the final version back onto a videotape where an analogue copy is made. Since the original video footage is digitised into the computer, all subsequent versions have no image deterioration as was the case with multiple analogue copies. Therefore, thousands of copies can be made with no loss in image quality. Eventually, new video cameras will shoot directly to digital and store the visual information on RAM cards. Moving parts will be eliminated, stability and reliability will be enhanced, and size will greatly decrease.

2.2.3.2 Video products

Concurrent to the developments mentioned above, there has been a revolution in video-oriented product development. The result has been that film cameras, based on chemically processed acetate film, have nearly been eliminated. Video cameras started as heavy, massive units. The first portable consumer products consisted of two parts, camera and recorder. The recorder was worn over the shoulder and contained a huge battery to power the equipment. Eventually this evolved into camera-recorder combinations and, finally, the amazing pocket-sized products of today.

As soon as the technology allowed Video cameras to be constructed which were of a reasonable size and weight, 16mm and 8mm motion picture cameras quickly became obsolete.

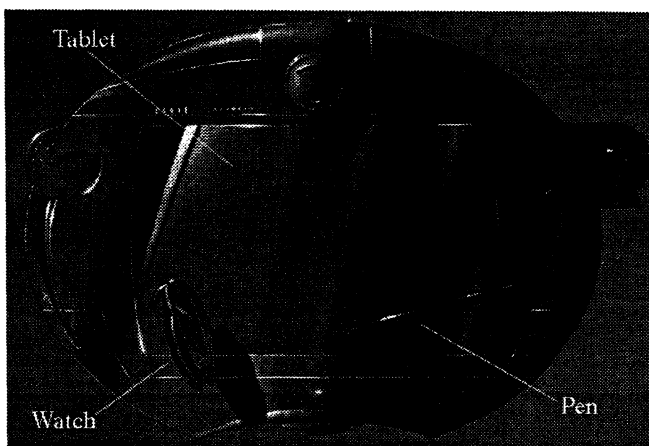
This same trend is beginning to affect still photography as well. A number of still-video cameras are now on the market with a wide variety of prices and picture resolution and prices ranging from under £1,000 to well over 40,000. While still-video has yet to replace film-based cameras, continuous improvements to resolution will eventually match that of standard chemically-based film. When this occurs, film cameras will quickly meet demise already experienced by their motion-picture counterparts.

In still-video cameras, images are digitised and stored directly in the camera. Storage can be on a miniature floppy disk, a RAM card or internal RAM memory. The images are then transferred to a computer for modification using one of the many new photo manipulation-management programs such as Photoshop. These programs allow for a vast number of digital darkroom techniques to be applied to images for enhancement and clarification as well as art- and graphics-oriented manipulation. When used with very high quality computing systems the generation and editing of images for publication can be accomplished. In fact, so much can be altered with these tools that photographic images can be completely faked thus creating the controversy that photographic images can no longer be believed or even accepted in legal situations.

3 3D Visualisation

Most three-dimensional computer representations are product-oriented. Even animations done for television or interactive presentation are most based on products. It is no surprise, therefore, that Industrial Designers play an important role in the development and use of CAD systems for high-visualisation. As soon as computers became powerful enough to display "believable" product drawings, designers have been busy trying to adapt. Photographic-like images of products allow manufacturers to evaluate and even test consumer reactions before major financial investments are made. For this reason, most large companies are investing heavily in visualisation software and are training designers to cope with the complicated technologies.

3.1. CAD vs. Visualisation



*TIME (Three-dimensional input, manipulation and evaluation)
by Gianni Orsini, 6.95*

The so-called Visualisation programs being used today are still based on the old CAD metaphor and use many of the same mechanical-drawing rules for the creation of 3D objects (products). Typically this involves the creation of objects from three orthographic views. In many cases, this is counter to the way designers are taught to draw, thus leading to a lot of frustration when trying to learn a new computer visualisation tool. What is really needed is new tools which better simulate the drawing activities of the designer and allow for an easier and more intuitive interface for product creation, especially during the early phases of design.

Current research in the IDEATE project is also attempting to look at new ideas for the generation and manipulation of 3D computerised objects.

3.2 Current Visualisation Software

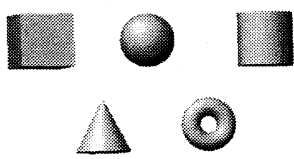
The sophisticated (and expensive) visualisation software of today needs powerful computers to exploit their features. Programs like ElectroGig (taught at the Faculty of Industrial Design Engineering in the elective course)

"Computer Visualisation") require, for example, unix-based computers like SUN and Silicon Graphics. However, many new programs are being designed for smaller systems like Macs and PC's in order to capitalise on the enormous users market. This should put high-level visualisation in the hands of just about anyone who can afford the generally high prices of the software. Because of the complicated programming issues involved, most visualisation programs are divided into two distinct parts: Modelling (Shape editing) and Rendering.

3.2.1 Modelers and Shape Editors

Modelers are the programs that allow the user to create and define the shape they want to display. Most modelers use the "traditional" mechanical drawing metaphor of three orthographic views in which the user places points, lines and planes. The combination of these elements define the 3D object. There are three distinct types of object-generating methods used by modelers: CSG, Splines-Nurbs and Voxel-based.

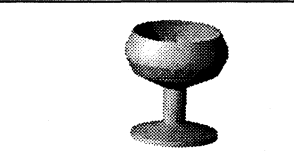
3.2.1.1 CSG Modelling



The basic primitives



Extrusion of a profile



Rotational shape-creation

CSG stands for Combined Solid Geometry and is the most commonly used form of modeler. In this type of system, pre-defined objects called primitives can be placed on the screen. The standard primitives are the cube, cylinder, sphere, cone and torus. They are made up of 3D points (vertices) and their connecting lines. These are mostly displayed as wire-frame shapes but more sophisticated modelers create shapes with the hidden-lines removed or with the object shaded in some way..

The primitives are then edited by changing the location of their points and lines. New points can also be added and points can be taken away resulting in different shapes. Other new shapes can be created by drawing a profile in 2D and by extruding the profile in 3D space along a line.

Another method is the creation of a shape by defining a profile and rotating around the edge of that profile by a specific number of degrees from 1 to 360. This is called rotational shaping or, sometimes, the spin function.

Once objects are created they can be assembled by combining them to each other. In simple modelers, the only possibility is to add each shape together. More complex modelers allow for smoothing of the transition between shapes or radiusing of the area where the shapes join. Even better modelers allow for the Boolean operations of Addition, Subtraction, Union and Intersection to be applied. In this manner, shapes can not only be added but can be subtracted from each other, forexample, a cylinder subtracted from a cube would leave a hole through the cube.

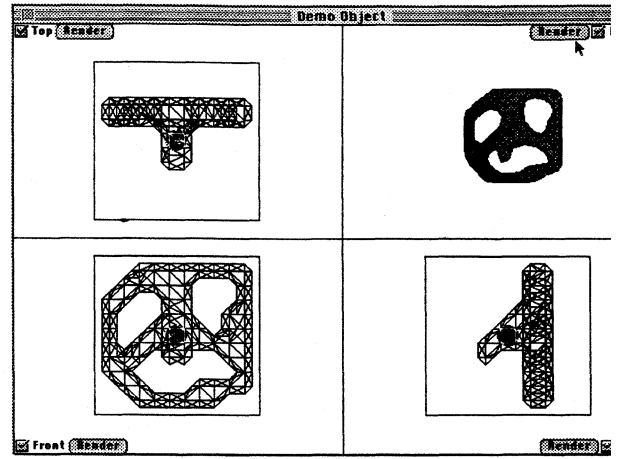
3.2.1.2 Spline and NURB modelling

Spline-based modelling is a different way of creating objects. It is mostly used for warped continuous surfaces and lends itself to products like automobiles and airplanes. Splines are lines which contain a number of control points. The number of control points and distance between them can be defined by the user. Changing the 3D position of these points alters the curve of the spline while the integrity is maintained. By combining splines into a connected grid, surfaces can be defined. These surfaces can be very complex because each spline which comprises it can be individually altered to change the shape.

3.2.1.3 Voxel-based modelling

Voxels is a term derived from Pixels. Pixels are 2D points on a computer screen while Voxels are 3D; "*Volumetric Pixels*". Voxels are typically spherical (because a sphere is the most easily defined geometric primitive - it only needs two points for its definition, the centre and the radius) but they can be any shape. They can also be any size which is convenient based upon the size of the screen and the speed and memory capabilities of the computer. Large clusters of voxels can be used to create basic shapes likes cubes and cylinders. The voxels can then be selectively "carved" away to form complex shapes. This techniques is sometimes referred to as "*virtual clay*". Voxel-based modelers are still somewhat experimental because the

computer requirements to manage even a small 3D array of voxels is quite extensive. This makes voxel-based modelling very slow and cumbersome while producing only "chunky", undetailed results. Experiments with computers like the CRAY, however, have shown that voxel-based modelling is a valid tool that is simply waiting for technology to catch up.



3.2.2 Renderers

The second part of good visualisation software is the Renderer. The renderer takes the object definition created in the modeler and gives it colour and texture. The user has complete control over the view, whether is parallel or perspective, with or without shadows, the number, position and intensity of light sources, how close or far the object is, what textures are applied, etc. Renderers create solid looking objects which, depending upon the resolution and quality of the rendering method, look like real products. The higher the quality, the more "photographic" the look of the final rendering. In order to produce fully shaded and properly detailed models, Renderers use a number of different techniques which include: shading, Polygon-shading, Ray-tracing, Texture Mapping and Luminosity

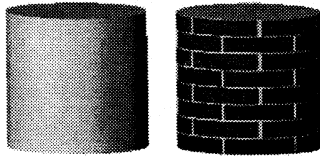
3.2.2.1 Flat-shading Methods

Wireframe objects are OK for manipulation and editing of 3D shapes but when the time comes to make an evaluation of the actual product form, designer needs a solid-looking object, in colour. One of the simplest and fastest methods for drawing objects as solids is the flat-shaded method. In this method, the object is defined by planes: flat surfaces defined by 3 (or more) points (vertices). By filling these planes individually with colour, the computer can create a solid-looking object. The hue of each plane is based on the position of the plane in respect to the lighting and its intensity. To assure that objects correctly overlap each other in a view, there are a number of algorithms which mathematically calculate which planes are to or away from the viewer. By filling in the back planes first, the object is built-up, back to front. By filling the rearmost objects first, overlapping in the scene (hidden surface removal) looks acceptable and believable. However, when certain viewer positions are taken, it is possible to fool the algorithms leading to strange polygons which are in the wrong place. None of the current algorithms are foolproof. For this reason, high-quality Renderers don't use Flat-shading methods, even though they are fast to perform.

3.2.2.2 Polygon-shading Methods

Polygon shading is a different technique which leads to more acceptable results when rendered. In a Polygon-shaded Renderer, objects have pre-defined shading characteristics. The primitives, for example, are automatically defined regarding their geometry so it is easy to add definitions for how they should be shaded. The algorithm used, in this case, differentiates the geometry's of all the assembled primitives on the screen and, after determining what parts of the object are visible to the viewer, proceeds to render the view. More calculation time is needed for this method since the complexity of the scene and, consequently, what parts of the object are visible are mathematically intensive. But, the overall effect is much better than Flat-shading and has less errors in its hidden surface removal. It is even possible to show semi-transparent colours on the surfaces. Many, if not most, of the visualisation programs of today use this method for object rendering.

3.2.2.3 Texture-Mapping Methods



Texture mapping

An interesting trick used with Flat and Polygon shaded renderers is to fill the triangulated areas with a bit-mapped picture of a texture instead of a colour. The idea is to make more believable-looking objects than these methods are capable of rendering. A picture of any complex material or texture can be used to fill in the polygon. The technique can be applied and calculated very quickly and is the basis for the fast 3D scene rendering used in some programs. It is also very apparent in 3D games where the walls are generated and displayed very quickly by texture-mapping the image of stones or bricks onto them. The result is the maintenance of the speed of Flat or Polygon shading but with better-looking results.

3.2.2.4 Ray-tracing Methods



Typical ray-traced product
(ElectroGig)

A more sophisticated method for visualisation is the use of Ray-tracing for object rendering. In Ray-tracing an invisible ray from the eye of the viewer to the object(s) in the scene is calculated by the algorithm. The first ray starts at the upper left corner of the screen (for example) and works its way horizontally across, pixel by pixel. When it reaches the end of the screen it jumps back to the left and then down a line. In the same manner as before it goes horizontally across the next row. Eventually it has scanned the entire screen, looking at each individual pixel. At each and every location, a calculation is made to see if the invisible ray comes in contact with the object. If so, it calculates exactly what shade and hue the colour of the pixel should be to accurately define the object. If not, it makes the pixel the colour of the background. While ray-tracing is the slowest method of rendering, it also produces the best results. Virtually any type of surface can be rendered: wood, metal, plastic, glass, chrome, etc. Additionally, shadows cast by the object can be calculated and displayed. Multiple shadows from many different light sources (and light source colours) are possible and these can be accurately done even if they overlap or fall on parts of the object itself. Reflections and mirroring can also be calculated and drawn. True photographic-level quality can only be achieved by using Ray-tracing methods.

3.2.2.5 Luminosity Methods

One of the latest methods to be applied to high-level photographic rendering is the use of Radiosity algorithms. Radiosity is a form of Ray-tracing in which a multitude of subtle light sources as well as all of the reflected light from the surfaces within a scene are calculated. The effect is an absolutely accurate rendering of the objects and their environment. This technique was first applied to architectural rendering and, in some cases, the computerised output as so good that it could not be distinguished from a real photograph. Lately, the same technique has been used for product rendering with remarkable results. The problem with this method is that it takes enormous amounts of time to do the calculations for each and every light source and each and every reflection. It is not unusual for Radiosity renderings of even a modest scene to require 2 or 3 days of calculation and drawing time. At the moment this is a technique used only on the biggest and fastest computers. However, enhancements and improvements to the Radiosity algorithm will bring this method to the domain of the average designer in the near future.

4.0 Animation, Simulation and Virtual Reality

In recent years, the expanding capabilities of graphical software, especially for desk-top computing systems like the Mac and PC, have put enormous visualising power into the hands of the everyday user. The expectations of the design-oriented computer user are no longer satisfied with just CAD or even "photographic" product visualisation. The combination of modelling

and animation software has created a new industry: the making of computerised product prototypes. Computer prototyping lends itself especially to the early stages of design when quick visual models and suggestions for user interfaces are required to help the designer in his evaluation of different product ideas. Often, simulations can be so realistic as to allow for user-testing and evaluation as well as marketing perceptual studies. The costs of doing computer simulations and prototyping are far less than for building and testing real products so it is no surprise that manufacturers are now becoming very interested in these prototyping techniques. It is also important to point out that knowledge of the tools for computer prototyping will be as important for future designers as the knowledge of CAD/CAM is now.

4.1 Animation programs

An overview of animation approaches

4.1.1 Cell Animation

Animation programs were the first to be developed shortly after the introduction of high-quality "paint" programs. Once artists and designers had the capability to obtain reasonable drawings on the computer, they were quick to demand software which would give "life" to their drawings by animating them.

The first programs were "Cell" animators. A cell is a single picture in a series which, when displayed in a sequence will simulate motion. This means that each frame of a film is a cell in which art work is displayed. Since typical motion picture film travels at 24 frames per second, one can expect the animator to draw 24 cells for each running second of a movie. Thus, a simple five minute sequence would require as many as 7,200 drawings ($24 * 60 * 5$). As a hand-done process, this was exceedingly time consuming and tiring work. With the introduction of computer animation the laborious task of calculating the movement from the beginning of a sequence to the end could be done automatically by telling the computer the starting and ending locations of the objects in the sequence. The computer would then calculate the in-between cells of the sequence by incrementing the objects in each cell. This is known as "tweening"; the process of creating cells "between" the first and last cell of a sequence.

4.1.2 Object-oriented Animation

By capitalising on the automatic technique of "tweening", programmers began to develop Object-oriented animation packages which were no longer cell-based. An animator could create an object or import it from a library of existing images. The computer could then move and position these objects easily according to the animator's wishes. The object definitions and their positions (time based) were all that needed to be stored in a file so the file sizes (and memory requirements) for a full-length animation were much smaller than a cell-based animation. The library of objects could be used over and over again so hundreds of versions could be made with the same objects. The cartoon industry, especially the made-for-TV versions which were produced weekly, were the first to exploit this new method. It might also explain why there was a boringly similar format and look to these types of cartoons which "true animators" despised as a poor-quality, short-cut approach. However, the tools for animation have become so sophisticated that all of the major animation studios, including Disney, Hanna-Barbera and Bluth, use computer-based solutions. Hand-done cells are now a thing of the past.

4.2 Animation and Compression Formats

Not all animation techniques involve hand-drawn images. The merging of photographic-quality renders with animation capabilities quickly developed. At this point in time, virtually all of the high-level rendering packages have some sort of animation capability. In a typical situation a complex 3D object

is developed and, by altering the camera and eye position of the viewer, animations which appear to "fly-around" the object can be made. The first instances of this type of animation was used for television promotions and "flying logos". But, as the images got better and more detailed, the movie industry started using the same techniques for special effects (SFX). It would be too lengthy to talk about all of the special-effects techniques that are used today and, besides being outside of our field of Industrial Design, it is already widely covered in special programs on TV. The real point to be made is that the same tools are available to product designers for the purpose of showing, explaining, selling and/or testing new product concepts.

Besides using images from high-level rendering programs, a lot of animators use video techniques as well. The computer is capable of accurately mixing (or overlaying) computerised objects into (onto) real-time video to such an extent that the two cannot be distinguished apart. The movies are abundant with techniques ranging from the dissolving of one image into another (morphing) to the complete altering of video by redrawing each and every frame. We are at an age where movies and videos (just like photographs) can no longer be accepted as proof of the truth or as any form of reality.

Naturally, as these methods to computerise video and animations began to develop, programmers began to worry about how much memory and storage space they needed. Soon, the need to develop methods of compressing this information became obvious. Compression algorithms were developed which could encode the raw data of the file and reduce its final size by as much as 50-70%. The better techniques, however, took time to compress and, subsequently, decompress the information. If the video or animation was to be played back in "real-time" (24 fps), the method of decompression had to be very fast. The point we are at today is that we are just working on formats which will allow full-screen video on the computer together with real-time decompression rates.

4.2.1 FLI-movies

FLI format animation is specific to the DOS and IBM-PC world. It is a format which allows a series of single images to be collected, compressed and played-back on any PC. FLI-based animators have been developed and FLI-file creators have been added to many of the existing CAD programs.

4.2.2 Quick-time

Quick-Time (QT) is a trademark of Apple Computer Co. and while it was developed as a special video and animation format for Mac computers, it has been licensed to Silicon Graphics Corp. for use on their computer systems. Recently, Quick-Time technology has been brought into the world of the PC with a "Windows"-oriented player. Unlike other formats, Quick-Time is a system expansion which operates in the background of the computer. It provides the interface between the video of the computer and the quick translation and decompression of QT movies and videos. There are many player programs and utilities which use the QT technology for the creation, editing and displaying of video and animation information.

4.2.3 Jpeg and Mpeg compression

Emerging as the standard for the video industry, Jpeg and Mpeg formats offer the highest compression ratios and fastest decompression times. Improvements are being made to these formats constantly and it is expected that the objective of "real-time" decompression will be reached soon. The large video producers are also developing digital cameras and recorders which all use the new Mpeg format for storage. Clearly, these compression formats will play an important role in the digital imaging and editing capabilities of future products.

5 Simulation Programs

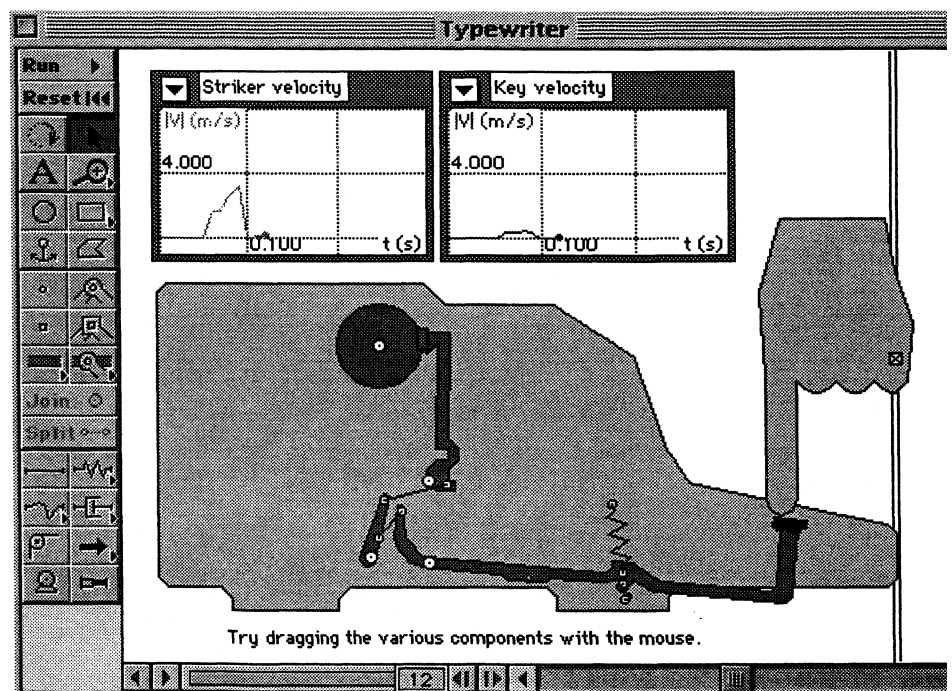
Simulation implies something quite different from animation. While an animation is viewed passively, simulators are used interactively and attempt to accurately mimic the behaviour of a real product or situation. This makes computer simulation a valuable tool for product development and user-testing. In the world of Industrial Design Engineering, there are two areas which can be simulated. One area is the simulation of technical or physical phenomenon such as mechanical linkages or electrical circuits. The other area is the simulation of product behaviour or user interfaces. In this chapter we will only discuss the first area of simulation. An extended overview of the second area can be found in the next chapter "Interactive prototyping".

5.1 Technical and Physical Simulators

Computer simulators have proven to be effective alternatives to a great number of scientific instruments. There is no area of scientific measurement or testing which doesn't use computer-based versions of instrumentation. These simulators are made for two different purposes: 1.. to duplicate the actions of a test instrument or 2. to simulate the behaviour of a mechanical or electrical design.

5.1.1 Mechanical Simulation

One of the popular programs for testing mechanical linkages and mechanisms is called *Working Model*. The designer can easily "paste" together various arms, gears and links. To this, *Constraints* can be added which limit or restrict the motion or movement of the components in the same manner as the real object. Forces can then be applied to the assembly and the program will accurately show the results of those forces, both graphically (in real-time) as well as numerically. Very complex mechanisms or models can be created and tested in this way. The forces of gravity, friction and acceleration/deceleration can also be applied. In this way, the designer can prove the mechanical characteristics of his design before anything is actually built thus saving enormous time and costs.



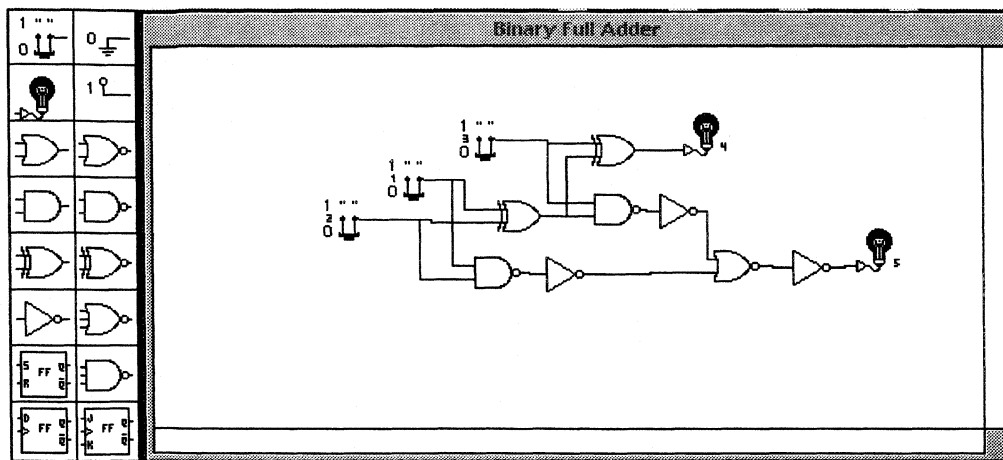
A screen from Working Model

5.1.2 Electrical and Electronic

On one hand, computerised simulators can be used to model test instrumentation such as the program *Digital Oscilloscope*.¹ The computer can be equipped with a special input/output board which communicates through the parallel or serial port. Electrical test connections are made through this board. The computer then displays the actual wave form

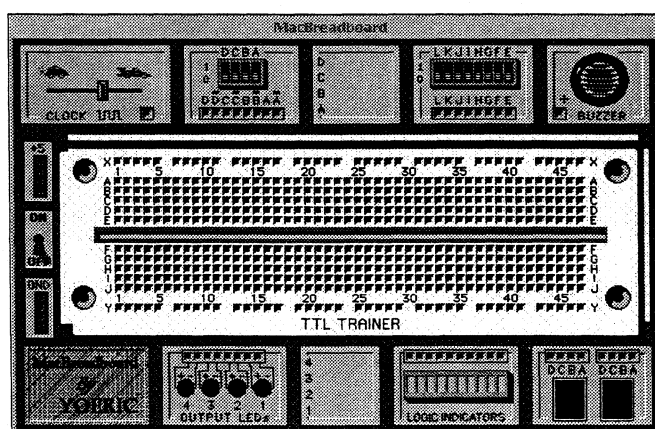
all of the control and functionality of a real Oscilloscope. In fact, Oscilloscopes themselves are becoming more computer-controlled and, thus, computer-like. Digital Oscilloscope is a public domain program for the Mac (there is a PC version as well) which uses the built-in microphone and audio capabilities to display audio waves and to measure frequencies.

On the other hand, computerised simulators like *Circuit Board Sim* and *Digi-sim* are used to "breadboard"² electronic circuits to see how they will behave. Digi-sim is specially designed for digital circuits and has a library of commonly used digital chips such as counters, flip-flops and adders.



A screen from Digi-sim

Circuit Board Sim is more diversified and includes a library of other common components such as transistors, resistors and capacitors. Both programs are good examples of how engineers and designers can create experimental circuit layouts and test how they work without the need to buy expensive components.



A screen from Circuit Board Sim

5.1.3 Other Physics-based phenomenon

The ways in which computers can be used to simulate physical phenomenon is endless. As the technology for microscopic visualisation improves, more and more realistic simulations in areas like Electron analysis, Molecular analysis, DNA-chaining, etc. can be accomplished. On the other end of the scale, computer simulations of Planet and Comet

¹ An oscilloscope is a test instrument used to measure and display electrical waveforms. These waves can be below audible to well beyond the range of hearing, from 1 Hertz to 10000 MegaHertz and beyond. They are used to measure Audio sources (Stereo systems), Video and computer cycle times. All electronic manufacturers use oscilloscopes for periodic testing of components during the time of assembly.

² Breadboard - a test circuit, usually wired by hand. The name came from the fact that these circuits were typically constructed on a non-conductive and portable surface such as a bread cutting board, which most hobbyists had at home.

motion as well as the visual reconstruction of planets which are too far away for the eye to see (based solely on spectrogram information) can not be done. One can readily see that computer simulation is a vast field in its own right.

6 Virtual Reality

One of the most discussed and promoted concepts in the computer world today is the growing interest in Virtual Reality. For most, VR is expected to become the next big explosion in the entertainment industry. For others, it is a new way to look at things from a new perspective; the inside of an atom, the outer edges of the universe. For the Industrial Designer, VR also holds the promise of being a fantastic presentation and evaluation tool.

At this point in time, VR is still an experimental media. There is a sharp contrast between the affordable, low-end equipment which can be coupled to the home PC and the very expensive, complicated high-end systems which are used for scientific applications. As is already occurring in the computer arena, the high-end and low-end are beginning to merge somewhere in the middle as systems become more powerful yet affordable. At the current rate of growth, VR, in the near future, can be expected to play an important role in our lives both as an entertainment media as well as a design tool.

6.1 Immersive VR vs. Augmented Reality

The VR which we normally see consists of a fairly large and bulky Helmet which contains a pair of colour LCD screens, one for each eye, and a set of stereo speakers. On top of the helmet is a special positioning sensor which can tell the computer the exact position, tilt and angle of the head within very precise measurement. A typical device for this purpose is called a *Polhemus* which consists of three coils oriented in the x,y and z plane. These coils send magnetic waves to a receiver located just above the helmeted-user which calculates the orientation of the coils based on its own x,y,z coils inside. The correct 3D view, based on the user's head position, is calculated by the computer and displayed on the two LCD screens. Thus, the feeling of being in a computer generated (virtual) space.

In addition to the Helmet, many systems allow the user to navigate (move around in) the 3D space by controlling some sort of input device like a *Joystick*. Zooming through virtual space with a joystick is necessary because the physical limitations of the equipment limit the user to an area of about four square meters. More complicated systems allow the user to wear one or two *Gloves* which are also equipped with Polhemus devices. This allows the user to pick up and manipulate objects in the virtual environment.



Some new ideas for
VR Helmets

One of the problems of these systems is the high cost of the technological sophisticated equipment. Another drawback is its cumbersome design. Most Helmets can only be worn for a very short time because of the weight and the build-up of heat. Other users complain about the gloves not fitting their hand and also being hot and sweaty to wear. Designers are now working on new, lightweight versions of these VR products and we can expect better, less intrusive hardware in the near future.

It can be easily seen that the wearing of *Full-immersion VR* equipment which shuts out the real world from the user might create problems. Helmeted users are essentially "blind" to the environment they are in and can only see what the computer displays. Coupled with loud stereo sound they can become totally isolated from reality. For some applications, this may be acceptable in order to achieve the desired visual effect. But many other types of applications may require that the user stay in touch with his surroundings, for example while using or driving machines. This technology

is called *Augmented Reality* because it offers some Virtual Imagery which is projected into the real environment. For example, in one of these methods the user wears a special optical device in front of one eye. A video image from the computer is projected onto an angled glass surface which can also be seen through by the user. The resulting effect is the overlaying of the video image into the environment of the user. Coupled with head movement sensing, the positioning of this virtual image can be made to correspond with a certain area of the user environment. An example would be the projection of a conceptual automotive design into the room which allows the user to walk around it and view it as if it were actually there. Another use of this system is the mapping of computerised images from a user or repair manual into the actual object to be repaired. The repair person, wearing the device, could then see exactly what the next step in the repair would be because it is superimposed directly onto the physical parts to be repaired. The uses for Augmented Reality are endless and, in some ways, are expected to match, if not exceed those of VR.

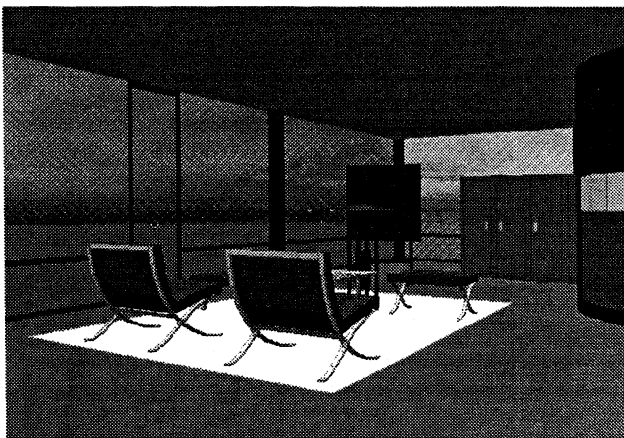
In a number of user tests and interviews done by the *IDEATE research* group, section Design Techniques, vakgroep Vormgeving, TUDelft, it became clear that Industrial Designers would not like to use immersive VR technology because of the isolation factor. Therefore, within this research group, proposals for new virtual imaging tools for conceptual design are being done using augmented reality systems.

6.2 Low-end Systems

As an answer to the high prices of professional VR equipment, many electronic and computer hobbyists became interested in some form of VR for their own experimentation or entertainment. The types of Low-end VR systems to come out of this experimentation fall into two basic categories: viewers of 3D scenes and various types of input devices leading to immersive VR.

6.2.1 Software (Interactive 3D viewers)

A lot of functionality has been added to basic 3D modelling programs in order to achieve a form of Virtual Reality. Not just content with static 3D images, programmers began to add quick-rendering routines which would allow for rapid changes in the camera and eye positions of the viewer. The term "fly-thru" or "walk-thru" was created to represent the ability of the user to move through a computerised 3D space. At first the process was very slow because each new camera or eye point had to be calculated into a scene, drawn by the computer, and then saved as a bit-map of the screen. The collection of resulting bit-maps, played in sequence, became the "fly-thru movie". Simple scenes, rendered in Wireframe could be achieved fairly quickly but complex scenes which were fully rendered (shaded and shadowed), sometimes took weeks to be drawn and assembled into a movie.



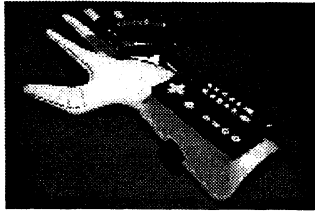
Screen from *Virtus Walk-thru*

This area has also been quite an active one for researchers, programmers and algorithm developers such that dramatic speed increases have been achieved. Quick (and extra-efficient) Renderers coupled with other tricks like texture mapping have brought on the new wave of real-time rendered games (such as *Wolfenstein*) as well as serious applications such as the architecturally-oriented *Virtus Walk-thru*.

Lately, a new idea has emerged of using 3D virtual space as a metaphor for new concepts in user interfaces which allow "browsing" of data in a pictorial way. City-scapes representing books or stacks of papers, rotating Space-stations which

represent corporate links of personnel, Star-clusters of data, and new ideas for travelling through the Internet are all recently developed methods suggested by research groups. As an entertainment medium, design presentation tool or new interface metaphor, interactive 3D software will continue to expand its capabilities and usefulness for designers.

6.2.2 Inexpensive and home-made Hardware



Mattel Power-Glove

As soon as VR became popular, hobbyists and home computer buffs wanted to build their own systems. The high cost of real VR systems required that much of the first efforts of the hobbyist had to be hand-built from bits and pieces of other technology. A pair of small LCD TV's glued to a welding mask and coupled to some video cards in a PC was an exciting beginning the enthusiast. Toys like the *Mattel Power Glove* originally intended for the Nintendo Arcade Game, were quickly adapted for use.



VPL VR Helmet

Soon, the experimental research of people like Jonathan Lanier spun off companies like *VPL* which made and sold high-quality, reasonably priced VR helmets and gloves.

Polhemus Inc. also began to offer lower-priced sensors. Quality improved and prices started to fall. There are now a large, and ever-growing number of VR equipment suppliers who are entering the market. It is still, to a large extent, a hobbyist, home-construction industry but the interest is genuine and mushrooming.

6.3 High-end Systems

Some manufacturers are now focusing on the high-end of the VR market. The most expensive and technologically sophisticated applications are military-oriented and are, thus, classified and unknown. Another large area is entertainment, especially arcade games. A third area is in simulations other than military such as driving, flying, traffic management, airflow analysis, etc.

6.3.1 Hardware

One of the most interesting hardware technologies not already mentioned is the *Pixel-Plane technology* developed by the University of North Carolina. In a normal computer, the bit-map of the screen is generated bit-by-bit. Each bit is computed separately and, by scanning across and down the screen, a complete screen of pixels can be accomplished. The computer can do this fairly quickly, refresh rates of 60 hertz are common and higher rates can be achieved through special monitors. If the only task the computer had to do was put pixels on the screen, it would be able to do it fairly well. However, in a complex, ray-traced colour screen, the computer must also calculate the exact pixel colour which is appropriate to that scene. The computer now has to work very hard and, as a result, slows down considerably. The idea behind Pixel-Plane technology is to give each pixel on the screen its own small computer. Each small computer calculates the correct pixel hue and, since they all work simultaneously (an excellent example of true *parallel processing*), the scene is rendered in a mere fraction of the time. While this technology has been available for licensing for the past four years, only recently has a company started working with Pixel-Planes for the creation of games and flight simulation. However, it promises to be a significant technology because of the vast improvements it makes to real-time VR.

6.3.2 Design Research Software

Research groups within the TUDelft, Industrial Design Engineering program have been working on both VR and Augmented Reality. The group, Vormtheorie from the vakgroep Vormgeving, in cooperation with the department of Computer Science, sponsored a two-student graduation project titled "Manipulating Objects in a Virtual Environment" (*MOVE*). This project was the first significant step in our faculty to use VR in a practical way and its intention was to develop a "*Designers Toolkit*" for conceptual

modelling of products. The MOVE project was implemented on a VR system from the *Virtuality* Company LTD, England. It included a full-immersion helmet, glove, joystick controller and CD sound capabilities. It used an AMIGA 3000 computer running two separate Texas Instrument video boards for the imagery. Recently, through another arrangement with Virtuality, the section has obtained two new systems which are Pentium-PC based.

Together with the IDEATE research group, also from the vakgroep Vormgeving, immersive and non-immersive technologies are being explored which will assist the designer in the development of products by enhancing the conceptualising phase of the process.

7 Summary

The application of 2D and 3D visualisation techniques is shaping the way Industrial Design Engineers will create and display their future work. Consistent improvements to computer technology such as screen resolution, speed and memory capability will bring more affordable tools into the design workplace. Coupled with new ideas for interfaces allowing easier creation and manipulation of 3D objects, the tools of the near future will have a strong effect on the designer, his task and his results.

Animation, Simulation and Virtual Reality all play a significant role in how designers will use computer tools to present and test their conceptual ideas. A number of established technologies are merging with emerging, innovative ones to form new directions and possibilities for designers. Conceptual ideas will be easier to create and view using VR and Augmented Reality methods. Ideas will be easy to convey using the new presentation and animation tools. And product concepts as well as user interfaces can be tested and evaluated using simulation techniques. The work methods of Industrial Designers are quickly changing to include the knowledge and use of these new tools. Being aware of these new capabilities and being willing to adapt them to one's work methods and style will be a necessary requirement for future designers.

Interaction prototyping: tools en technieken

Een belangrijke activiteit in het ontwikkelingsproces van interactieve producten, diensten en systemen, vormt het maken van een prototype waarin de ideeën en concepten die de basis vormen van het eindproduct kunnen worden gepresenteerd en getest. Voor het simuleren van de bij dergelijke soort prototypen zo belangrijke interactie tussen de gebruiker en de aangeboden informatie schieten traditionele middelen en technieken zoals schetsen en spugmodellen te kort. Hiervoor kan de ontwerper echter een beroep doen op een groot aantal software tools en technieken.

Dit hoofdstuk staat in het teken van het ontwerpen en bouwen van (interactieve) multimedia prototypen. In paragraaf 1 zullen allereerst een aantal vormen van prototypen worden behandeld. Vervolgens zal in de paragrafen 2 en 3 dieper ingegaan worden op de activiteiten die nodig zijn voor het bouwen van een prototype, waarbij een overzicht gegeven wordt van de daarvoor beschikbare computer software en hardware. In paragraaf 4 wordt tenslotte een stappenplan gepresenteerd voor het bouwen van een prototype.

1 Prototypen: een classificatie

Een prototype is een voorlopige, vereenvoudigde weergave van het uiteindelijke product of een onderdeel daarvan, waarin is geëxperimenteerd met mogelijke technologieën, technieken en gereedschappen. Het doel van het maken van een prototype is het op een zodanige wijze vorm geven aan de ideeën uit de concepten dat een representatief beeld van het eindproduct wordt gecreëerd, welke aan evaluatie kan worden onderworpen. Een belangrijke reden voor het maken van dergelijke prototypen is dan ook om deze het mogelijk maken om reeds in een vroeg stadium van ontwikkeling waardevolle feedback van gebruikers te verkrijgen.

In deze paragraaf wordt allereerst een classificatie gegeven van een aantal mogelijke vormen van prototypen. Hierbij wordt het begrip 'prototype' ruimer opgevat dan in de beschrijving van het ontwikkelingsproces het geval was: Elke representatie welke is bedoeld om één of meerdere aspecten of onderdelen van het eindproduct te presenteren, te simuleren en/of te testen, wordt gezien als een prototype. Hierdoor vallen ook vormen als het storyboard en de flow-chart evenals aanduidingen als demo, model, presentatie en simulatie binnen de classificatie, waardoor een compleet overzicht ontstaat.

De classificatie is gebaseerd op verschillen in het doel waarvoor ze gemaakt zijn, en als gevolg daarvan ook in de mate van detail, compleetheid en interactiviteit die ze representeren en de middelen waarmee ze gemaakt worden. Hierbij wordt gewerkt van een abstracte, tekstuele, passieve, goedkope en incomplete weergave naar een concrete, visuele, (inter)actieve, kostbare bijna-complete weergave van het eindproduct.

- **Scenario**

Een scenario is een tekstuele beschrijving van een mogelijke situatie waarin het product gebruikt gaat worden. Hierbij wordt vaak een verhalende vorm gekozen, bijv. "Een dag uit het leven van ...". Het opstellen van een dergelijk scenario zorgt ervoor dat de context waarin het product gebruikt gaat worden, wordt verkend en vastgelegd.

- **Storyboard**
Een storyboard bestaat uit een aantal afbeeldingen, waarin de belangrijkste scènes of informatieschermen in de vorm van schetsen, waar nodig aangevuld met een korte tekstuele beschrijving, worden vastgelegd. Hoewel passief, kan een storyboard wel degelijk gebruikt worden voor een eerste onderzoek door met een groep gebruikers stap voor stap de verschillende schermen door te nemen.
- **Flow-chart**
Een flow-chart is een grafische weergave van de organisatie van de informatie, waarin de onderlinge relaties en de mogelijkheden tot navigatie tussen de verschillende onderdelen van de inhoud is vastgelegd. Flow-charts zijn daardoor met name geschikt voor het tonen van het grote overzicht, ze vormen als het ware een 'kaart van de omgeving', zoals die door de informatie wordt gecreëerd. Eenvoudige flow-charts kunnen het beste met pen en papier gemaakt worden, maar voor meer complexere structuren die zijn opgebouwd uit meerdere lagen, kan worden gegrepen naar softwarepakketten als TopDown (Macintosh) of Inspiration (Macintosh).
- **Diashow**
Hierbij worden de verschillende informatieschermen in een logische volgorde achter elkaar geplaatst om een mogelijk gebruiksscenario visueel weer te geven. De schermen zelf zijn passief en een mondelinge toelichting is dan ook vaak noodzakelijk om het concept verder te verduidelijken. De dia's kunnen worden gemaakt met de traditionele gereedschappen (fototoestel, diaprojector etc.) of met software tools zoals Microsoft PowerPoint (Windows, Macintosh). Eerder in het proces gemaakte handschetsen kunnen worden ingescand. De gebruikte media-objecten beperken zich tot tekst en beeld, eventueel sporadisch aangevuld met geluid.
- **Lineaire demo**
Een lineaire of 'self-running' demo is een autonoom lopende presentatie, welke zelfstandig een weergave van het concept geeft. Dit betekent dat een dergelijke demo een duidelijk 'verhaal' met een kop en een staart moet vertellen. Hiervoor kunnen naast tekst en beeld, nu ook geluid, animaties en video ingezet worden. Een dergelijk prototype laat zich eenvoudig vastleggen op videotape, wat een presentatie naar buiten vergemakkelijkt. Een lineaire demo is vaak een goed middel om het basisconcept van het produkt aan buitenstaanders te presenteren. Dit kunnen mogelijke gebruikers zijn die na het bekijken van de demo om een reactie gevraagd kunnen worden of de opdrachtgever die op basis van de demo moet besluiten over het doorgaan van het project.
- **Gedeeltelijk functionele simulatie**
Door het toevoegen van interactiviteit kan de rol van de gebruiker aan een demo worden toegevoegd, waardoor een wat diepgaander gebruiksonderzoek mogelijk is. Vaak is het hiervoor niet noodzakelijk om alle, in het uiteindelijke produkt aanwezige functionaliteit in het prototype op te nemen. Uitgaande van de vragen die men graag via het gebruiksonderzoek beantwoord wil zien worden, wordt een keuze gemaakt welke gedeelten interactief gemaakt worden. Dit betekent overigens vrijwel altijd dat programmatuur aan het prototype moet worden toegevoegd.
- **Volledig functionele simulatie**
Als laatste stap voordat de uiteindelijke produktie wordt geïmplementeerd kan besloten worden om een volledig functioneel prototype te bouwen, welke dezelfde functionaliteit bezit als het eindprodukt maar niet het uiteindelijke detail- en kwaliteitsniveau. Een dergelijk prototype vraagt veel investeringen, maar kan door zijn hoge realiteitswaarde ook veel nuttige informatie opleveren.

- **Videoclip**

Een vrij kostbare vorm van prototyping is het maken van een videoclip. Dit zal vrijwel altijd moeten worden uitbesteed aan een professioneel productiebedrijf. Een voordeel van het gebruik van video is echter wel dat hardware modellen en software prototypen gecombineerd kunnen worden.

2 Het bouwen van een prototype: de software

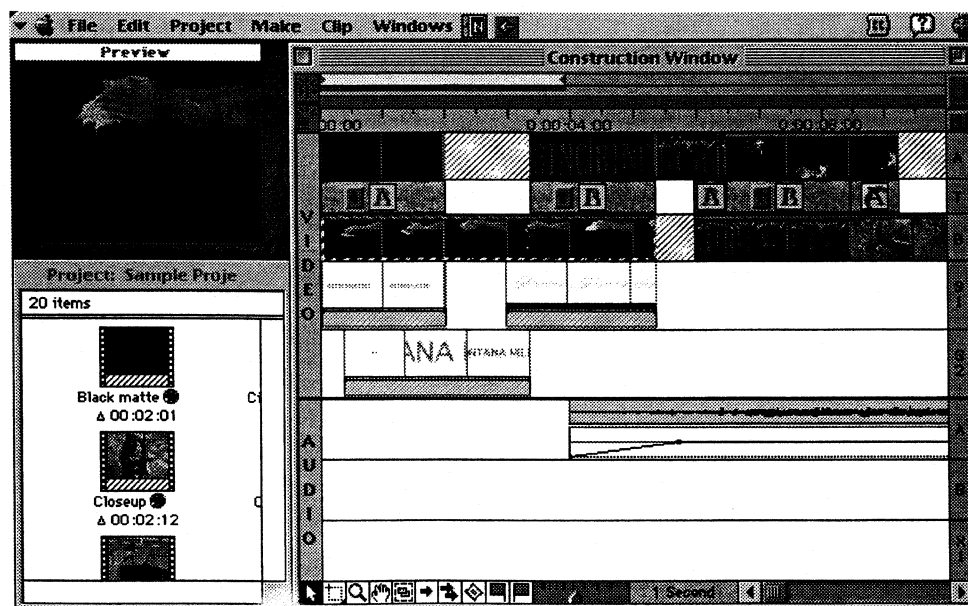
Voor het bouwen van een prototype zijn twee hoofdactiviteiten nodig die min of meer parallel plaatsvinden: het ontwikkelen van de inhoud en het structureren van de inhoud. Het ontwikkelen van de inhoud omvat het genereren, verzamelen en bewerken van de media-objecten die de inhoud van de produktie zullen gaan vormen. Om tot een geïntegreerde produktie te komen dient de inhoud vervolgens te worden samengevoegd volgens een van tevoren vastgelegde structuur. Voor deze activiteiten kan de ontwerper een beroep doen op een groot aantal software pakketten, welke in de volgende paragraaf besproken zullen worden.

2.1 Het genereren en bewerken van de inhoud

Voor het genereren en bewerken van tekst, afbeeldingen, animaties, geluid en video bestaan diverse gespecialiseerde software pakketten. Zie voor een overzicht van 2-D en 3-D visualisatie software het vorige hoofdstuk "The use of computing in industrial Design Engineering". Twee gebieden zullen we hier even kort behandelen: het bewerken van video en geluid

2.1.1 Het bewerken

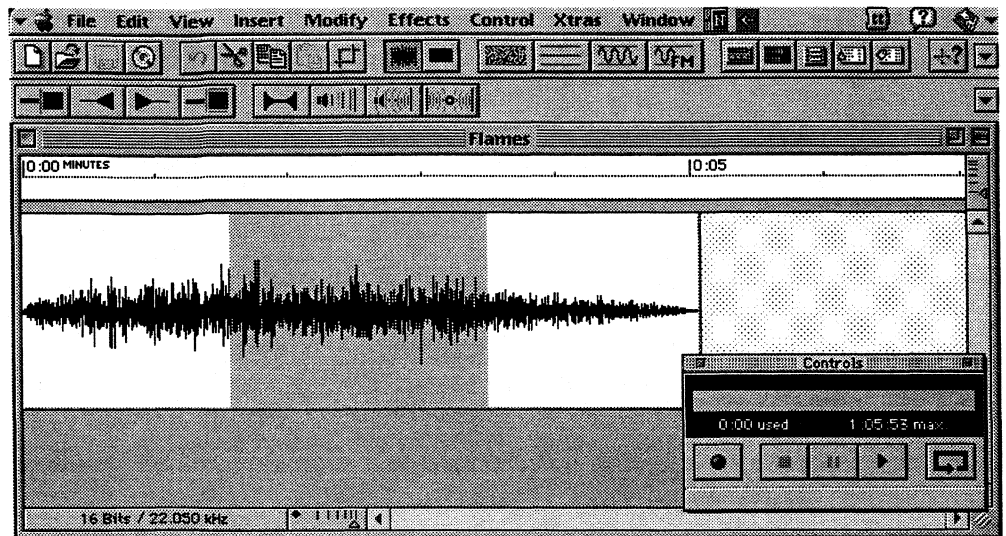
Om video digitaal te bewerken zal eerst het analoge videosignaal moeten worden omgezet naar een digitale vorm. Hiervoor is een videokaart nodig (zie ook de paragraaf over hardware). De digitale video clip kan vervolgens worden bewerken met speciale software tools, waarvan Adobe Premiere (Macintosh, Windows) de bekendste is. In Premiere worden allereerst de fragmenten waaruit de clip gaat bestaan (zowel video als audio) geïmporteerd. Door de fragmenten vervolgens in de gewenste volgorde op het gewenste moment op de tijdsas in het Construction window te plaatsen kan de clip worden opgebouwd. Premiere kent daarnaast diverse filters voor het bewerken van de fragmenten zelf. Ook kunnen overgangen tussen de fragmenten worden toegevoegd. In het Preview window kan het uiteindelijke resultaat worden bekeken. Indien men hierover tevreden is kan het eindresultaat worden opgeslagen in diverse formaten zoals QuickTime Video for Windows en Mpeg. Het is op dit moment nog niet mogelijk om door het aanbrengen van 'hotspots' of 'scripts' interactiviteit aan een clip toe te voegen. Hiervoor is men aangewezen op de zgn. authoringtools die in paragraaf 3.4. worden behandeld. Hieronder zie je een project in Premiere



Een project in Adobe Premiere

2.1.2 Het bewerken van audio

Ook voor audio geldt dat meestal een analoog signaal via de geluidskaart moet worden omgezet in een digitaal signaal. Dit digitale signaal kan vervolgens worden bewerkt met daarvoor geschikte software, zoals bijv. Macromedia SoundEdit 16 (Macintosh). In dit pakket wordt het audiosignaal afgebeeld als een geluidsgolf, waarop diverse modificaties en effecten kunnen worden toegepast zoals fade out, echo, galme ect. Hieronder een voorbeeld uit SoundEdit 16.



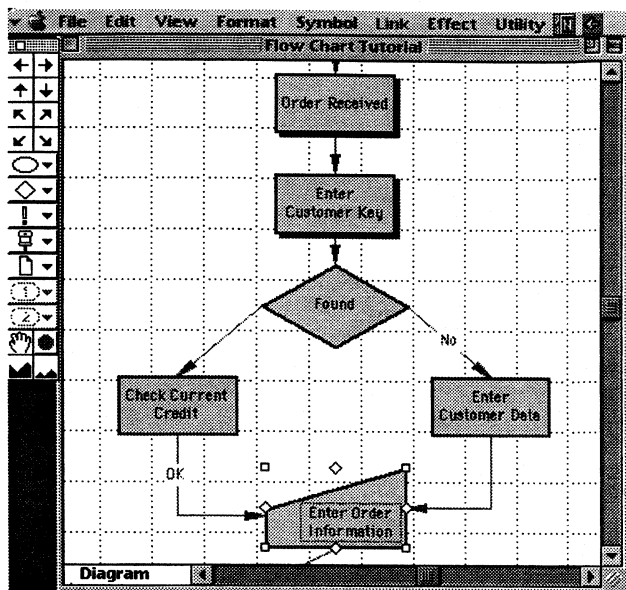
Een audiosignaal in
Macromedia SoundEdit 16

2.2 Het opslaan en beheren van de inhoud

Voor het opslaan en beheren van de gemaakte media-objecten kan een bestand worden aangemaakt in een standaard database pakket zoals Filemaker Pro of Paradox. Nog handiger is het om gebruik te maken van een pakket voor beheren van multimedia collecties. Een voorbeeld van een dergelijk pakket is Aldus Fetch. In Fetch kunnen objecten van verschillende mediatypen in een catalogus worden ondergebracht. Hiervoor maakt Fetch van elk object een versimpelde versie, een zgn. 'thumbnail' welke in een overzichtswindow worden geplaatst. Omdat een link wordt gelegd tussen de thumbnail en het origineel, kunnen alle objecten in Fetch worden bekeken of afgespeeld worden. Doordat aan elk object keywords en een tekstuele beschrijving kunnen worden toegevoegd, beschikt Fetch ook over uitgebreide zoek- en selectiemogelijkheden. Hieronder zie je een voorbeeldscherm uit Fetch.



Een multimedia catalogus in
Aldus Fetch



Voorbeeld van een flow-chart in Inspiration

2.3 Opzetten van een structuur

Voor het opzetten van een structuur kan de ontwerper, naast uiteraard pen en papier, een beroep doen op een aantal software pakketten waarmee flow-charts en outlines gemaakt kunnen worden. Een voorbeeld van een dergelijk pakket is Inspiration. Inspiration beschikt over een groot aantal grafische symbolen, die eenvoudig op diverse manieren met elkaar verbonden kunnen worden. Grote structuren kunnen worden verdeeld en bekeken op meerdere niveaus zodat het overzicht behouden blijft. Daarnaast kan snuut tussen een grafische weergave (flow-chart) en een tekstuele weergave (outline) worden geschakeld. Hiernaast zie je een deel van een flow-chart in Inspiration.

2.4 Aanbrengen van structuur in de inhoud: authoringpakketten

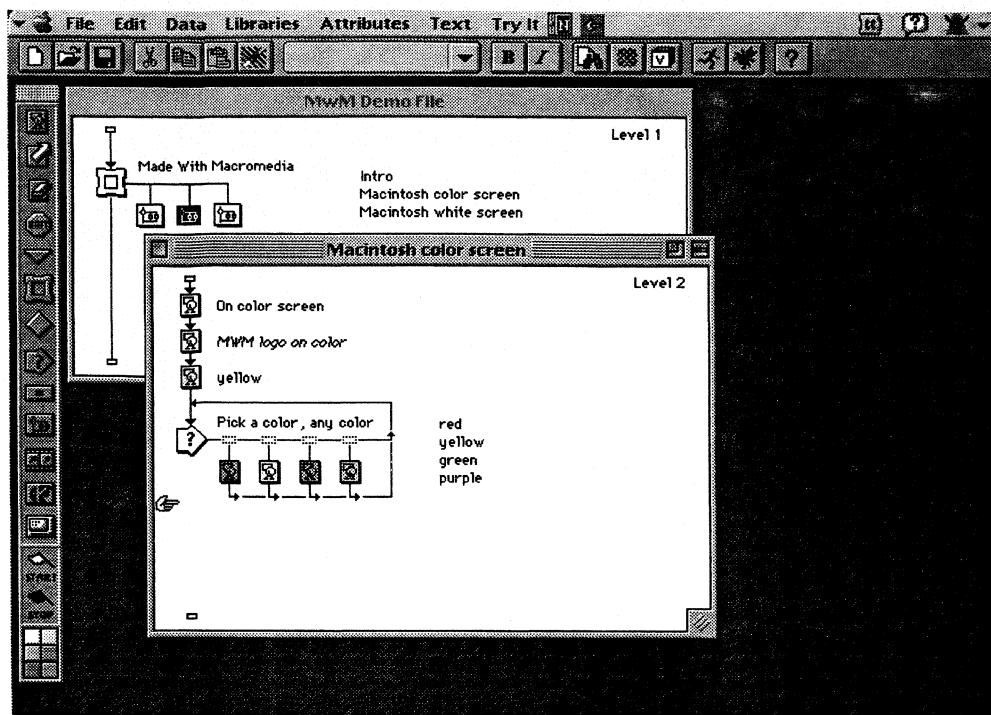
Voor het aanbrengen van de structuur en samenhang in de inhoud, welke bestaat uit objecten van diverse mediatypen (beeld, tekst, geluid, animatie en video) kan de ontwerper een beroep doen op diverse authoringpakketten. Hiervoor beschikt elk authoringpakket over een aantal gereedschappen, welke toegankelijk zijn via een visuele interface zodat ook ontwikkelaars met weinig tot geen programmeerervaring met dit soort pakketten overweg kunnen. Daarnaast bezitten de meeste pakketten tevens over een ingebouwde programmeertaal, die het mogelijk maakt om zeer geavanceerde interactiemogelijkheden aan de multimedia productie toe te voegen. Door het toepassen van een authoringpakket kan bovendien de ontwikkeltijd van een multimedia titel worden teruggebracht tot een 1/8 van de tijd die het zou kosten om dezelfde productie geheel in een standaard programmeeromgeving zoals C++ te maken. Vaak kan dezelfde authoringtool waarmee het prototype is gebouwd, ook worden ingezet bij het bouwen van het eindproduct.

De meeste authoringpakketten bevatten ten minste twee modes waarin de applicatie bekeken kan worden. De 'organisatie'-mode geeft een top-down overzicht van de onderdelen van de applicatie door het tonen van hun volgorde en onderlinge relaties. In de 'presentatie'-mode worden de schermen getoond zoals ze ook daadwerkelijk op het beeld verschijnen. De wijze waarop structuur wordt aangebracht en de gereedschappen die gebruiker hiervoor krijgt aangereikt, hierna aangeduid als het authoringprincipe, verschillen echter nogal per pakket.

In deze paragraaf zal een overzicht van een aantal authoringsprincipes worden gegeven, waarbij elk principe zal worden geïllustreerd met een concreet voorbeeld.

Authoringprincipe 1 Iconic / Flow Control

Bij dit principe wordt uitgegaan van stroomdiagrammen en pictogrammen. Een structuur wordt opgezet door pictogrammen vanuit een bibliotheek te slepen naar de gewenste plaats in een stroomdiagram of flowline. Elke pictogram heeft een bepaalde functie. Zo zijn er bijv. pictogrammen voor het tonen van tekst of afbeeldingen op het scherm, voor het testen van bepaalde condities en voor het inbouwen van interactie. Deze pictogrammen kunnen dan vervolgens worden gevuld met de objecten van de titel. Het stroomdiagram toont dan de onderlinge relaties tussen de pictogrammen. Door dit principe zijn dergelijke pakketten zeer geschikt voor het bouwen van Computer Based Training-producties, waarbij sprake is van leerprocessen waar de gebruiker stap voor stap doorheen moet lopen.



Voorbeeldscherm uit
Macromedia Authorware

Bekendste voorbeelden van dit principe zijn IconAuthor (Windows) en Authorware Macintosh, Windows). Hiernboven is een voorbeeldscherm uit Authorware afgebeeld.

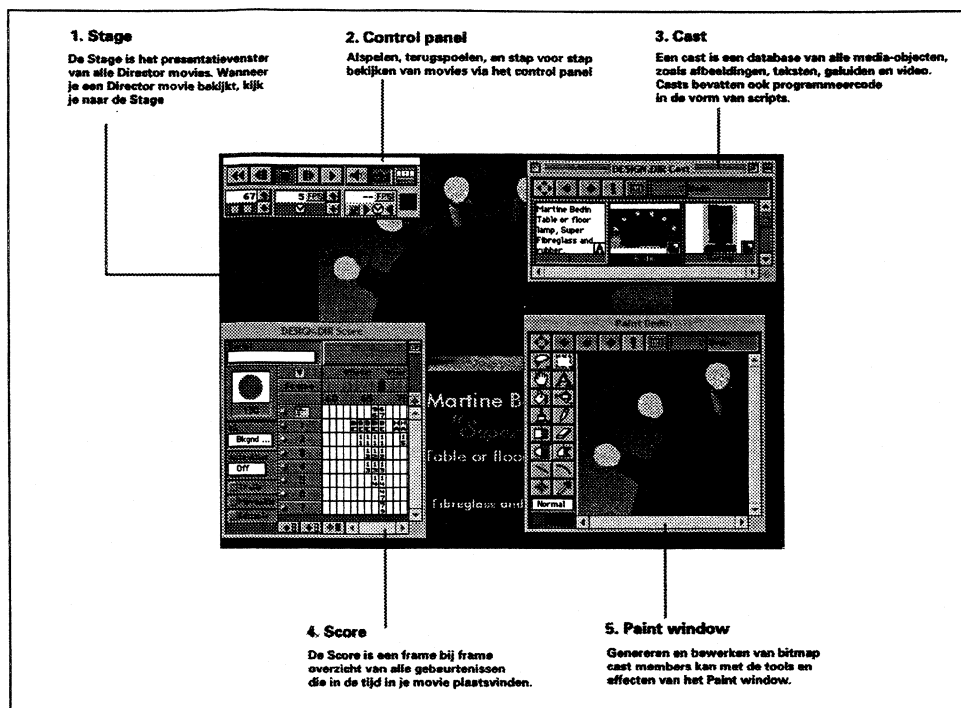
Authoringprincipe 2 **Cast / Score / Scripting**

Gebaseerd op een theater of muziekmetafoor wordt bij dit principe de 'organisatie'-mode gevormd door de Score (draaiboek of muziekpartiture) die bestaat uit een matrix, waarin elke kolom een bepaald moment in de tijd weergeeft (frame) en elke rij een plek waarop een onderdeel van de titel geplaatst kan worden (channel). Alle objecten van de titel (acteurs) worden opgeslagen in de Cast. Door nu de gewenste objecten uit de Cast op de gewenste tijdstippen en plekken in de Score te plaatsen, kan de applicatie worden opgebouwd. De 'presentatie'-mode wordt hier gevormd door de Stage (toneel), waarop alle acties worden weergegeven. Interactiviteit kan worden toegevoegd door middel van een ingebouwde scriptingtaal.

Bekendste voorbeeld van deze categorie authoringtools is Macromedia Director (Macintosh, Windows). Een applicatie in Director, movie genaamd, wordt opgebouwd door eerst de benodigde objecten te importeren in de Cast of zelf te creëren met de eenvoudige tekst- en paint-tools van Director. Daarna worden de objecten op de Stage of in de Score geplaatst, waarna beweging en interactie kan worden toegevoegd. Om bewegingen te creëren bezit Director over een aantal gereedschappen zoals Key Frame Animation, waarbij de tussenliggende posities tussen het beginpunt en het eindpunt van een beweging automatisch worden opgevuld. Tevens beschikt Director over een zeer uitgebreide scriptingtaal, Lingo genaamd, waarmee alle objecten en eigenschappen van de titel kunnen worden gecontroleerd en gemanipuleerd.

Omdat Director uit de animatiewereld afkomstig is, blinkt het pakket voornamelijk uit in dynamische presentaties met veel beweging en interactie. Ook simpeler toepassingen laten zich echter vrij eenvoudig in Director bouwen. Op de volgende pagina zie je een overzicht van de belangrijkste onderdelen van Director

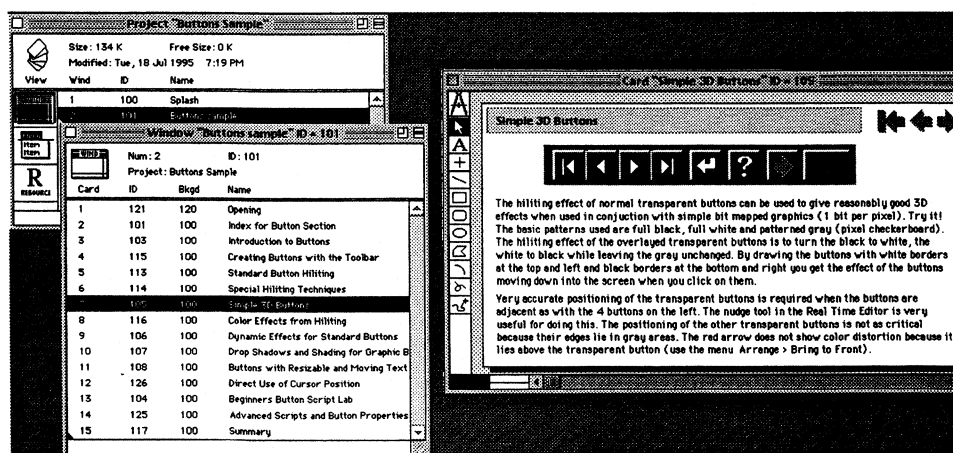
De onderdelen van Director



Authoringprincipe 3 Card / Scripting

Bij deze categorie authoringtools wordt de structuur gevormd door uit te gaan van een kaartenbak of boek. De 'presentatie'-mode wordt gevormd door een kaart of pagina, waarop verschillende objecten zoals velden, knoppen, afbeeldingen, geluiden etc. geplaatst kunnen worden. Elke kaart/pagina bezit over een voor- en achtergrond. Op de achtergrond bevindt zich de informatie die door meerdere kaarten wordt gedeeld, terwijl de voorgrond de kaart-specifieke informatie bevat. Kaarten kunnen met elkaar worden gecombineerd tot een stapel of boek, welke op hun beurt weer onderdeel van een groter geheel kunnen vormen. De kaarten kunnen eenvoudig met elkaar verbonden worden zodat onderlinge relaties gelegd kunnen worden. Bovendien kunnen in de meeste pakketten ook aan alle objecten acties worden toegekend door toepassing van een ingebouwde scriptingtaal.

De meest bekende voorbeelden in deze categorie zijn Hypercard (Macintosh), Toolbook (Windows) en SuperCard (Macintosh). In SuperCard wordt een applicatie gedefinieerd als een project, dat is opgebouwd uit één of meerdere windows, welke weer bestaan uit één of meerdere cards. Hieronder zie een voorbeeldproject weergegeven in de 'organisatie'-modus. In Supercard is deze ondergebracht in een aparte module, SuperEdit genaamd, welke gescheiden is van de 'presentatie'-mode. Hierdoor kunnen aangebrachte veranderingen niet onmiddellijk worden gekeken, maar pas door over te gaan tot het runnen van het project, wat nogal vertragend werkt.



Een project in Supercard

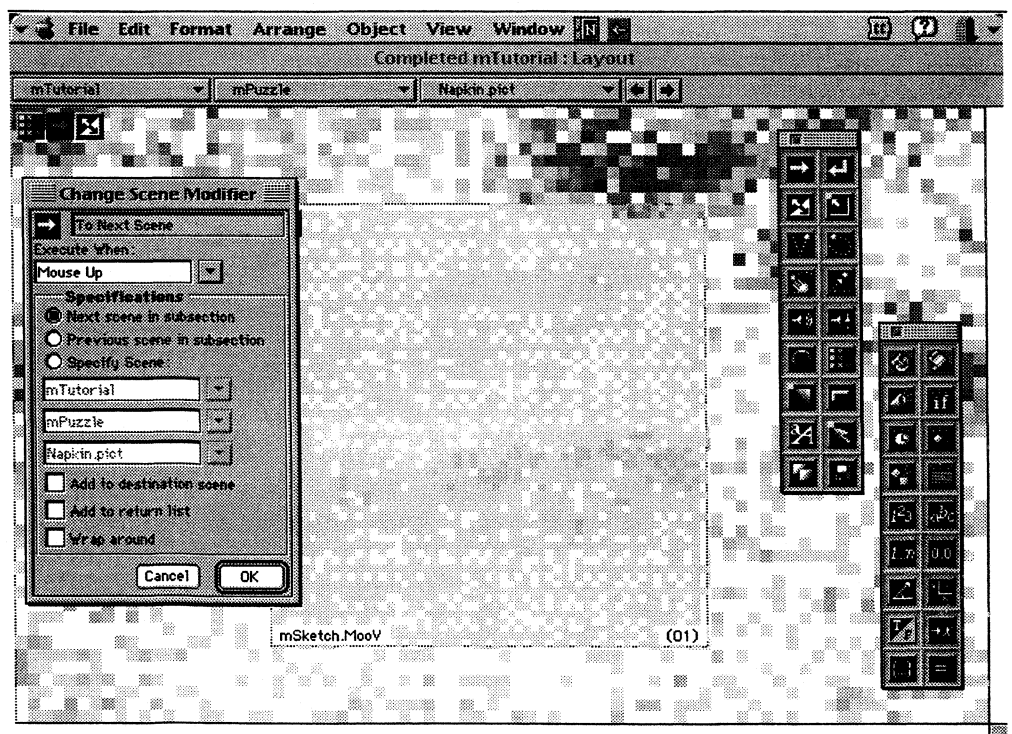
In tegenstelling tot de twee voorgaande principes is het bij dit type authoringtools verstandig om eerst de verschillende kaarten of pagina's te ontwerpen, om deze dan daarna met elkaar te gaan verbinden. Door een dergelijke opzet leent deze categorie zich uitstekend voor navigatie-intensieve toepassingen, waarbij de gebruiker snel en gemakkelijk tussen verschillende informatieschermen moet springen. Een voorbeeld van een dergelijke toepassing is het bekende spel Myst. Dynamische toepassingen, waarbij veel beweging en interactie in één scherm plaatsvindt, laten zich minder eenvoudig met deze categorie authoringtools bouwen.

Authoringprincipe 4 **Object-oriented**

Uitgangspunt bij dit nieuwe type authoringtools is een object-oriented (OO) omgeving, waarin eigenschappen (bijv. de achtergrondkleur van een afbeelding) en gedrag (bijv. het bewegen van een afbeeldingen langs een bepaald pad) aan multimedia objecten kunnen worden toegekend. Interactiviteit wordt dan ook direct ingebouwd in de objecten in plaats van naderhand te worden toegevoegd. Objecten kunnen reageren op acties van buiten en kunnen boodschappen naar elkaar sturen. Door de object-georiënteerde opbouw kunnen objecten gedrag van elkaar erven, kunnen families van objecten worden gemaakt en kunnen objecten eenvoudig opnieuw worden gebruikt in nieuwe projecten.

Een voorbeeld van dit type authoringtools is mTropolis (Macintosh). In mTropolis wordt een applicatie onderverdeeld in sections, subsections en scènes. Een scene wordt opgebouwd door allereerst de benodigde objecten te importeren. Deze objecten worden vervolgens geplaatst en gearrangeerd in het Layout-window. Alle eigenschappen en gedragingen van objecten, scènes, subsections en sections kunnen worden ingesteld door middel van zgn. modifiers. Zo zijn er modifiers voor het maken van overgangen tussen twee scènes, voor het sturen van berichten tussen twee objecten of voor het pauzeren van een scene. Elke modifier beschikt hiervoor over een aantal parameters, welke door de ontwikkelaar kunnen worden ingesteld. Meer complexe functionaliteit kan worden toegevoegd door middel van de scriptingtaal Miniscript.

In onderstaand figuur zie je het Layout-window met rechts de modifier-paletten en links een voorbeeld van zo'n modifier.



Layout-window in mTropolis

De 'presentatie'-mode is ook hier gescheiden van de 'organisatie'-mode, zodat de titel gerunt moet worden om veranderingen te bekijken. Doordat alle objecten in mTropolis gedefinieerd worden als zelfstandige, onafhankelijke eenheden (vergelijk ze met Legoblokken) kunnen projecter goed worden opgesplitst, zelfstandig worden ontwikkeld om daarna later samengevoegd te worden, wat bij het werken in teamverband een groot voordeel kan zijn. Tevens kunnen door deze opzet eenvoudig bibliotheken van objecten en gedragingen worden opgebouwd voor gebruik in volgen projecten. Nadeel van mTropolis is dat het nogal een overkill aan mogelijkheden biedt, waardoor het minder geschikt is voor onervaren ontwikkelaars. Bovendien is het pakket erg duur.

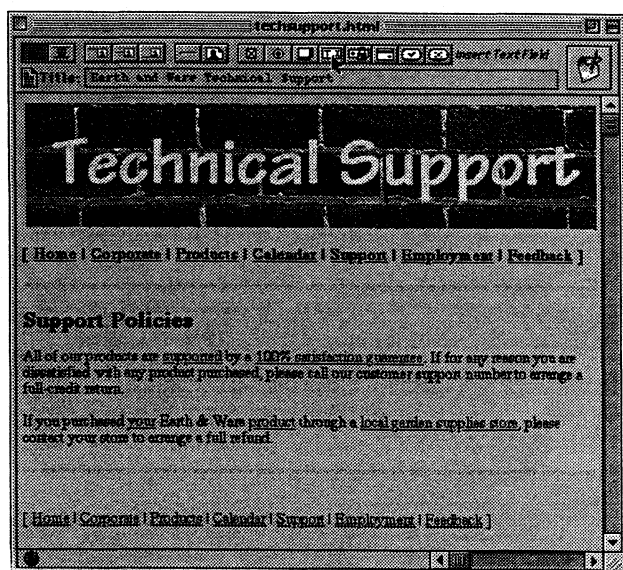
Authoringprinciple 5 World Wide Web-authoring

Een steeds belangrijker wordend platform voor interactieve informatie is World Wide Web. De informatie wordt hierop aangeboden in de vorm van Web-pagina's, die voornamelijk bestaan uit opgemaakte tekst, afbeelding en formulieren. Daarnaast bevatten dergelijke pagina's hyperlinks, waarnaar andere pagina's kan worden gesprongen of een bestand kan worden gedownload.

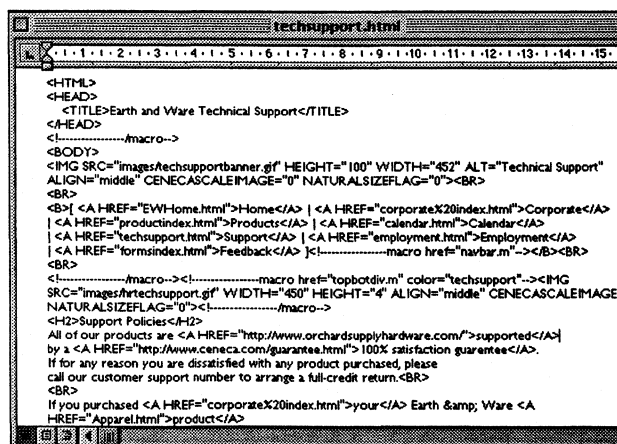
Een Web-pagina is geschreven in een speciale programmeertaal, HyperText Markup Language (HTML). Deze taal maakt het mogelijk dat een Web-pagina op verschillende computers met verschillende Web-browsers zoals Netscape of Explorer, gelezen kan worden. Om het maken van web-pagina's te vergemakkelijken zijn speciale Web-authoring-pakketten ontwikkeld. Deze bieden via een visuele, meestal tekstverwerker-achtige interface de gebruiker een aantal gereedschappen aan voor het inrichten en opmaken van een pagina. Is de gebruiker eenmaal tevreden over de pagina, dan zal het authoringpakket automatisch voor de omzetting naar HTML.

Een voorbeeld van een dergelijk Web-authoringpakket is Adobe Pagemill (Macintosh). Ook hier is een opsplitsing gemaakt in een "organisatie"-mode en een 'presentatie'-mode. In de "organisatie"-mode kan de gebruiker zijn pagina's opmaken door het invoegen en bewerken van tekstvelden, afbeeldingen en formulieren en door het maken van de gewenste hyperlinks. In de 'presentatie'-mode kan dan vervolgens worden bekeken hoe de pagina's er op het World Wide Web uit gaan zien. Bovendien zijn alle hyperlinks actief, zodat deze kunnen worden getest. Omdat niet alle Web-browsers dezelfde HTML-codes ondersteunen, is het echter wel raadzaam om alle gemaakte pagina's ook direct in de verschillende browsers te bekijken.

Hier zie je een voorbeeld van een Web-pagina in de 'organisatie'-mode van Pagemill, met daarnaast een deel van de bijbehorende HTML-code



Web-authoring in Pagemill



3 Het bouwen van een prototype: de hardware

Naast de hiervoor besproken software, worden er natuurlijk ook bepaalde voorwaarden gesteld aan de benodigde hardware. In deze paragraaf zal een basisopzet gegeven worden van de hardware die nodig is voor het bouwen van interactieve prototypen. Omdat de (prijs)ontwikkelingen op dit gebied nog steeds razendsnel gaan, zal altijd voor aanschaf een grondige verkenning van de huidige stand van zaken moeten worden uitgevoerd. Het hier geboden overzicht kan daarom slechts een globale indruk geven.

3.1 Computer en monitor

Als hart van de ontwikkelomgeving dient een voor multimedia toepassingen uitgeruste computer. Dit betekent een snelle processor, een intern geheugen van minimaal 16 mByte, een grote (externe) harde schijf (1 gByte), een CD-Rom drive, een geluidskaart, een videokaart en een kleurenmonitor. Hierbij geldt natuurlijk hoe sneller en groter, hoe beter. Omdat een groot aantal authoringpakketten slechts op één specifiek systeem draaien, is de keuze voor het systeem een belangrijke. De twee belangrijkste systemen zijn Apple Macintosh en Microsoft Windows. Algemeen kan worden gesteld dat beide systemen elkaar niet veel ontlopen in hun geschiktheid voor multimedia en dat een uiteindelijke keuze daarom vaak gebaseerd zal zijn op persoonlijke voorkeur, de te gebruiken programma's en de reeds aanwezige faciliteiten.

Naast snelheid is uitbreidbaarheid een belangrijke voorwaarde voor een multimedia computer. Door het toevoegen van extra kaarten zoals een MIDI-kaart of een 3D-grafische kaart, kan de functionaliteit van het systeem worden vergroot. Zo kan met een extra grafische kaart een tweede monitor op het systeem worden aangesloten. Dit is met name handig bij het werken met een authoringpakket, omdat hierbij vaak meerdere windows of applicaties tegelijkertijd open staan. Dit heeft als gevolg dat het beeldscherm al snel overvol raakt. Het is daarom erg prettig om een tweede monitor aan te schaffen, zodat de functionaliteit kan worden opgesplitst: de ene monitor toont de 'organisatie'-mode met alle windows, terwijl op de andere monitor het prototype in de 'presentatie'-mode kan worden bekeken.

3.2 Audio- en videoapparatuur

Een videocamera kan zowel worden gebruikt voor het opnemen van bewegende beelden als voor het maken van stilstaande afbeeldingen. Omdat een videocamera een analoog signaal aflevert, dient je computer te beschikken over een videokaart die het analoge signaal omzet naar een digitaal signaal. De nieuwe multimedia modellen beschikken vaak standaard al over een dergelijke kaart. Deze worden steeds sneller en beter, en full-screen (640 x 480 pixels), full-motion (60 frames per seconde) video is dan ook geen utopie meer.

Voor serieuze audio-toepassingen zijn een goed stel luidsprekers, een goede microfoon en een CD-ROM drive voor het afspelen van audio cd's gewenst. Indien met instrumenten zoals een keyboard gewerkt gaat worden, is een MIDI-kaart noodzakelijk. Deze dient als interface tussen het keyboard en de computer.

3.3 Overige randapparatuur

Naast de hierboven opgesomde uitbreidingen kan de volgende randapparatuur worden gebruikt:

- Een (kleuren)scanner, voor het invoeren van afbeeldingen en schetsen. Essentieel voor het bouwen van prototypen. De resolutie van dergelijke scanners is meestal vele malen hoger dan de resolutie van een videocamera (300-600 dpi t.o.v. 72 dpi).
- Een tekentablet en pen. Uitermate handig als veel met tekenpakketten gewerkt moet worden.

- Een videorecorder en televisie. Voor het bekijken en opnemen van videomateriaal.
- Een (kleuren)printer, voor het afdrukken van rapporten, afbeeldingen etc.

4 Het bouwen van een prototype: een stappenplan

Nu de activiteiten en de gereedschappen die nodig zijn voor het bouwen van een prototype zijn behandeld, zal dit hoofdstuk worden afgesloten met een aantal overwegingen in de vorm van een stappenplan voor het maken van een prototype. Bedenk dat hierbij constant een evenwicht gevonden moet worden tussen de beschikbare tijd en middelen, de te maken kosten en de gewenste kwaliteit en het doel van het prototype.

- 1 Denk eerst duidelijk na over het doel en de vorm van je prototype. Bedenk dat een prototype altijd een vereenvoudiging is van je eindproduct en dat dus dingen zullen moeten worden weggelaten of versimpeld. Houd hierbij rekening met overwegingen als:
 - Welke vragen wil je met behulp van het prototype beantwoord zien?
 - Welke eigenschappen of functies van je product wil je wél en welke niet gesimuleerd zien?
 - Welk publiek wil je bereiken?
 - In welke fase bevindt zich het totale project, wat is belangrijker in deze fase: details of flexibiliteit?
 - Dient het prototype als presentatiemiddel of als testobject?
 - Over welke mate van interactiviteit dient het prototype te beschikken?
- 2 Stel op basis van dergelijke overwegingen een strategie op waarin je het doel en een voorlopige uitwerking (tijd, middelen, kosten etc.) vastlegt.
- 3 Werk je eerste ideeën uit in de vorm van schetsen. Grijp hiervoor niet naar de computer, maar gebruik potlood en papier. Leg de gemaakte concepten ter discussie voor aan de rest van het (eventuele) team.
- 4 Kies op basis van het uiteindelijke concept de meest geschikte vorm voor het prototype. Hierbij zal een evenwicht gevonden moeten worden tussen de beschikbare tijd en middelen, de te maken kosten en de gewenste kwaliteit. Hierbij speelt de aard van de produktie ook een belangrijke rol. Indien de produktie kan worden opgesplitst in delen met dezelfde functionaliteit, dan is het volledig in detail uitwerken van één zo'n deel tot een volledig interactieve simulatie een logische stap. Lig de nadruk mee op het geheel of het overzicht, dan zal bijv. meer tijd worden besteed aan het prototypen van de overkoepelende navigatiestructuur in een diashow en gedeeltelijk interactieve simulatie.
- 5 Bepaal welke media je waarvoor wilt gaan gebruiken. Zo zijn stilstaande afbeeldingen in een hoge resolutie geschikt voor het laten zien van detail terwijl in een video-opname in de vorm van een Quicktime movie de mogelijke interactie van een gebruiker met een hardware model getoond kan worden. Ook hier spelen de beschikbare faciliteiten en kennis weer een belangrijke rol.
- 6 Maak een keuze voor een authoringpakket, waarbij zowel zaken als beschikbaarheid, ervaring en kosten als de besproken sterkten en zwakten van elk authoringpakket een rol spelen.
- 7 Verzamel, creëer, bewerk en organiseer de inhoud. Gebruik voor het behouden van je afbeeldingen, teksten, geluiden, animaties en video's een gewone database of een speciaal multimedia beheerprogramma zoals Aldus Fetch

Zorg voor een dusdanige opslag dat je je media ook nog in andere projecten kunt gebruiken.

- 8 Wanneer je begint te werken in de authoringomgeving, 'vertaal' dan eerst de structuur uit het concept naar het principe van de gekozen tool door het maken van een eerste, ruwe opzet, waarin het raamwerk van het prototype wordt vastgelegd. Hierbij kan gebruikt gemaakt worden van simpele, 'dummy'-objecten die later vervangen kunnen worden door de uiteindelijke objecten.
- 9 Voeg de gewenste interactiviteit toe door het schrijven van de benodigde instructies in de beschikbare scriptingtaal. Test het geheel en verwijder de fouten.
- 10 Vervang de dummy-onderdelen door de uiteindelijke afbeeldingen, teksten, video's, geluiden en animaties. Maak eventueel aanpassingen in de lay-out. Test en optimaliseer het geheel opnieuw.
- 11 Voeg een titelpagina of animatie toe met daarin de naam van het prototype, het project, het bedrijf en het ontwikkelingsteam.
- 12 Zet je uiteindelijke prototype om naar een standalone applicatie. De meeste authoringpakketten beschikken over een mogelijkheid om automatisch een dergelijke applicatie te genereren, welke onafhankelijk van het pakket afgespeeld kan worden. Test je applicatie wel op een andere machine om te controleren of de omzetting is gelukt.

Samenvatting

De in dit hoofdstuk besproken prototypen vervullen een belangrijke rol in het ontwikkelingsproces van multimedia producten en diensten. Een goed prototype vormt een ideaal experimenteerplatform, waarop ideeën, concepten en technieken in een vroeg stadium van het proces kunnen worden gepresenteerd en getest. Voor het bouwen van interactieve prototypen heeft de ontwerper een groot aantal gereedschappen en technieken tot zijn beschikking, die op vele manieren kunnen worden ingezet. Het maken van een verstandige keuze hieruit en het vervolgens vaststellen van de juiste opzet en strategie, blijft een essentiële stap in de productie van een succesvol prototype. Hopelijk kan dit hoofdstuk hierbij ondersteuning bieden.

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Algemene multimedia site.

4 Ontwerpelementen

In dit hoofdstuk wordt ingegaan op het ontwerpen zelf, en de elementen die de ontwerper daarin zal moeten structureren en vormgeven. Gezien de beperkte tijdsduur van dit vak kunnen echter niet alle mogelijke aspecten aan de orde komen, waardoor noodgedwongen een selectie gemaakt is.

Het eerste artikel concentreert zich op het organiseren, visualiseren en vormgeven van informatiestructuren, die de basis vormen van elk interactief systeem. Een groot aantal organisatie-modellen worden besproken, geïllustreerd met een concrete toepassing. Ontwerpelementen als 'ruimte' en 'tijd' komen hierbij aan de orde.

Het tweede artikel behandelt het uitwerken van een informatiestructuur tot een concreet product, door het op de juiste wijze inzetten van diverse media zoals tekst, beeld, geluid, video en animaties. Ontwerpelementen als 'navigatie', 'usability', 'storyboards' en 'metaforen' worden hierbij aangestipt.

Bronnen Mok, C. *'Designing Business'*, Macmillian Computer Publishing, Indianapolis, USA (1996) pp. 97-114, 116-121, 127

Kristof, R., Satran, A., *'Interactivity by design'* Macmillian Computer Publishing, Indianapolis, USA (1995) pp. 36-69, 94-95, 116-119

The economy is now based on a vast system of knowledge created by the merging of technologies, information, and media. In the past, knowledge systems were in the domain of information services managers and information scientists (otherwise known as librarians) whose professions weren't highly esteemed because of their focus on organizing data, rather than creating it. Now, small chunks of data appear in huge high-speed conglomerations, and they're often unedited and have no identifiable connection to original sources. It's little wonder the media explosion perplexes people.

Information architecture, the meaningful organization of information, is becoming an important discipline because it concentrates on deciphering data and giving it shape within the complex structures behind the computer screen. The Edward Tufte and Richard Wurmans of ten or fifteen years ago were correct in their prediction that people would begin paying close attention to information science.

Today, information is a product. When information is in the right hands, it can be translated through design into powerful products and services – and successful businesses.

Visualizing Information Structures

the integration of the structures underlying a system. The challenge for an information designer is to create an architecture that reveals a system of knowledge.

Every display of information has a framework that supports the structure of ideas, thoughts, and principles; a display of information could be an on-line shopping network or the portrayal of weather patterns on television. The framework behind intelligible information displays is often taken for granted because our early language training automatically supplied the myriad connections between ideas, thoughts, and principles.

People working together on a design or business project require a common language to describe ideas and processes. They need a mutual understanding of verbal and written signs as well as a common vocabulary for visual elements. We learn our visual vocabulary from familiar structures such as picture books, where sequences of images create narrative by carrying ideas from page to page. Comic books are a good example of a visual medium with a unique language; comics readers know that "POW!" means that one comics character is punching another in the jaw. We pick up thousands of undocumented visual cues from television and books. The visual arts are so varied, however, that their language is more difficult to analyze; yet some people have an innate gift for understanding the inexplicable.

Information graphics and information design have a rich history, beginning with pictures and diagrams of hunts on cave walls and including the notebooks of Leonardo da Vinci. Music annotation and computer programs are kinds of information design.

The formalization of information design as a practice is relatively recent, but in its current form information design seems to touch on almost everything because its arts are tied so closely to the pervasive disciplines of graphic design, interface design, media studies, and linguistics. Each of the information arts is a craft on which the practice of information design is built. Information architecture is

a time: first the square of a length, then the hypotenuse of a right triangle, and so on. This flow of information, from one point to the next, is a line of information. A point of information is immediately comprehensible; a line is only understood over time.

Charles Altschul, an educator in new media studies, explains the nature of information by deconstructing the definition of the Pythagorean theorem: "The square of the length of the hypotenuse of a right triangle is equal to the sum of the square of the lengths of the other two sides." The entire statement is an accumulation of information pieces, each of which can be considered an information point. Each noun in the sentence, for instance, has a specific, learned meaning. In turn, each word is composed of a series of letters, each of which is also learned. Points of information grouped together form larger points. As we read the definition, we think about one idea at

Information Architecture

The assembly of the collective whole, or the integration of technological applications.

- globe
- book
- software application
- musical
- exhibition
- template
- annual report
- transportation system
- Web site

Information Design

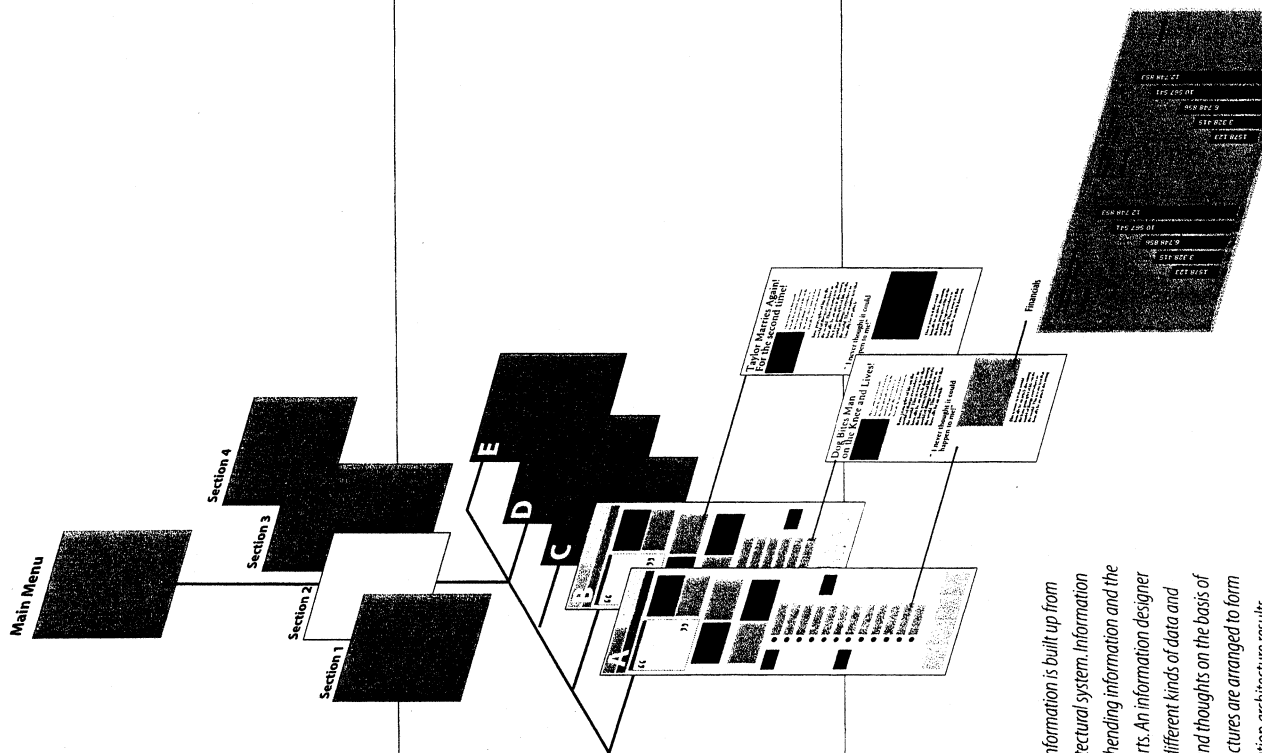
The organization of the products of information arts, or the arrangement of information structures.

- map
- paragraph
- programming subroutine
- music score
- painting
- layout
- financial reports
- signage system
- Web page

Information Arts

The thoughtful arrangement of data.

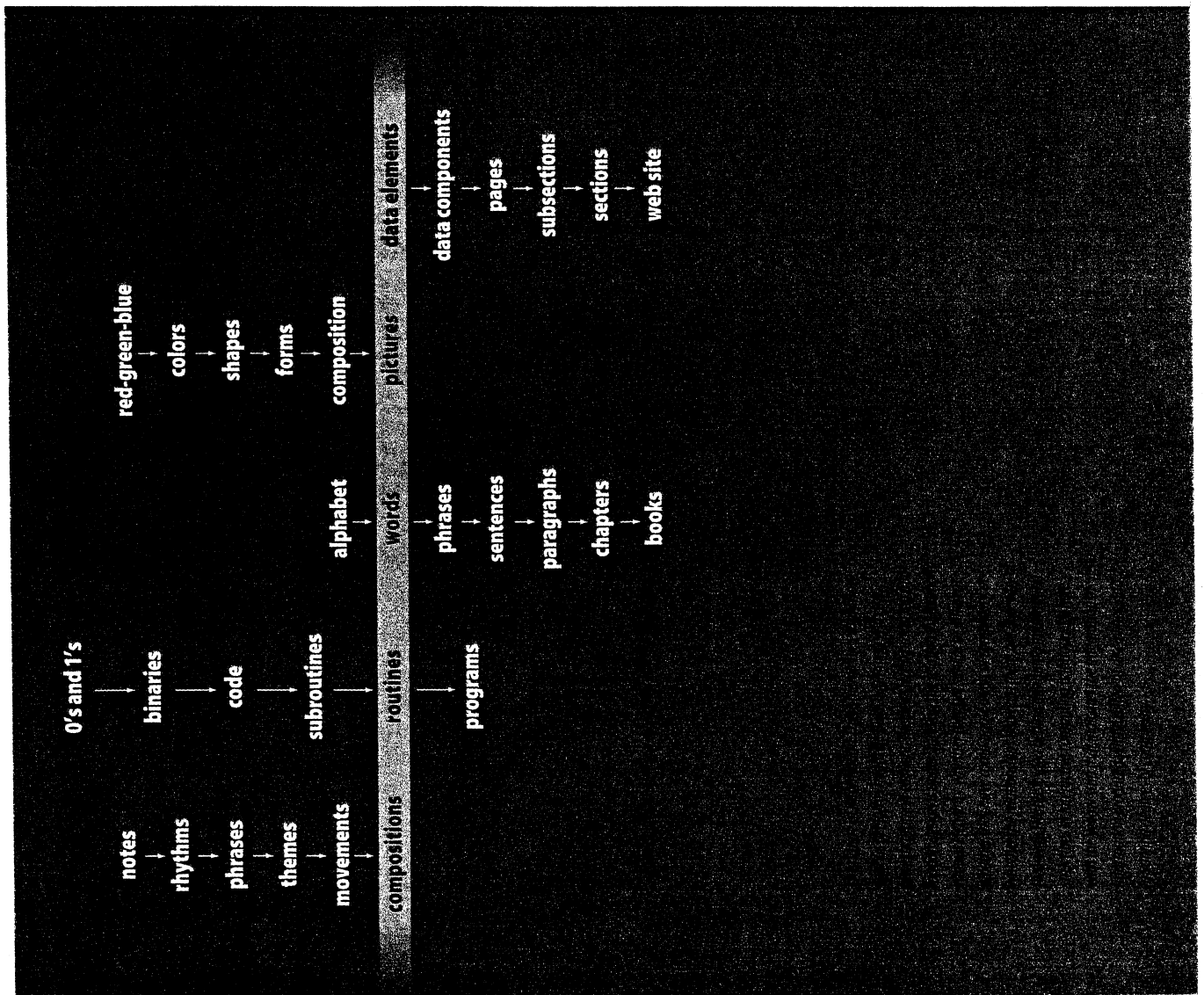
- schematic
- sentence
- numeric model
- sound
- image
- sketch
- bar chart
- sign
- CGI script



This diagram shows how information is built up from data into a complete architectural system. Information design is based on comprehending information and the relationships among its parts. An information designer evaluates the behavior of different kinds of data and then organizes principles and thoughts on the basis of that evaluation. When structures are arranged to form a complete system, information architecture results.

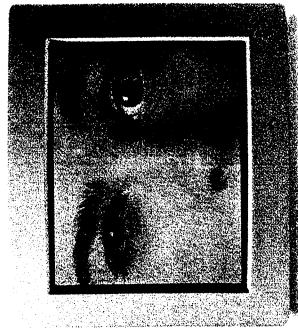
Unlike the study of written language, the study of the language of visualization is not an integral part of educational curricula. It is confined to art and drawing classes, most of which teach skills such as drawing and mixing paint. Curricula include little formal instruction that might further students' understanding of visual organizational principles or methodologies. Such principles are learned mostly through ad hoc channels.

A major aspect of design involves the search for behavior patterns, and then refining those patterns until they perform efficiently. People who follow the stock market use groupings of like data as a means of understanding; market trends are information patterns that can be plotted on x and y axes to represent increments and values. Just as patterns indicate the way a complex system is built in the physical world, they can also help construct frameworks in the computing medium. Looking only at patterns as a source for design direction, however, is not always the best approach; certain projects defy all the rules but still possess great systematic richness. Buildings that have survived from the gothic and romanesque periods acquired additions over centuries, merging into structural hybrids. They appear to us as wonderful singular objects, when in fact, they are a cluster of contradictory values and beliefs.

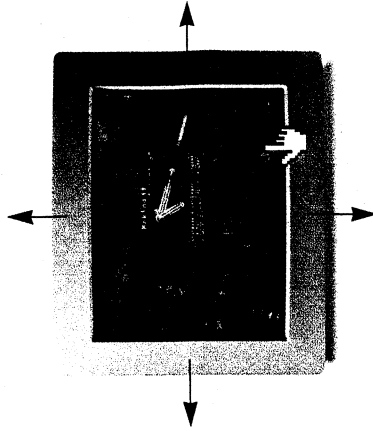
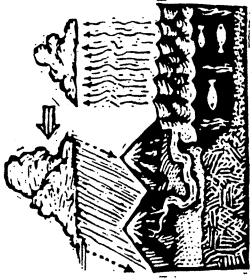


Abstract modeling principles are often used in working with raw data. Depending on the profession using them, these principles are called comparative analysis, cluster diagrams, or Cartesian coordinates. No matter the name, plotting x and y coordinates defines the ranges and constraints of the features a designer wants to apply; the x's and y's track and plot information paths. This formula is especially useful when working with the computing medium because of the unpredictability of digital data. The x and y axes can be assigned to any type of data or process; understanding x and y ranges enables information designers to create context.

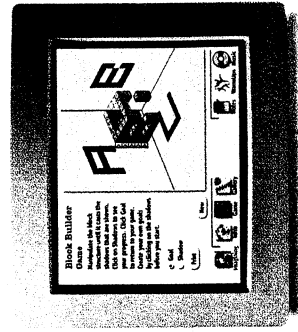
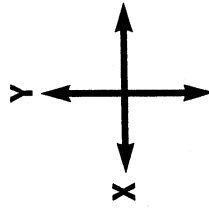
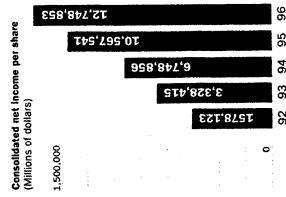
In the physical world, when a third axis is introduced – the z axis – a project takes on spatial characteristics. In the computing medium, the z axis indicates complexity rather than space; the computing medium's "alsos" and "manys" are beginning to make the z axis a familiar design element. For example, a company selling Shaker furniture through a Web site is a model with x and y axes. If the company also began offering its products through interactive television, that added complexity would be the z axis.



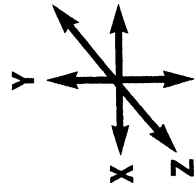
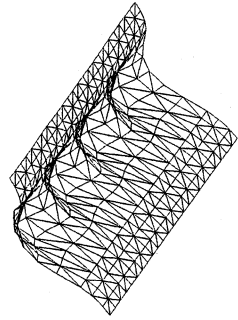
Morph



Interactive Map



3-D Puzzle

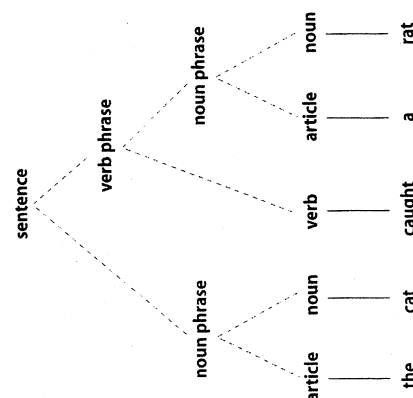


This chart shows how the x, y, and z axes apply to graphic design.

Information Arts

Information arts are the thoughtful arrangement of data. A chapter title in a book, for instance, is a composition of word data. Information arts have many functions, but the function most relevant in the context of the computing medium is supplying navigation mechanisms. The print medium has pagination, divider pages, display heads, pull quotes, and captions – all are conventions that help the reader navigate through a book or magazine's content, and each is a highly evolved information art form. Our familiarity with the book form makes the comprehension of its information arts, and their use as navigational mechanisms, second nature; anyone who picks up a book knows where to find the bibliography, the index, and the table of contents.

The digital equivalent of such a vital art form does not exist. Because digital media have no tactile depth, we have a limited understanding of the size of a body of work or the amount of information on a CD-ROM or behind a screen – whereas in the print medium, we just have to leaf through a book or magazine to get that information. In this early stage in



the development of information arts for the screen, we still lack a comprehensive vocabulary for expressing concepts, such as sequences. Some conventions – icons, directional arrows, and main menus – have already become established in the digital lexicon, but others – morphing navigation bars and virtual 3-D spaces – are too new to make the list.

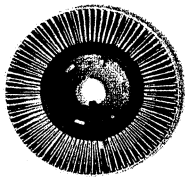
One reason our digital wayfinding vocabulary is scant is that the so-called screen real estate available for displaying information and navigational cues is limited. In print, organization of and navigation through content are intrinsic to form and function. No one wonders whether the numerical data on a printed page are prices or page numbers; the data's location and context determine meaning. Digital media are some distance from attaining the clarity of the print medium, but one way to work toward resolving navigational problems and accommodating content in digital formats is to understand how information is organized.

Organization Models

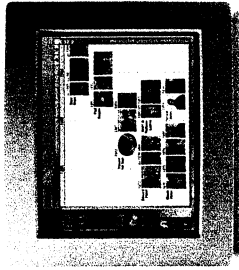
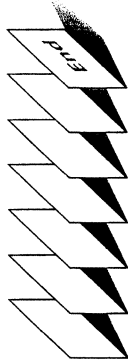
Although named differently in linguistics, music, and the visual arts, the seven universal data organization models – linear, hierarchical, web, parallel, matrix, overlay, and spatial zoom – underlie the structure and presentation of ideas. They support five data types: text, audio, music, pictures, and moving pictures. These models can be used as diagnostic tools

Organization Models

Linear



Slide Show

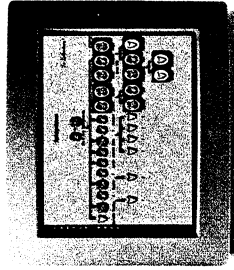
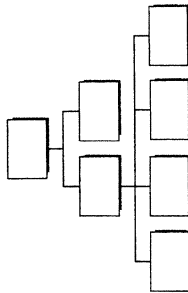


Interactive Art Gallery

Hierarchical

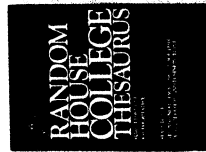


Babushka Dolls

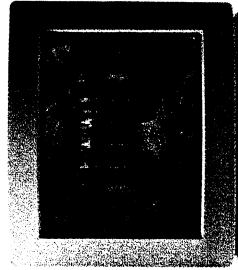
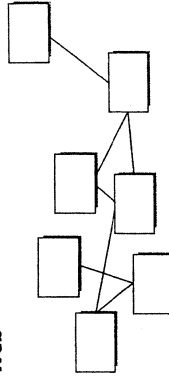


Biographical Family Tree

Web



Reference Source

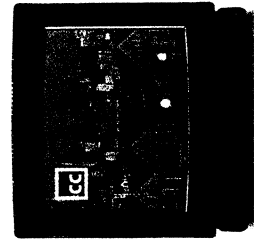
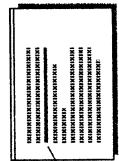


Interactive Game

Parallel

MONDAY PRIME TIME

Time	Program	Channel	Rating	Genre
7:00 PM	60 Minutes	20	TV14	News
7:30 PM	48 Hours	20	TV14	News
8:00 PM	60 Minutes	20	TV14	News
8:30 PM	48 Hours	20	TV14	News
9:00 PM	60 Minutes	20	TV14	News
9:30 PM	48 Hours	20	TV14	News
10:00 PM	60 Minutes	20	TV14	News
10:30 PM	48 Hours	20	TV14	News
11:00 PM	60 Minutes	20	TV14	News
11:30 PM	48 Hours	20	TV14	News



for examining the behavior of data types in the computing medium; they help decipher the function and form of data, determine whether structural models are transformable and transferable to other media, and indicate the context for the information after it is translated into a new data type. Rarely are the seven principles applied singly to any structure; integrated systems in both the physical and digital worlds generally are based on a combination of several models.

It is the purpose of any project that determines which information arts will be applied (in the form of data types or organization models). The specific purpose of a dictionary, for instance, determines its function and organization model; the linear model would be the wrong one to use to format a dictionary, but it would be the right one for a novel. For every purpose, there is an organization model that will facilitate its function.

A dictionary has a rule-based design system, which means that the parameters for arranging the data are fixed – altering the organization model results in a dysfunctional dictionary. Introducing a dictionary format into the computer medium requires that a bridge (in the form of computer code) be built between the engineer and the user. The software engineer creates the code for the dictionary application using database structures such

as inverted indices, hash tables, and hardware access metrics; these structures have little relevance to the potential dictionary user – who only wants to look up a word – but are essential for the dictionary to function properly.

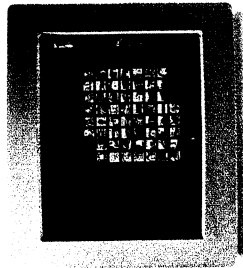
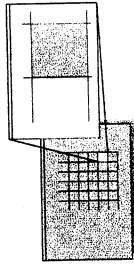
The computer code, which optimizes the performance of a system and the use and display of content, can't be seen by the user, but its effects are perceptible. An information designer bridges the gap between a user's cognitive model and an engineer's database structures by creating an interface that deploys familiar organization models, corraling data into groupings and perceptible hierarchies.

The unlimited possibilities resulting from combining organization models change data relationships, especially when these models are transferred into digital form. A designer must define and quantify the potential functions of organization models – choosing one or another set of features for a product or service. Through compromise, information designers create balance among portions of data – making the decisions that transform the data residing in organization models into meaningful work.



Bingo Card

Matrix

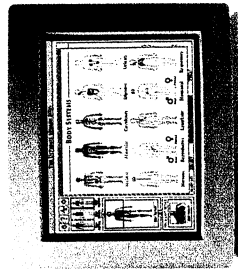
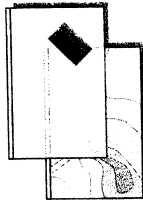


Interactive Thumbnail Index

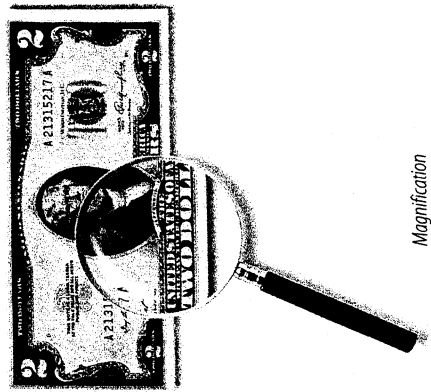


X-ray

Overlay

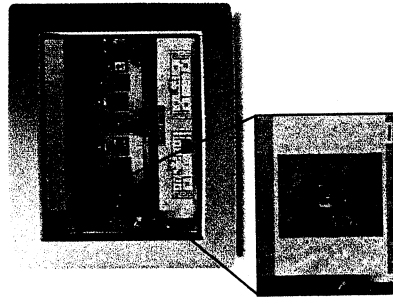
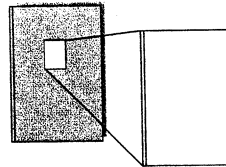


Interactive Anatomical Reference

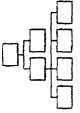
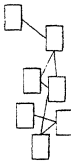
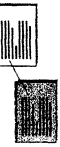


Magnification

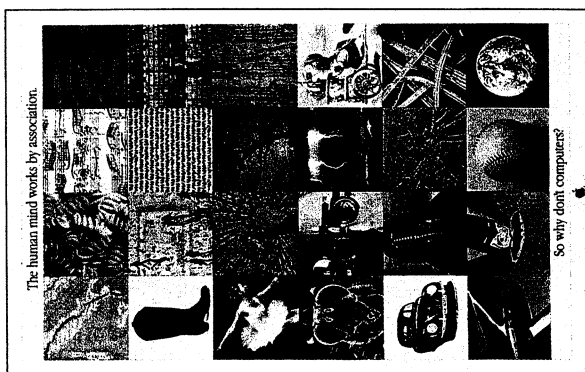
Spatial Zoom



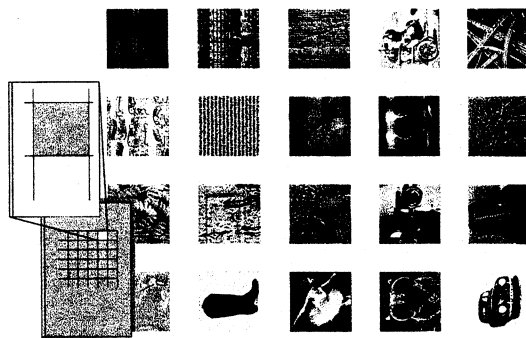
Virtual Art Gallery Tour

Organization Models		Linear	Hierarchical	Web	Parallel	Matrix	Overlay	Spatial Zoom
Application								
Print	Dictionary	•	•	•	•	•	•	•
	Encyclopedia	•	•	•	•	•	•	•
	Phone Book	•	•	•	•	•	•	•
	Almanac	•	•	•	•	•	•	•
	Library	•	•	•	•	•	•	•
	Thesaurus	•	•	•	•	•	•	•
	Textbook	•	•	•	•	•	•	•
	Brochure	•	•	•	•	•	•	•
Broadcasting	Journal	•	•	•	•	•	•	•
	This Book	•	•	•	•	•	•	•
	Toll-free Number	•	•	•	•	•	•	•
	Infomercial	•	•	•	•	•	•	•
	Teleconference	•	•	•	•	•	•	•
Computing	Documentary	•	•	•	•	•	•	•
	Interactive TV	•	•	•	•	•	•	•
	CD-ROM title	•	•	•	•	•	•	•
	Internet	•	•	•	•	•	•	•
	Intranet	•	•	•	•	•	•	•

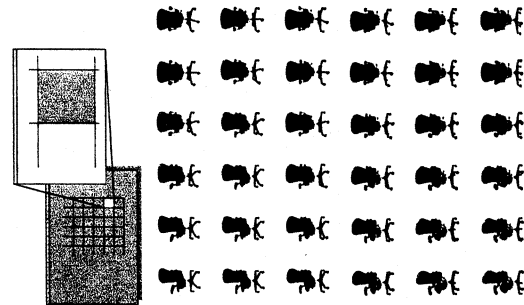
This matrix shows how strong an influence each of the seven organization models has on the basic structure of familiar applications in different media. The larger the dot, the stronger the influence. The structures at the bottom are applications that the computing medium has made possible. The potential of the technologies those applications are based on has not yet been realized, although that makes it impossible to determine definitively how the organization models might influence those applications, it's likely that the influence of all the models on all such applications will be great.



Left: A matrix built with pictures. Each of the seven organization models is flexible and can be manipulated to accommodate any data type. A matrix, for instance, can hold either thoughts or patterns, and can accept endless types of data, thereby giving rise to many different experiences. Matrices are familiar forms in print: they show one set of values along one axis and another set along the other, with hybrid instances in between. In the matrix here, the hybrid instances are displayed – the matrix structure is self-evident.



This interactive demonstration of Herman Miller's Aeron chair is an extravagant use of the matrix structure. Fifteen hundred photographs of the chair were taken from various angles. Each photograph was placed in one frame of an interactive QuickTime movie. (QuickTime technology allows for the storage of movie frames in a matrix as well as a linear sequence; see page 222.) On screen, the perspective from which the chair is viewed changes as the user moves the mouse pointer around the screen, giving the illusion of motion. What makes this application of the matrix model so unconventional is that the matrix can't be seen: the structure isn't revealed to the user.



Information Design

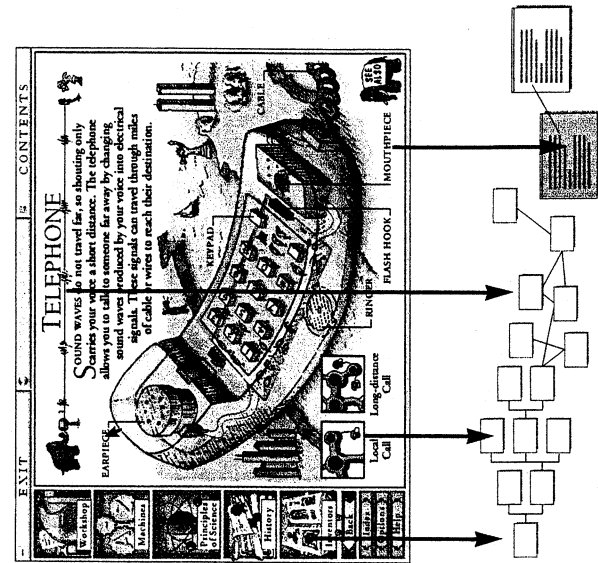
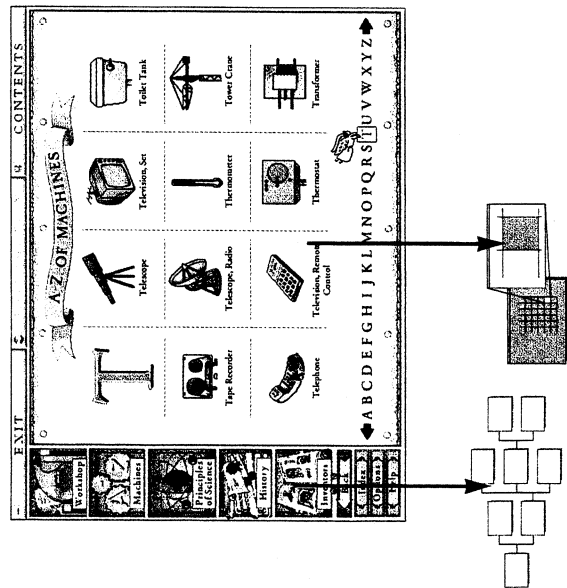
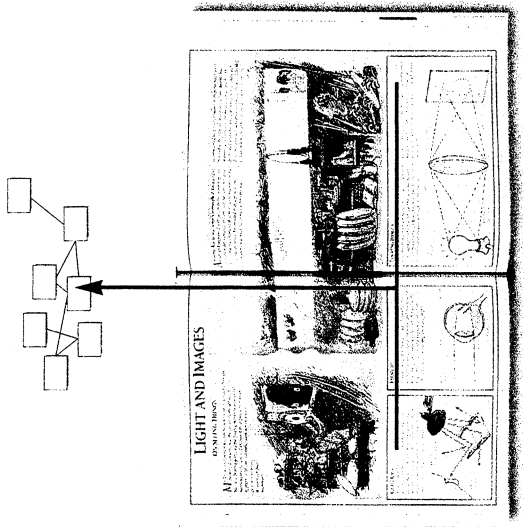
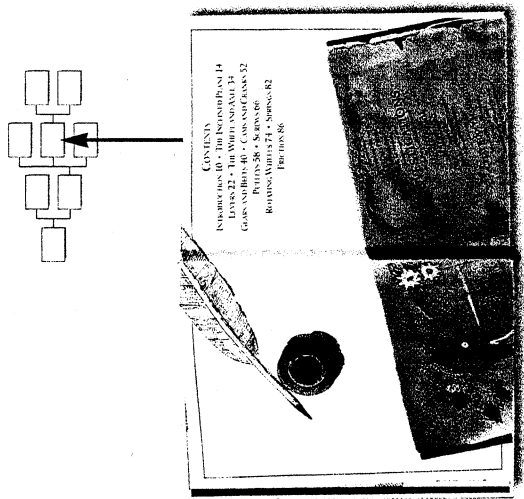
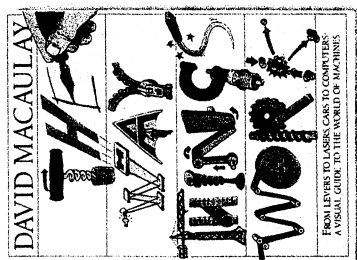
Information design begins where all other design disciplines do: with a specific purpose. Information design is the arrangement of organization models to provide context and meaning for the information. Once the purpose of a project is specified, whether it's to sell vintage jazz recordings over the Internet or provide stock market tips on CD-ROM, the design of the information – the way data types (text, pictures, moving pictures, audio, or music) are organized into structures (linear, hierarchical, web, parallel, matrix, overlay, or spatial zoom) – can begin.

Our perception of how data and content are built changes once these elements are transferred to the computing medium. An example of this is the seemingly simple function of mouse clicking on a computer. When a user clicks to get around the parts of a program, it has a different implied meaning than clicking to summon data. The difference is barely discernible, but critical to an understanding of the way the computer perceives information. If a user clicks to go to a screen, a place, or a page and the information at the starting and end points is similar in

weight, this could indicate parallel construction within the program. However, if the weight of the information at the destination is different, another type of organization structure might be implied. If the user clicks and the information is brought forward, a nested thought within the broader context of the structure is implied. Even though both clicking options provide access to the content, the user gets distinct ideas about the arrangement of information from each. Information structures that employ the clicking function have to be carefully designed because of its implicit behavior.

The nature of a project's purpose also affects how much influence each organization model has on the content. A shopping community on the Web requires a different organization from a comparatively simple online catalog. The two-way communication at ATMs is structured in hierarchical sequences similar to those of push-button telephone services: the user makes one choice, then another, then a third.

The process of information mapping (see case study, pages 150-159) helps determine how to integrate organization models into the digital format. Information mapping begins with identifying the type and volume of information, and the information's intended use. The designer puts ideas and intended forms and functions down on paper and begins looking for similarities, disparities, and patterns among the various elements.



Top: The organization models that apply to the printed book version of David Macaulay's book The Way Things

Designers creating Web sites face the problem of designing navigation through content at the same time that browser applications impose their own navigation controls, such as the forward and back functions. It is possible, though, to design a Web site that allows direct access to information without insisting that the user take an extra "go back" step every time he or she wants to reach a new level of information. This kind of problem can be solved with creative processes such as parallel navigation, which is an integrated system of navigation and content – it can reveal the structure of a site and the selected

path through it so that a user never has to think about what "going back" means.

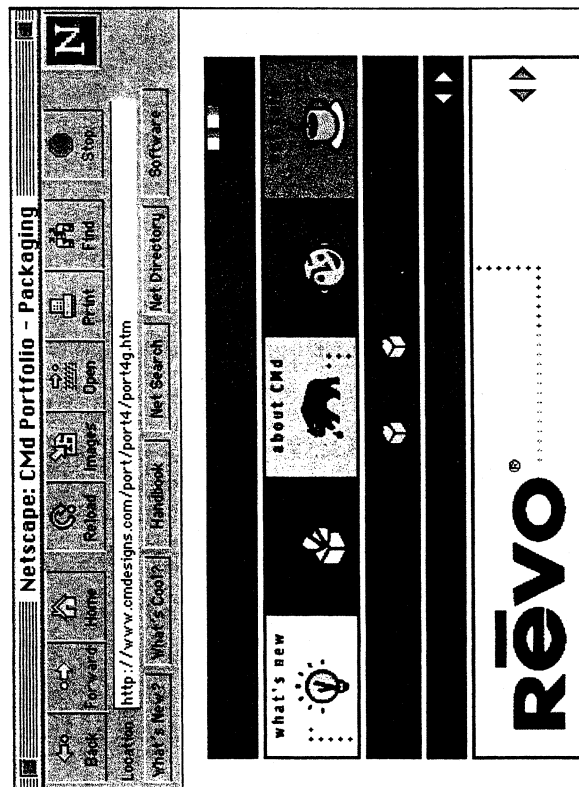
In working with multiple media, a designer's objective is to shape a harmonious whole. A designer's ability to create breakthrough crossovers, such as using parallel navigation to reflect the underlying computing structure *and* enhance the content – makes the difference between a good multiple media project and a great one.

Third and Fourth Dimensions

The seven organization models described previously are all two-dimensional. When information designers are working in the computing medium, however, they also have to reckon with the third and fourth dimensions of space and time. Every discipline has its own unique methodology for defining data's absolute and relative relationships to people, time, and space. Architects and filmmakers work with time and space as a matter of course, and designers working in the computing medium can learn a great deal from them.

TIME Great design systems accommodate time very well. The monuments in Washington, D.C., for instance, appear beautiful during the day, and they are just as impressive at night. Online community chat rooms, which are accessible to virtually anyone,

The Netscape Navigator browser application uses a page model that has a forward and back mode, which doesn't accommodate complex structures of data. The design of this Web site is based on parallel navigation to clarify the hierarchical nature of the information organization.



To view other CMD Collateral projects, select 3Com, Harper Collins, Farallon, CMCD, Global Village, MacroMedia, or Logitech.

See What You Have Been Missing

Revo had built their reputation on a decade of advanced lens technology, originally targeted towards professional skiers. Over the years, Revo continued to innovate by developing new lenses and frames with unique

Intent

+

+

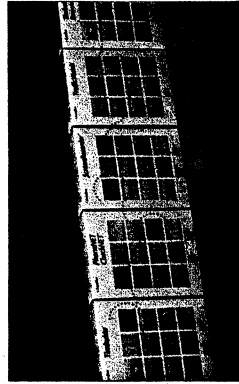
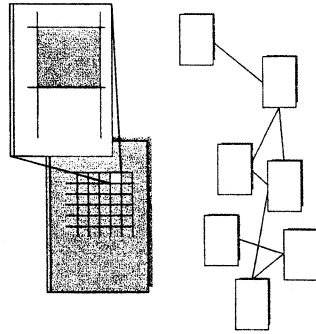
Organization Model

Design

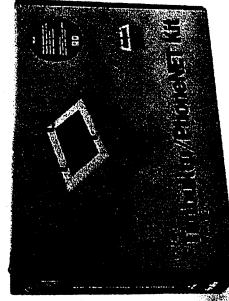
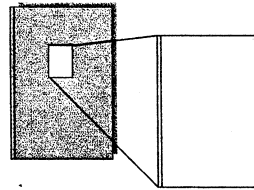
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Solution

Farallon's packaging system was designed in 1989 to communicate the breadth of the company's product offerings and how they are related to one another. The construction of this system required the use of the matrix and web organization models.



In 1992, after the distribution requirements for Farallon's products changed, a new packaging system was designed to accommodate the popularity of the product line and consumer demand for specialized products. The structure of this system was based on the spatial zoom organization model.



anywhere, at any time, are the digital equivalent of adaptability to the time element.

Although time doesn't take on physical form, it has an expressive visual lexicon in the quantitative display of information. Clocks and calendars are constructed consistently, and their meanings don't change no matter what the context. In the computing medium, it's difficult to provide context for real time. The telephone system's ubiquitous and flexible infrastructure accommodates the quirky aspects of human communication, letting people talk any time, wherever they are. Computer networks use the

telephone infrastructure to transport data; telephone systems, however, cannot distinguish data from voice signals so computer systems have no way of detecting what kind of data is being moved around.

SPACE Designers have interpreted and transformed many different concepts of space into screen environments, but two of them are especially relevant in the context of information design. One definition of space is a container in which people design communication and house information; an example is an electronic document. This kind of space has constraints: how big is the container? how much can it hold? The other definition of space incorporates a metaphorical understanding of environmental surroundings and the rules of human behavior in those surroundings. The electronic document is contained, and has definite parameters; the office building is also contained, but its parameters – shape, size, divisions, sequences – are determined by what people do in office buildings. Office buildings aren't designed to accommodate ballroom dancing because people don't go to office buildings to dance.

These two very different spatial modes can cohabit, for example, in an art exhibition: people move around in the bigger space (a museum) to look

This chart shows the contexts in which communication can take place. Communication can occur in either of two modes. Synchronous communication – conversation in person or by telephone – takes place in real time. Asynchronous communication is delayed in time and disconnected in space; letters, voice mail and e-mail messages, and online chats are all communications in asynchronous mode.

Place	Real Time	Delayed Time
Same		
Different	Telephone Teleconference Fax	Voice Mail E-Mail
Any	Cellular Phone PDA Internet	Wildfire® System 1-700-Number

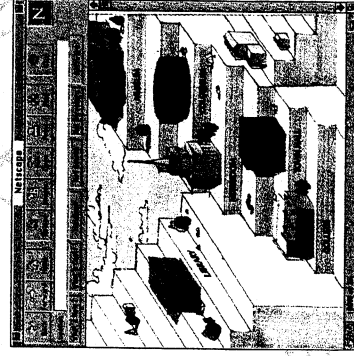
The Net negates geometry. While it does have a definite topology of computational nodes and radiating boulevards for bits ... it is fundamentally and profoundly antispacial ... You cannot say where it is or describe its memorable shape and proportions or tell a stranger how to get there. But you can find things in it without knowing where they are.

William J. Mitchell, *City of Bits*

at what's contained in smaller spaces (the paintings). Most spatial systems, however, function independently. In the computing world, on the other hand, just as media and disciplines are converging, so are the two spatial modes. The computing medium can be used to design a virtual place where users can explore, create, work, and play outside the constraints of physical space; that place is both an information container and a destination.

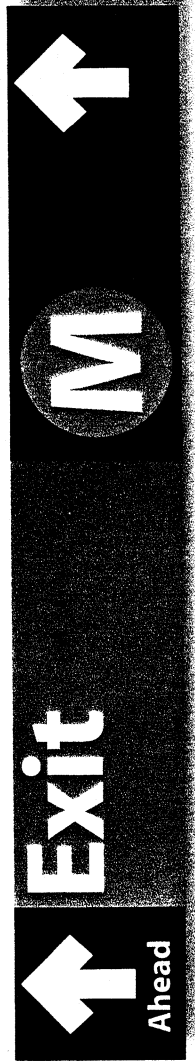
Computers can also be a place where users browse through merchandise and make transactions. Successful retailers and merchandisers in both the physical world and cyberspace know where and how to place products, what kinds of products sell, and the proper amount of information to supply about each. In the physical world, retailers who don't quite comprehend information design rely on their instincts and knowledge about merchandising and display to orchestrate where certain products are

placed in a store – deciding whether to play elevator music or classical music in a restaurant, or whether a cappuccino bar would be a success in the lobby of a medical building. Such experiential decisions are common retail practices, and they are just as relevant in the computing medium, where retail needs aren't different but have to be translated from material space to computing space.



Navigating Through Information

People, time, and space – how do they all come together? Information designers need to know how people move through spaces and what they do in those particular spaces. One of the most important issues in information design is determining how to



navigate through a designed space. When information designers identify the particulars of time, space, and place, they can create familiar structures and syntax that help define the paths which people, or – in the case of computing – information will move along to get from point A to point B. Navigation is a system in itself, and there are many ways to design navigation in cyberspace so that people can visit places, buy things, or play or work with each other. If people are engaged in those activities in the computing medium, how does the information designer build an underlying navigation system? One way is to use the architectural model of signage.

A subway station is a good analogy for what users are trying to contend with in the computing medium. People using a subway system generally

have a limited understanding of how large the system is, but signage cues tell them whether they can reach a destination by moving "up" (ahead) or "down" (back) or left or right. Signage systems incorporate a vocabulary that helps people go where they want to go. That doesn't mean that designers should apply subway signage metaphors to everything they design for the computing medium – there are many other efficient navigation systems. Tables of contents and color coding are navigation systems we use all the time quite successfully. Subway signage is just an especially pertinent example of a navigation system with established conventions. The computing medium has few accepted conventions, so designers must practice information design as a way to begin building a core vocabulary for use in cyberspace.

Thank You, Mr. Beck

Mapping is a set of conventions that explains geographical concepts and the idea of place; it is a visual construction with the capacity to embrace the complexity of language itself. The London Underground map embodies a visual language that we can apply to the understanding of the way digital systems operate. A map is quite visceral – if people don't understand it, they get lost. The London Underground map is considered a diagram because it does not actualize the surrounding geography; however, it easily accommodates the diversity and complexity of the railway system. A look at the evolution of the London Underground diagram reveals many similarities to the evolution of the computing medium in terms of the creation and definition of language.

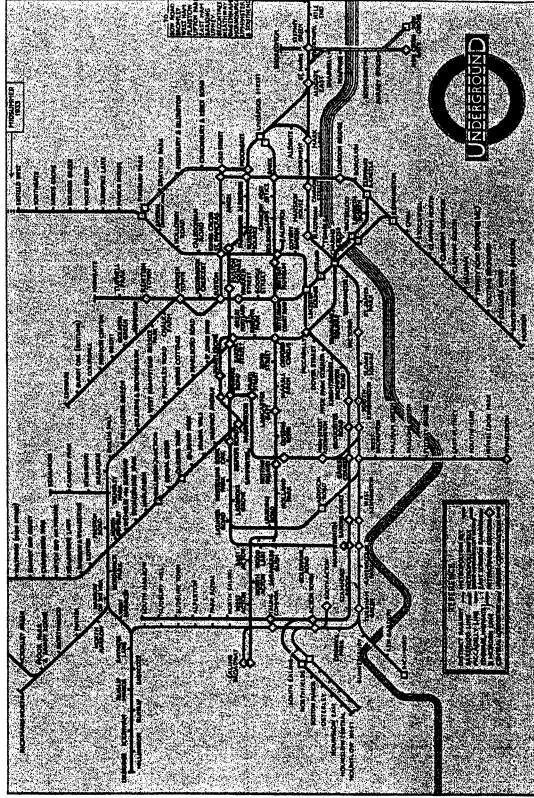
The London Transit Authority's first maps showed the actual railway routes in and around London. These first maps appeared to make sense because of the contextual relationship between the railway system and the actual area it covers –

it seemed that riders using this kind of map would know exactly where they were. People nevertheless got lost in the subway, and as the system grew, riders became more and more confused.

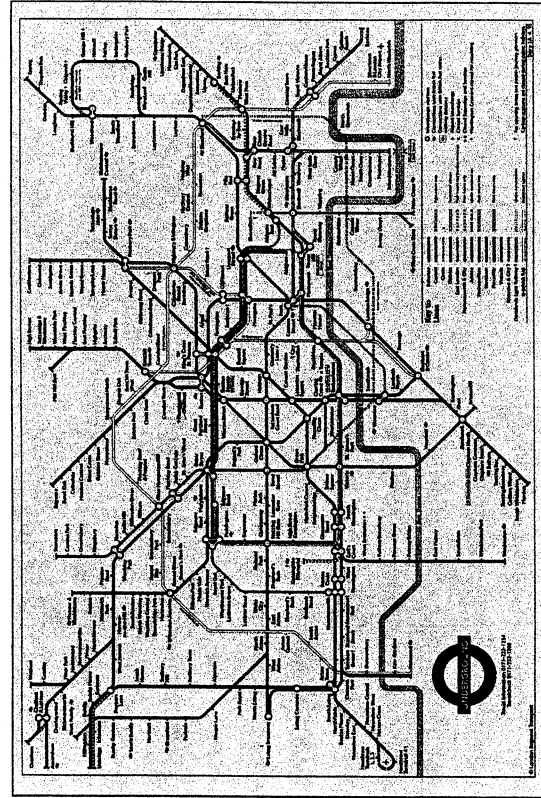
The diagram proposed in 1932 by Henry Beck, a 29-year-old engineering draftsman, contained only what was essential for riders to understand in order to get around inside the system. He abstracted routes and edited out what was not necessarily helpful to the riders' perception of where they were in the system, emphasizing the Underground's connections rather than its surrounding geography. In the end, the only contextual element Beck used was the River Thames. The rest of his diagram, made up of a network of vertical, horizontal, and diagonal lines, was purely functional: he compressed the outlying portions of the routes, which made room for the enlargement of the central district, with its complexity of interchanges and stations. To abstract the map into a diagram, Beck himself had to have a very good working knowledge of the railway system and its environs. Underground riders quickly adapted to the diagram.

People get lost in cyberspace too, and just as the art of mapping helps railway riders find their way, so too can it illustrate links within structures and crossovers between media and data types. Mapping is a prerequisite for smooth navigation through cyberspace. Once someone on a project team gets

all the thoughts and ideas about the project down on paper, the designer can use that material to map out the project's requirements. Once those requirements are mapped out the team can begin the scripting, programming, and graphic design. It may help an information designer mapping out a project to imagine designing Grand Central Station: where should the portals be? the different gates? where should they lead? In other words, how accessible should the elements of a project be? Mapping is the process of creating a framework, just as diagramming a sentence helps define the nature and scope of language. In the context of business initiatives, mapping is a terrific exercise for understanding the exact nature of a problem. Mapping can clarify many problems that seem nebulous at first glance.



Original 1932 London Underground Diagram



Current London Underground Diagram

If Mr. Beck Had a Computer

most structural problems, but most importantly, it is people-centric. Designers can use basic conversational language to build diagnostic tools, and language is an ideal structure for an information framework.

In one example, a design firm was asked to create an electronic reference resource library for a large medical institution. It took many months of research and development to examine all the aspects of the content and determine the system's optimum functionality. At this juncture, the challenge was to determine what kind of disciplines would be required to take the project forward. Is it the software engineering or the various medical specialities. Who should be doing what?

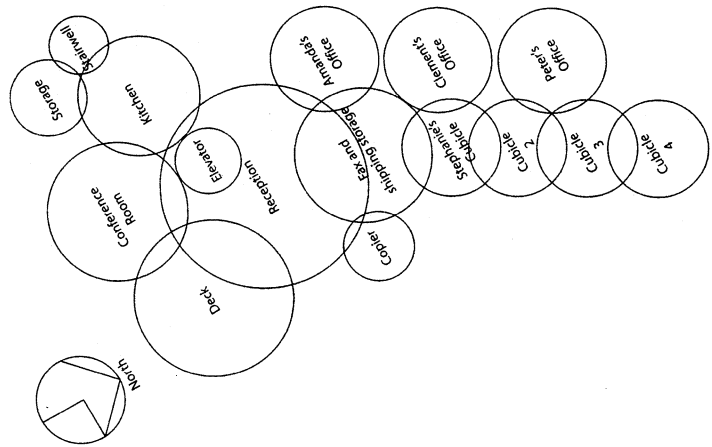
The designers used sentence diagramming to solve the problem. The simple sentence "Show me what I need to know about the heart," represented all the functionality the system required. The designers dissected each word and its meaning in the sentence to uncover its alternate computer function. "Show," for instance, meant present and display. "What I need to know" translated as information the computer had to identify and match. Once the project's basic functions were understood, the sentence diagram model was translated into the computer model, matching functions, knowledge levels, age,

What Mr. Beck did was visualize the kind of information riders needed to get from Victoria Station to Regent Park. His diagram for the Underground was the solution to a problem; it was also the end product of his work. In the computing medium, a solution is generally not something as absolute as a hand-held diagram; instead, it's a process. Mr. Beck was working with physical realities the computing medium doesn't offer. Designers used to design nouns; now they design verbs.

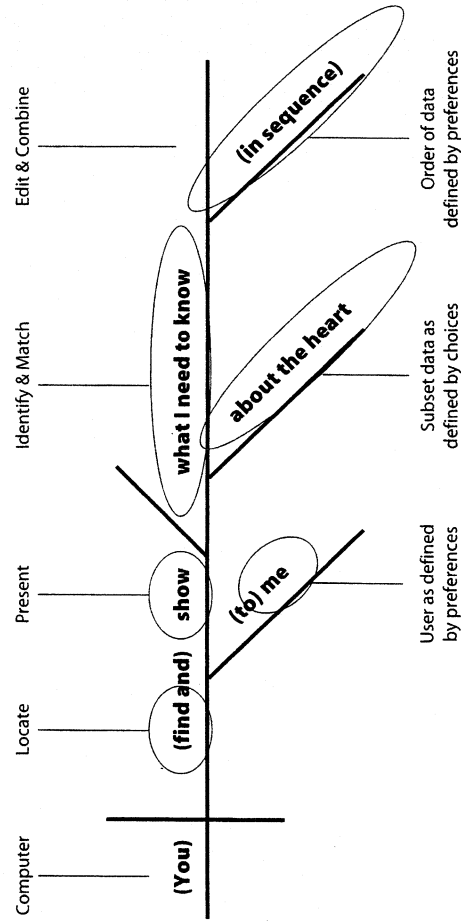
How can an information designer go about mapping complex systems and concepts to create a usable system? One way to determine the design parameters of complex information spaces and solve the design problems they present, is to understand what a user, viewer, or customer needs or wants to accomplish. The structures that underlie language are excellent diagnostic tools for those needs and wants. Language is a formal, universal framework that is common enough to encompass

learning levels, etc. Language helps diagnose and identify the nature of a problem, and match needs with appropriate solutions.

Bubble diagrams are another way for designers to create frameworks for efficient processes. Architects use bubble diagrams to organize people's movements through particular spaces in a specified order, as in determining how to accommodate the activities of people in a cafe and a bookstore, for instance. Designers need such visualization techniques to define navigation and interactivity.



Show me what I need to know about the heart.



Information Architecture

The architectural model is apropos to the computing medium because architecture is concerned with the relationships among people, time, and space – architects design and create systems to move people in time and space. The kinds of materials architects use to define space are cinder blocks, wooden beams, and copper pipes. In the computing medium, designers create systems by plotting structural and data type information as x and y axes; when different media are factored in, the z axis is introduced; and so is the equivalent of three dimensionality in cyberspace – complexity.

Consequently, spatial models are important to designers building models that represent relationships in the digital environment. Working with spatial models may be a stretch for many designers, since in general, designers have limited experience working with the spatial dimension.

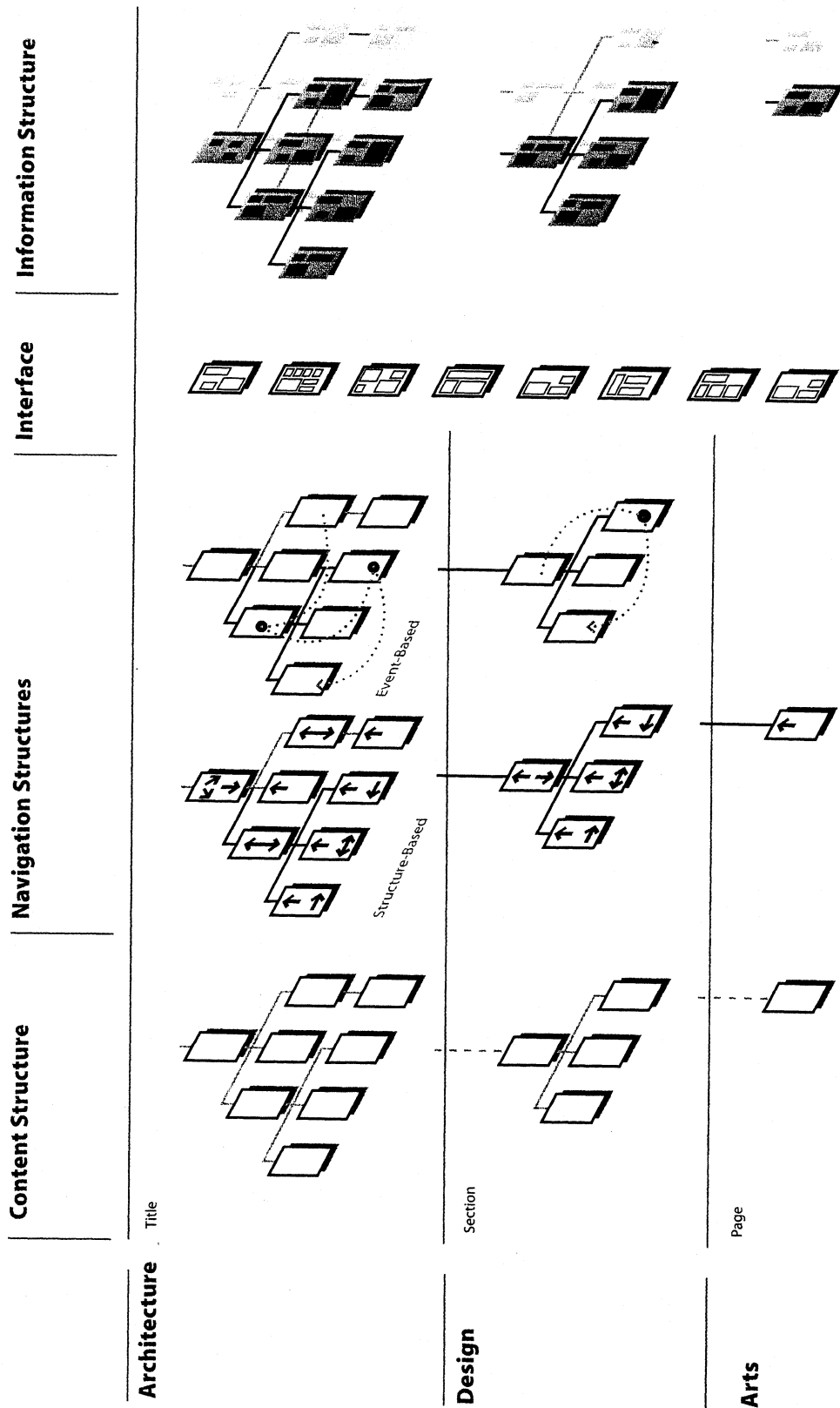
The architecture of an operating system is the organization of data instructions and computer code that indicate the way information should be passed along. Few designers have taken information structures to the level of spatial depth (see page 115). Most information in cyberspace is still

Architectural order is created when the organization of parts makes visible their relationships to each other and the structure as a whole. When these relationships are perceived as mutually reinforcing and contributing to the singular nature of the whole, then a conceptual order exists – an order that may well be more enduring than transient perceptual visions.

Francis Ching, *Architecture: Form, Space and Order*

two-dimensional; depth of information in cyberspace is detailed information.

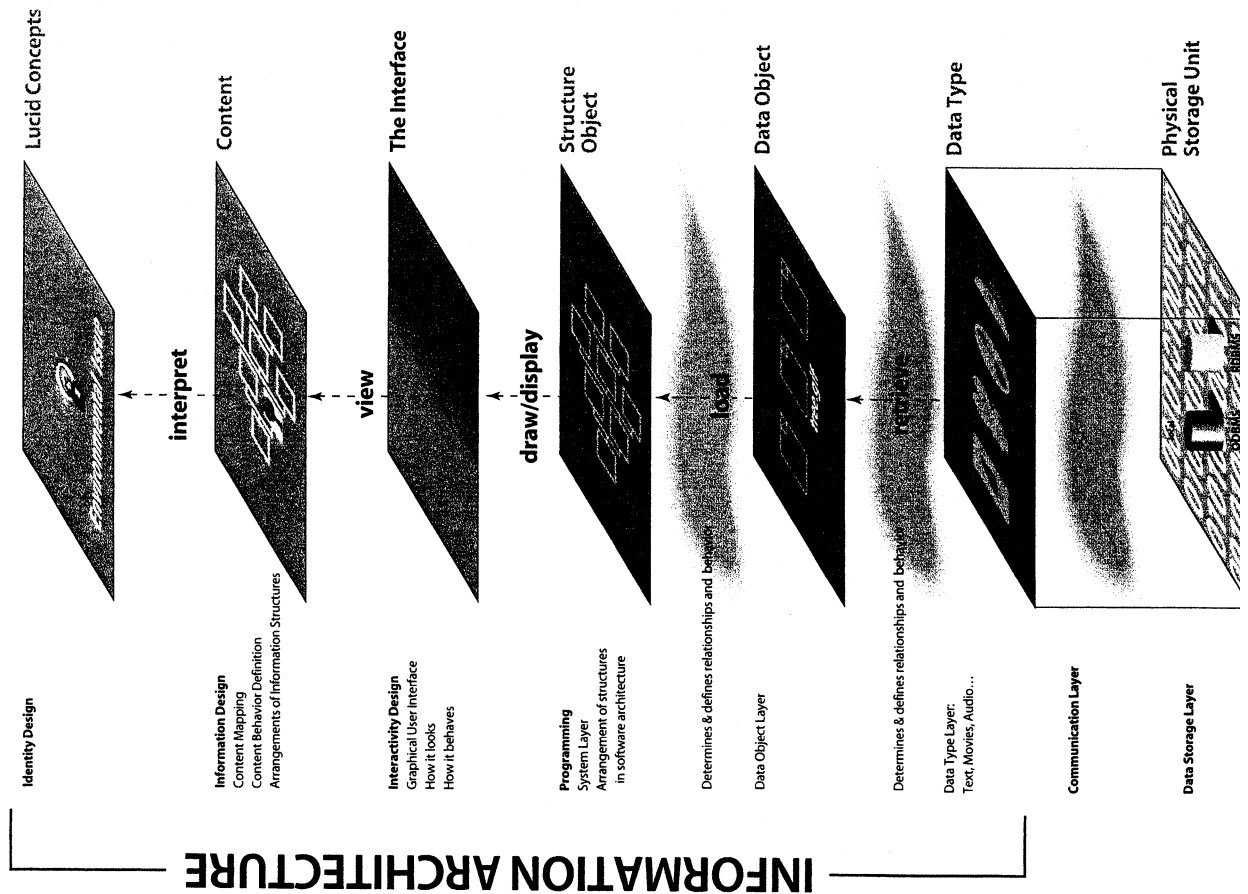
Designers have much to learn from architects. Just as an architect wouldn't go forward with a blueprint for a convention multiplex if the proposed site were on swampland, a designer shouldn't begin planning huge information systems before understanding the system's technological underpinnings. This doesn't mean that designers have to be computer engineers any more than architects have to be geologists, but they do need to know what the relevant technology does and who will be using it. A current, renowned example of construction on digital swampland is the Orlando project, which was supposed to bring interactive TV to homes – the alliance partners for this venture went ahead with the technology without reconciling the social wants and needs. Projects that are well designed only look simple because designers and others have spent countless hours making them look that way.



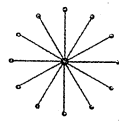
This graphic schema represents how content, navigation, and interface design combine into an integrated information structure. This deconstructed view shows the progression from the simplest art to a complete architecture.

Creating the database and operating system architecture for a multifunctional corporate Web site, for example, require that everything seen and used in the computing environment relate to the systems within. The diagram is not just information architecture, but an integrated view of the elements required to create that architecture. The gold represents right-brain professions and the blue, left-brain; that is, artistic and scientific. The lower levels of the diagram require the skills of scientists and computer programmers, while the top layers demand serious abstract design talent; right now, the most sought-after professionals are those who have the ability to mediate between the two worlds.

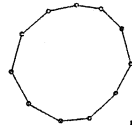
Data to Concept



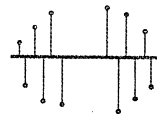
Daisy chain



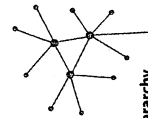
Star



Ring



Bus



Hierarchy

These configurations (see communication layer, left) represent the way information is passed along through networks. See William Mitchell and Malcolm McCullough's in-depth study in Digital

Critical tasks of interaction design

- Create a guidance system to orient users
- Design the navigation and access routes
- Define what happens in every screen
- Design controls for interaction
- Create a storyboard

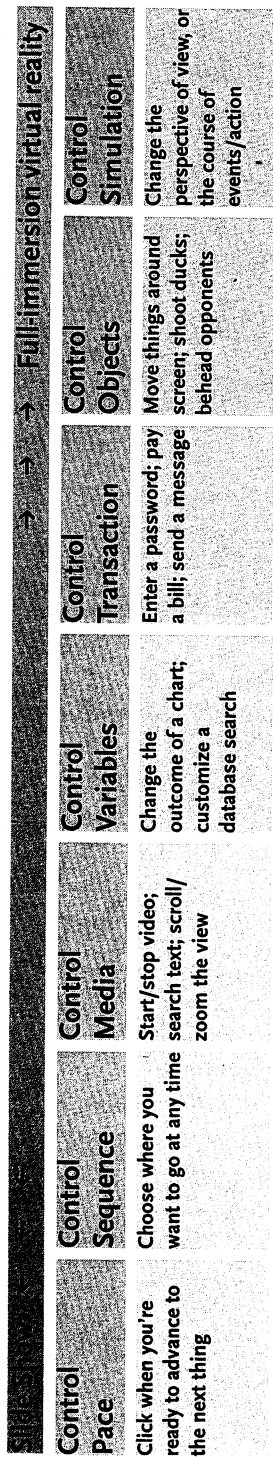
How does an information design become an interaction design? The tasks listed above represent the steps in that process. Starting with the information flowchart, you create the features that allow users to travel through and manipulate the content.

In the process of interaction design you are turning the flowchart, which shows only content and structure, into a storyboard, which shows pathways and controls as well.
In other words, moving from information design to interaction design means turning information into an experience.

At the big-picture level, this means

- motivating users to *have* the experience, by giving them clear guidance and options
- creating an interesting journey—or at least a clear path—through the information
- giving users controls that allow them to go where they want and do what they want
- making the experience as easy and intuitive as possible

→ How much interaction?



This continuum represents the range of possible user interaction and specifies the kinds of things that users can control. It's a vocabulary of interaction that can help you express your goals in basic terms.

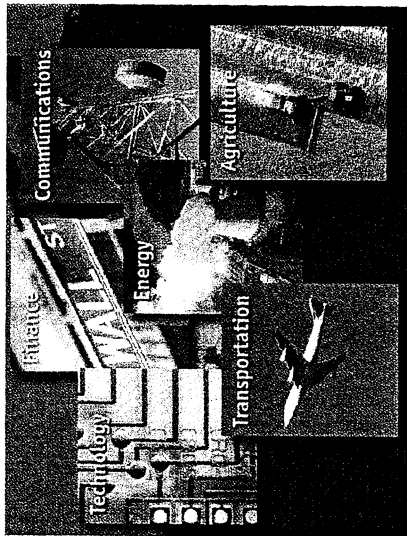
In any project, the interaction design is partly a function of development time, money, and technical resources. The more interactive control you give to users, the more complex the product will be to develop.

But how much and what type of interaction is needed really depends on the content itself: what sort of interactive experience are you setting out to deliver?

- A simple interactive document may need only basic navigation and media controls.
- An electronic catalog may need database search and transaction capabilities.
- A medical training course might need not only navigation and media controls, but also control over instrument "objects" and realistic 3-D surgical simulations.

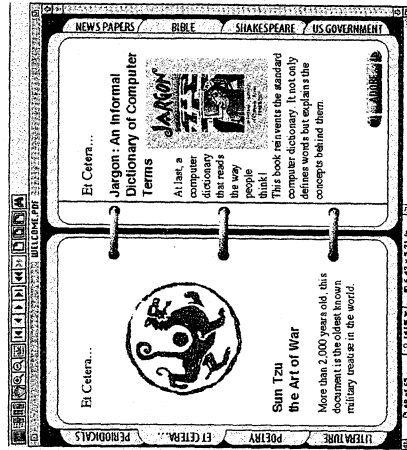
The methods used to create each product would be quite different. But whatever the level of interaction, the basic goals of interaction design remain the same: clarity, simplicity, and ease of use.

Image map



An image map uses images to represent content literally. The user just selects a topic to find out more about it.

Metaphor



The familiar looseleaf notebook gives users an intuitive method of getting around—by clicking section tabs—as well as an immediate overview of the content by showing all the categories at once.

Image maps and metaphors

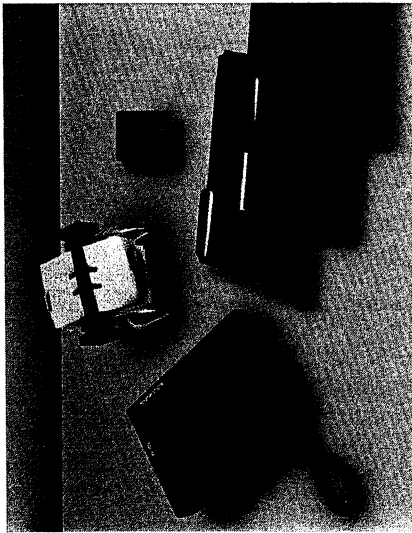
A natural place to get users oriented is the main navigation screen. Whether it's called a main menu, a home page, or something else, it has the same purpose: to set up the conceptual space in which users will navigate. When that space is made up of images that lead to parts of the content, it's called an image map.

An image map has two purposes: the images both represent and lead to the content. Any collection of images can be an image map—separate items or one integrated picture; images with or without words. The concern at this point in the design process isn't creating the images, but defining the concepts that will introduce users to the content.

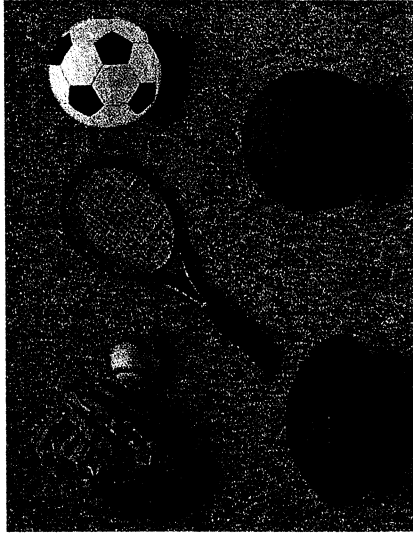
A metaphor is a special kind of image map that places images in a meaningful context, by presenting information in terms of an object (like a book), a location (like an office building), or a device (like a VCR) that people already use outside the computer environment.

A metaphor can only work—that is, make access to a product easier—if the audience is familiar with it, and if it's a good conceptual fit for the content.

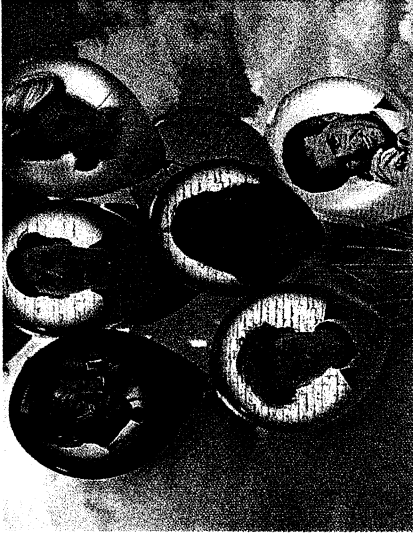
What is it?



Navigational or functional metaphor? This is a functional metaphor. Each item leads to a tool: calculator, address book, and so on.



Metaphor or image map? This is an image map. Each item leads to a part of the content, but there's no overarching context for the picture.



Good or bad metaphor? The whole point of a metaphor is to create meaning. If you have to ask what the meaning is, the metaphor isn't working.

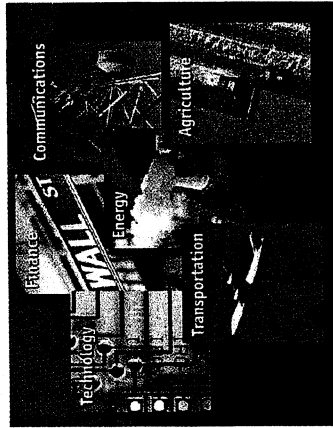
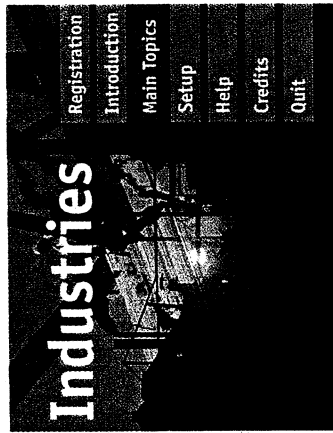
The right metaphor:

- Does it help viewers understand what to do?
- Is it appropriate for the content?
- Are there any parts of the content that clearly won't fit the metaphor?
- Does the metaphor create audience expectations you can't meet?

Metaphors are not just for complex multimedia programs or games. For example, to get information about medical procedures, users might click instruments arranged in an on-screen doctor's office. This is a navigational metaphor: the doctor's office provides a familiar context to make the search for information less abstract.

A functional metaphor, in contrast, creates an environment in which objects perform the functions they depict. The best-known example is the familiar desktop metaphor of many computer interfaces, where folders are places to file documents, trash cans are places to throw things away, and an electronic address book holds names and addresses.

Functional metaphors represent a level of interactivity that's found more often in software applications and high-end multimedia than in simple information products. But navigational metaphors can work in almost any information product.



Separating content from overhead

Since a product's main navigation screen (main menu or home page) is the gateway to the content, it's used more often than any other screen. So a problem arises if this screen is used for "housekeeping" items (things the user does once or infrequently): the screen ends up hosting many chores that have nothing to do with navigation.

Examples of housekeeping items:

- setting preferences
- product registration or sign-in
- credits

The illustrations show one way to simplify the main navigation screen: separate housekeeping items from the content by putting them on a different introductory screen. Then the main navigation screen doesn't need to be cluttered with items that are rarely used.

Navigation

In many interactive products, the user's primary form of interaction is navigating through the content. It follows that much of interaction design is really navigation design: creating interfaces that help people understand where they are, where they can go, and how to get there.

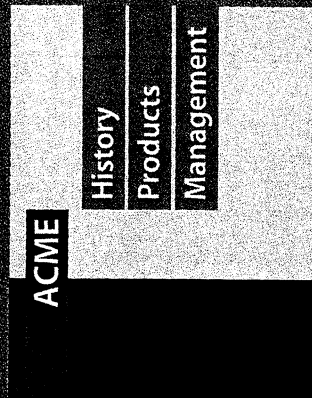
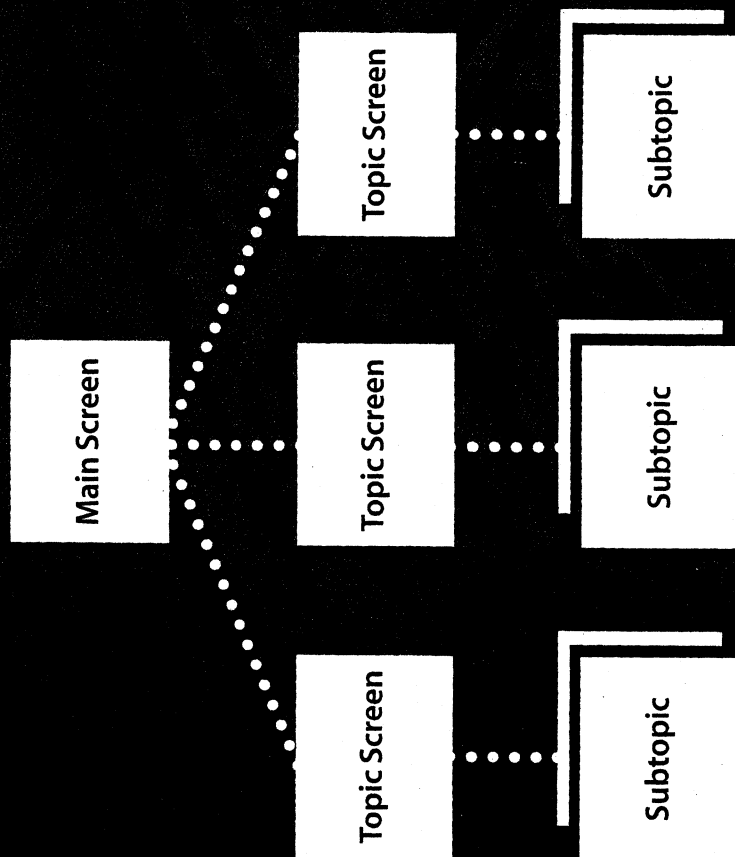
An information flowchart defines a product's structure, so once a flowchart exists, a lot of navigation design work has already been done. The next step is to design the access routes between topics and the controls that users interact with. As a result of this process, the flowchart will probably change—for the better.

A good navigation design will

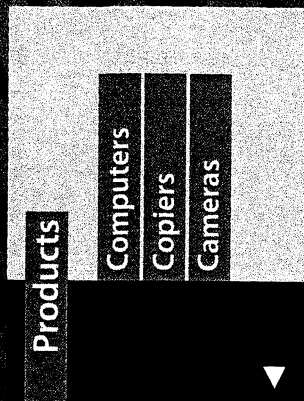
- Minimize travel: create the simplest and shortest path between any two points
- Minimize depth: create a hierarchy with the fewest possible levels (extra levels mean extra travel steps)
- Minimize redundancy: avoid creating multiple paths to the same place from the same screen (this causes confusion about which to choose)

How is an access route different from the links already shown in the flowchart? The flowchart typically shows *direct* links between adjacent levels and topics. But an access route could also be created, for example, by a Main Menu button on a screen three layers down, which would bring the user back to the Main Menu in one click. Designing navigation means specifying *all* the routes.

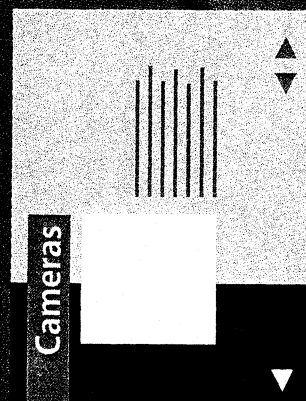
Every link in your flowchart represents an access route you'll need to create



Every screen needs controls that take users forward to the places they can go, and back to the places they came from. From this main screen, users need access only downward to topics.



The topic screen provides access in two directions: down to individual subtopics, and back up to the main screen.

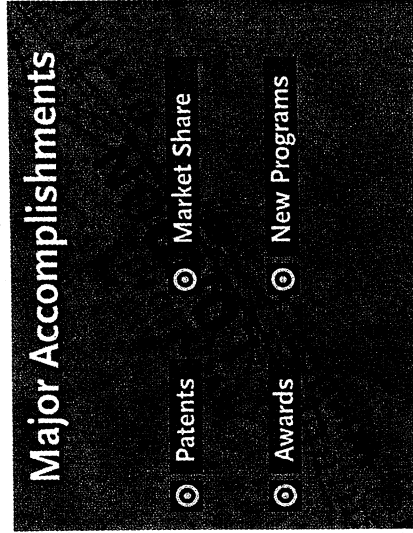


The next level of access is sideways — between items within the same subtopic. Access back to the topic screen is still available.

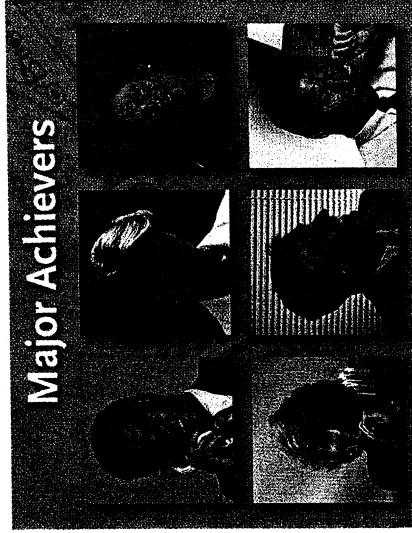
Types of access

Just as information can be organized to suggest a point of view (see page 31), access methods can also tell a story.

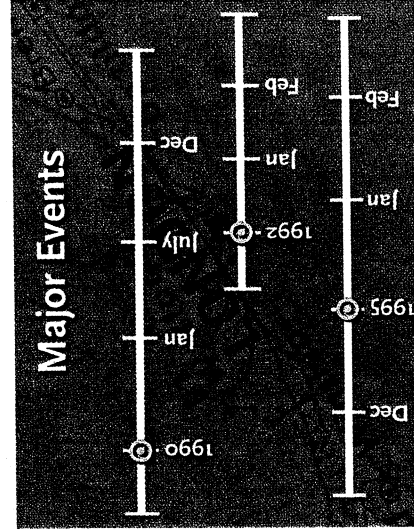
There are many different access solutions: menus, lists, timelines, icons, buttons, maps. Entirely different methods can be used to provide access to the same content.



In an interactive product designed to highlight major corporate accomplishments, a simple way to give users access is to organize the material into topic categories, each available by way of a button.

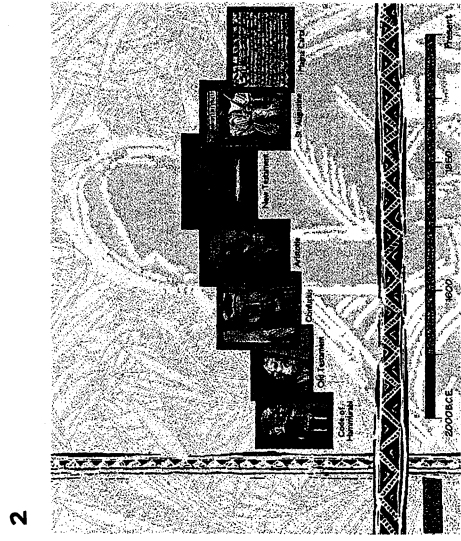


If the intent of the product is also to recognize outstanding achievers, major accomplishments can be featured instead through profiles of the people whose efforts were most significant.

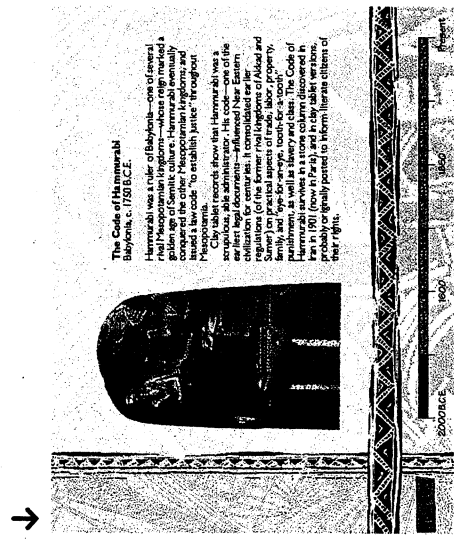
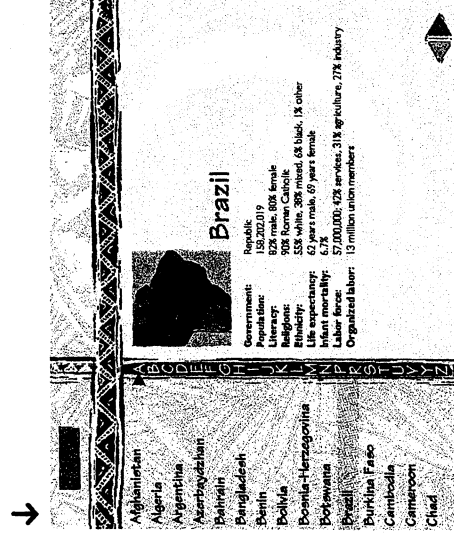


Or, if the intent is to convey a sense of history and progress, access can be provided by means of a timeline showing the major events along a spectrum of months or years.

Screens 1 and 2 are main topic screens from an educational program. While there is an obvious stylistic resemblance between them, the elements they contain are completely different, because the content they cover is different.



The two lower screens are subtopics of screens 1 and 2, respectively. Each subtopic screen retains many design elements of the corresponding topic screen, to make it clear that the user is still in the same space.



Levels of access

There are two levels of access:

- Access to a new topic: Going to a new topic can be a major leap and a complete change of scene.
- Access within a topic: Bringing up new material within the same topic should be as subtle as possible, to keep the user anchored and in control.

Few things cause as much traveler's anxiety as products that jump from screen to screen to screen, leaving the user wondering, "Where am I?" or "How am I ever going to get back?" There's a simple solution that helps keep users oriented and also reduces the number of screens you'll need to design: bring new material to the current screen, rather than sending users to a new screen.

Here's an example: Because documents on public networks use a system of links that typically lead to new pages, users can easily become disoriented while traveling within a document. But if the new pages retain visual anchors such as headlines, backgrounds, and other key graphics, users perceive that new material has been brought to the current location, not that they have traveled to a new location.

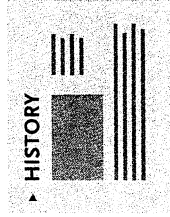
The price of a link

It's often considered desirable to provide a rich system of cross-links among topics. But each link carries a design price tag:

- If the link sends the user to a new location, access controls need to be created so the user can return without getting lost.
- If the link brings material from another topic to the current screen, the content may need to be redesigned to work in the new location.

For example:

- If a user clicked on a link in Screen A, bringing to this screen some content that had originally been designed for Screen B, the new content could fit in without problems.
- If the link in Screen A referred to content found on Screen C, this content could not be brought to Screen A without significant redesign. The user would have to be sent to Screen C, then brought back.



A



B



C

Random access: less is more

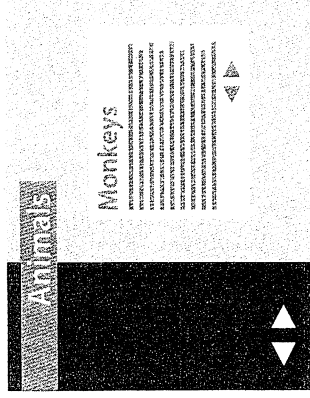
Random access and links between topics are two of the defining features of interactive products. But complete freedom of access with unlimited links can create confusion for users and design problems for you.

Net surfing, or browsing among the millions of documents published on-line, is by definition the act of following links. It's easy to get lost or to forget where in the chain of links an item of interest was located, but the overall experience is consistent with browsing: people don't expect an integrated look and feel or a sense of continuity among all those documents.

But having unlimited access and diversity among documents doesn't relieve the designer of having to maintain continuity and a sense of direction *within* a document.

Whether a product is distributed on-line, on CD-ROM, or by any other medium, the goal of designing access routes and links is to make navigation as simple and direct as possible.

The sphere of the self's power is simply the sphere of what happens well. It is the entire unoffending and obedient part of the world. —Santayana



A few examples that violate key principles of usability:

- Conflicting controls for similar operations
- Cryptic messages
- "Creative" redefinition of standard interface elements, such as menus that pop out of buttons
- Excessive and redundant media controls

Usability

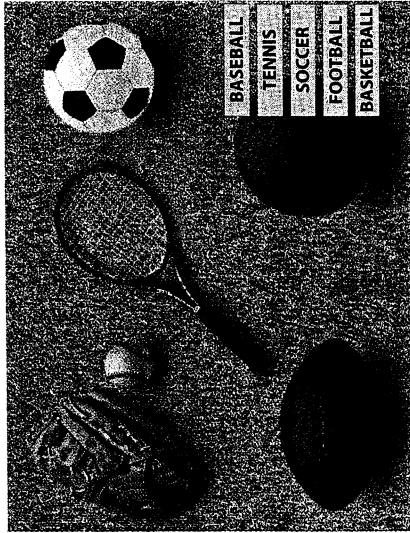
Designing usability is not a step in the interface design process—it's not something you do once and never think about again. It is an ongoing part of the design process.

An interface is intuitive only if it behaves the way people expect it to, and it can do that only if the designer was capable of anticipating what assumptions people would make about the product's behavior.

Interactive products that are considered intuitive and easy to use have had a lot of design effort invested in anticipating, understanding, and managing users' expectations.

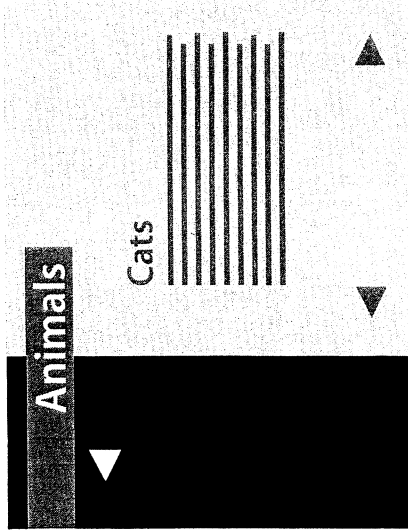
Luckily for you, users will bring many helpful expectations with them to the product. They will expect a mouse click to take them somewhere or show them something; they will expect icons they've seen elsewhere to do what they've done elsewhere. This doesn't mean that all interaction must be familiar. New kinds of interaction may be better, as long as they make sense to users.

Remove obstacles



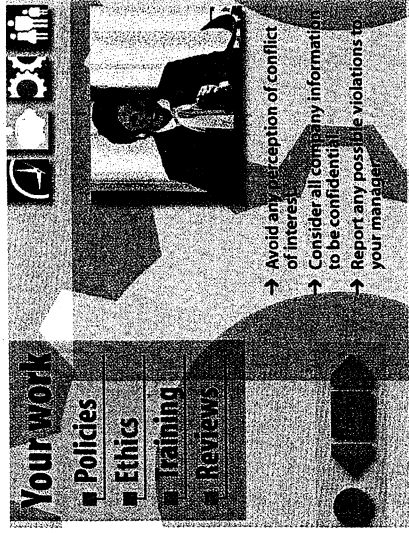
In this picture, the labels are an unnecessary and artificial layer between the viewer and the content. There's no reason to use menus or lists when the topics are clearly represented on the screen. Just let the user click the object of interest.

Minimize effort



People need to cover a lot of screen territory to navigate through this product. Navigation is easier when related buttons are grouped together.

Give feedback



The buttons at the top of this screen are used to move between the topics in the program. But although one of the buttons represents the current topic, it doesn't look any different from the others. Dimming this button, as shown below, would make it clear that the other three topics can still be selected.



Remove obstacles

A good interactive product doesn't get in the user's way. It doesn't use elaborate guidance schemes and symbols, and it doesn't try to explain itself or to direct the user's activities, unless the user wants it to.

One way to remove obstacles is to let people interact with the content as directly as possible. Let them click the things they want to find out about, and give them simple express routes to the information they're looking for.

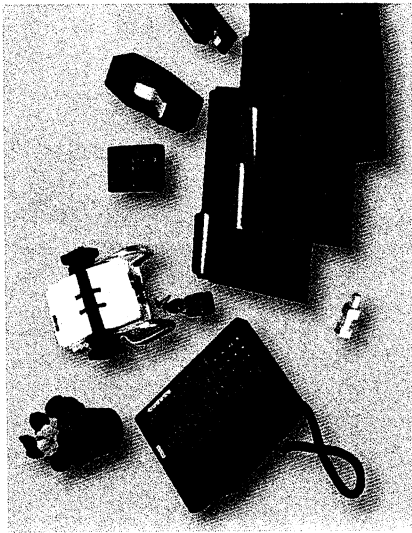
Minimize effort

Users shouldn't get the feeling that simply moving around the screen is work. You can minimize their effort by keeping related controls close together, and by putting frequently used buttons in places that are easy to reach in relation to other items on the screen. For example, in a reference product where someone might often be paging forward and backward, the Next and Previous buttons shouldn't be on opposite sides of the screen.

Give feedback

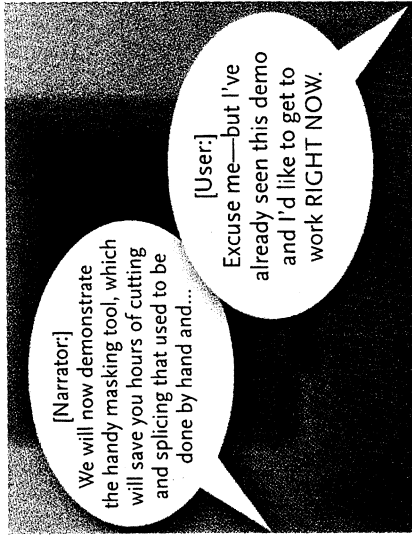
Most people assume that when a computer seems to be doing nothing, it is, in fact, doing nothing. If a product doesn't respond in some way to a user's action, the user will think the action hasn't registered. Feedback should be both appropriate and immediate—for example, responding to mouse clicks with a "mouse click" (or other) sound, and highlighting items that have been selected.

Be explicit



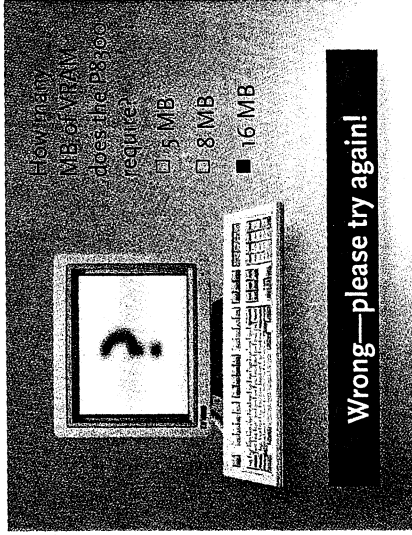
Which devices are active? Tape, stapler, calculator ...?
The only way to tell is to click them all.

Be flexible



Introductions and demonstrations are often necessary—once. There should always be a way to skip or interrupt them.

Be forgiving



At this point a user might simply quit or walk away. Even in instructional settings, where the user may have no choice but to work through the entire program, it's more helpful to add hints or a way to view the part of the program where the answer can be found.

Be explicit

Make it obvious what is clickable on the screen and what is not. Objects that look like buttons should act like buttons. If images have hot areas, make sure they are distinct from the rest of the image.

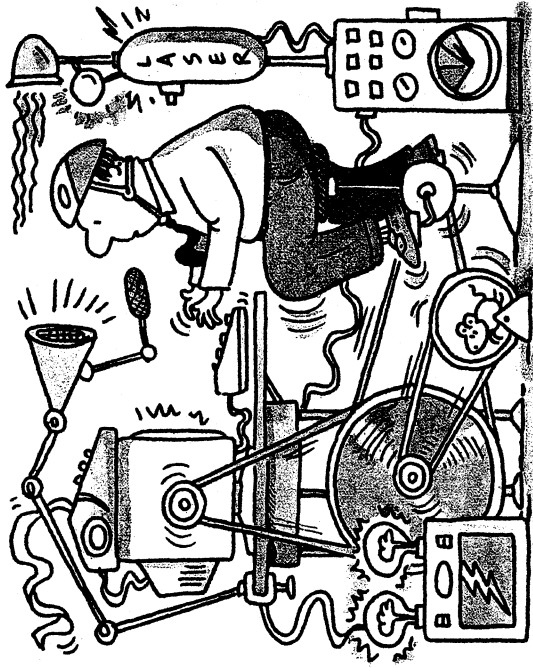
Certain tools for viewing interactive products, such as on-line document browsers, provide options to automatically indicate clickable text and images, and to highlight these when they are selected.

Be forgiving

Users will expect the product to let them do whatever they want, with no restrictions or penalties. They will make mistakes, change their minds, and generally expect the product to compensate. Don't create conditions where users have to "do the right thing" before they can move on—for example, by not letting them leave a screen until they choose a correct response, or by making them type a word correctly to search for a topic.

Be flexible

Users will expect the product to let them take shortcuts, so they can skip things they've seen before and go directly to wherever they think the action is. They will also expect to leave things that don't interest them—instantly. Make all media (sound, movies, animation) interruptible. Make it easy to quit at any time, from anywhere, by using the computer's standard keyboard shortcuts for quitting.



Functionality

Like usability, functionality isn't tied to just one step in the design process. It's been part of the picture since the earliest stages of product definition. But it comes into focus now because the storyboard—the big milestone of interaction design—will require you to nail down every functionality decision.

Designing functionality means specifying in detail what has been vague up to this point. It's a reality check that forces you to reexamine earlier assumptions about the content and what can be done with it, and to change the design until problems are solved.

Designing functionality also means watching the trees and the forest at the same time.

It's the process of looking at both the closeup view of individual controls that users interact with, and the big picture of how all the controls in the product work together.

Finally, designing functionality means asking a lot of questions and testing different answers until you find the ones that work best in the storyboard.

Designing functionality:

A macro view

These are the big-picture issues of functionality. Each represents design decisions that are part of defining how the product will work. Each has to be considered at the level of individual screens, as well as at the level of the whole product.

Defining interaction controls

Designing controls for interaction means defining not only *what* happens on each individual screen, but *how*: how users get there, how they leave, and all the actions they can take in between. While the specific controls for interaction are dictated by the immediate goals of each screen, the product's overall functionality should be developed as a system of well integrated parts.

Managing dependencies

In any product, there are dependencies created by relationships among different screens. An example is the dependency created by the sequence in which screens are viewed. If a product's main menu were to display a checkmark to indicate each section the user had completed, this feature would affect decisions about creating direct links between sections and bypassing that main menu.

Solving organizational problems

Solving organizational problems means addressing the many inconsistencies inherent in the content: even with your best efforts, no body of information can be perfectly organized or uniformly distributed. Every collection of data has a few items that are too long or too short, or that need special treatment, a different access route, and so on.

Controlling media and custom features

The controls users interact with represent only part of a product's functionality. The rest is the product's own behavior at any time: how it controls text, images, and sounds; and how it performs any custom functions that may be part of the design. Every individual decision that goes into defining these controls is part of designing functionality.

Ensuring consistency

Consistency in all the ways a product behaves makes the experience of using it more intuitive, and allows users to learn the fewest possible new behaviors. For example, if one part of a product offers the option to hear on-screen text read by a narrator, users will expect to find the same option when they move to a new topic.

Controlling video, sound, and text: A micro view

→ Video control decisions

How does it start?

Is the video window always on the screen, or does it appear only when needed? The answer depends on how video is used in different sections of your product. If it's an integral part of the presentation, video should appear and begin automatically at the appropriate moment. If it's there for enhancement or diversion, let the user click the movie window or a control to start it.

How does it end?

When the movie ends, you can leave up the last frame, replace it with a poster frame, or remove the video window altogether. Don't leave an empty window on the screen—it's ugly, and takes up space you could use for something else.

How much control?

Given the product and its content, how much user control is appropriate? Users should always be able to interrupt. But will they want to restart? And if so, should they restart where they left off, or back at the beginning? Will they want to replay the movie one or more times? Will they want to move between single frames?

What control device?

The appropriate control device depends on the level of user control. It can be as simple as clicking the movie to start or stop. If more explicit control is needed and your resources and authoring tool permit, custom-designed controls are generally easier to integrate visually than the built-in controller bars of digital video software.

→ Sound control decisions

How does it start?

Background music, sound effects, and introductory narrations are typically initiated by the program. Users may need to start sound or narration that is informational or instructional.

How does it end?

If the user chooses another topic or moves to another screen before the sound ends, should the sound stop, or fade out? Fading is usually more graceful, but you may need to experiment, especially with juxtaposed sounds that may be jarring.

Continuity?

If there are multiple screens in the section, does sound continue as the user moves between them? This would be fine for music, but narrations may need to be keyed to each segment.

How much control?

How much control do users need? Users should always be able to turn the volume down or off. In addition, depending on the content, they may need to stop and restart a sound segment, or replay one that has finished.

→ Text control decisions

Paging or scrolling?

If the text doesn't fit on one screen, do you want users to page or scroll to see the rest? From a design point of view, paging is navigation and not hard to implement. Scrolling, on the other hand, offers a disadvantage in either aesthetics (built-in scroll bars are not very attractive) or effort (custom scroll bars require engineering). From the user's point of view, if there are just a few extra words it's easier to scroll (or for you to edit text so it fits). But if the design uses a page metaphor, users may find it more intuitive to click and advance to a new page.

How much text?

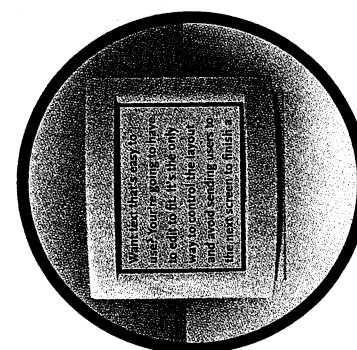
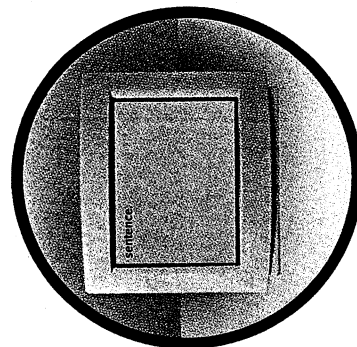
If the text can't fit on one screen, indicate how much there is to come. Are there five screens of material, or 45? A scroll bar is both a text control and a progress indicator, since it shows in relative terms how much precedes and follows the current screen. Or pages can be numbered—for example, "17 of 45"—so users retain a sense of where they are.

Hyperlinks?

Hyperlinks enhance the usefulness of interactive documents by allowing readers to jump to related topics. However, like index entries in a book, hyperlinks are only useful if they lead to places that contain relevant, helpful information. Users often pursue related topics and then want to come back to where they started, so it's helpful to provide a "breadcrumb trail" back through the most recent topics visited.

Searching?

Searching for a topic by typing or choosing a keyword is often a necessary text feature. The best way to implement searching depends on your authoring tool. Some tools include built-in search features; others don't. In some cases, having users type anything involves engineering overhead, since the product will have to cope somehow with variant spellings or mistakes; a list of key topics may be easier to design and use.



As content and functionality are integrated, what takes shape is the storyboard that will drive the rest of the project: a series of pictures and words that depict what users can see and do on every screen.

The storyboard

It's showtime! Not everyone's an actor, but there is an inescapable role-playing component in getting from flowchart to storyboard: the only way is to take each segment of the flowchart through a real-life walkthrough—acting out and then putting on paper all the actions and options available at every screen.

The storyboard is a communication tool you'll use to instruct and direct everyone from illustrators to narrators to engineers. It's also a marketing tool you'll use to get buy-in from the people who need to approve, fund, and promote the project. Like the flowchart, the storyboard is a living document that's modified and updated as long as the design process continues.

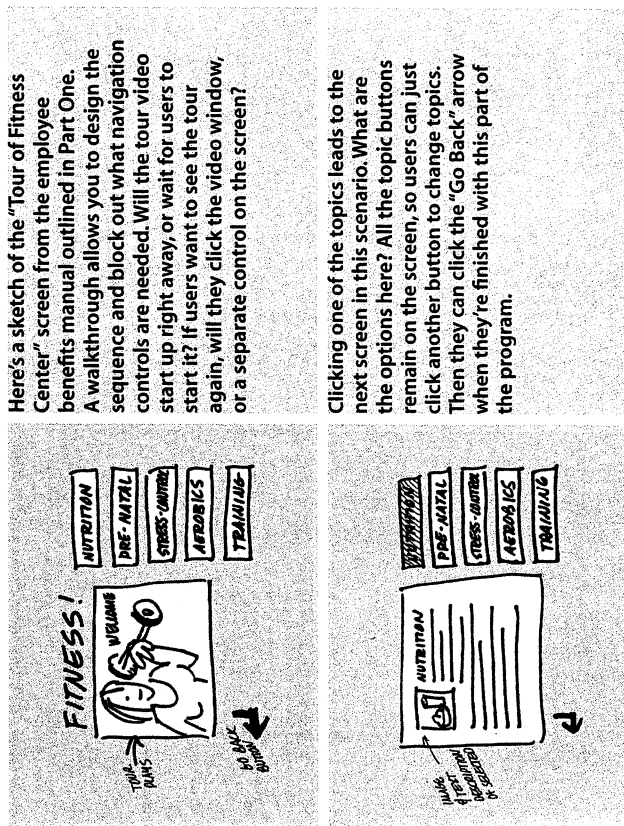
Even the simplest interactive document has a set of actions that represent each screen: what the user sees when arriving there, what navigation or other controls are available, and the sequence in which events occur. The way to get all this information into one place is to block it out—to begin with the flowchart and integrate the elements of navigation, functionality, and timing.

Time is simply what keeps everything from happening at once.

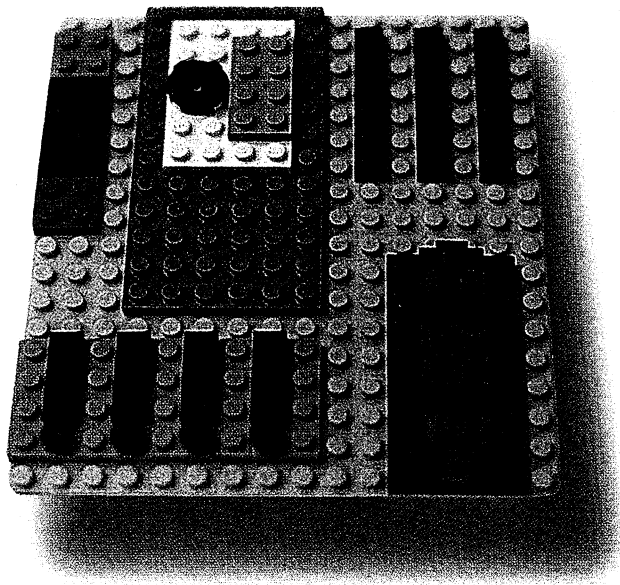
Unfortunately, this does not automatically apply to interactive products. You have to help. How much you help depends on the type of product: a simple interactive document may have no timing needs at all, while a multimedia CD-ROM may have tight relationships between images, sounds, and events that take place on the screen. Part of specifying functionality and mapping it onto a storyboard is specifying *when* things happen.

As the storyboard takes shape and the interactive scenario develops, the role played by time becomes apparent: each new action you specify has a relationship in time to the preceding action. Does the narration start as soon as the image appears, or a few seconds later? How long does the screen stay black after a blackout? Every decision of this type is recorded on the storyboard at the appropriate screen.

→ Doing the walkthrough



Does the narration start as soon as the image appears, or a few seconds later?



Interface elements

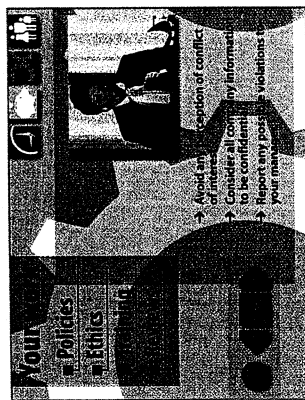
A good interface is a construction kit: a set of elements that fit together like building blocks, and can be moved and reused in many different combinations. When these elements are assembled into a family of screens, they work together to produce a coherent interface.

Up to this point, it's been important to look at the style and layout of an interface as a unified system. But while the system has to be conceived as a whole, it can only be created in parts. As the interface is assembled, its parts are used in a variety of screens, in different sizes, colors, and positions. These elements work as the building blocks of the interface, and their family relationship produces a sense of continuity and consistency.

In the upcoming pages, this system is deconstructed into its basic elements, focusing on each element in turn to identify

- the role that the element plays in an interface
- specific issues the element can raise for design, production, and usability
- interesting examples and types of uses

What is an interface made of?



Background
The backdrop that sets the scene, whether realistic or abstract, decorative or fully integrated with the content.

Windows and panels
Screen areas, with or without frames or borders, that contain media or delineate different functional regions.

Buttons and controls
Pictures, labels, and other devices that represent topics to visit or tools to control things.

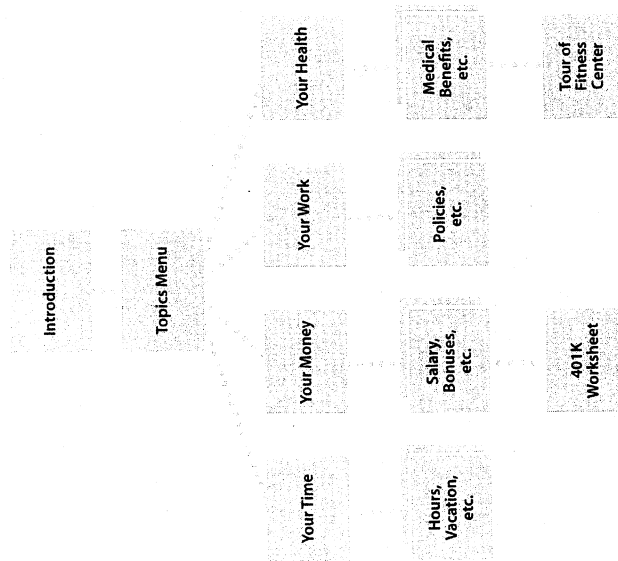
Images
Photographs or illustrations that may be part of the content, graphic design, or both.

Text
Any words on the screen, from headings and labels to entire documents.

Video
Digital movies of live action or animation, often with a soundtrack.

Sound
Music, narration, and sound effects that deliver content, reinforce action, and contribute to overall style.

Animation
Any motion created using the authoring tool (not as digitized video), from moving text to screen transitions and special effects.

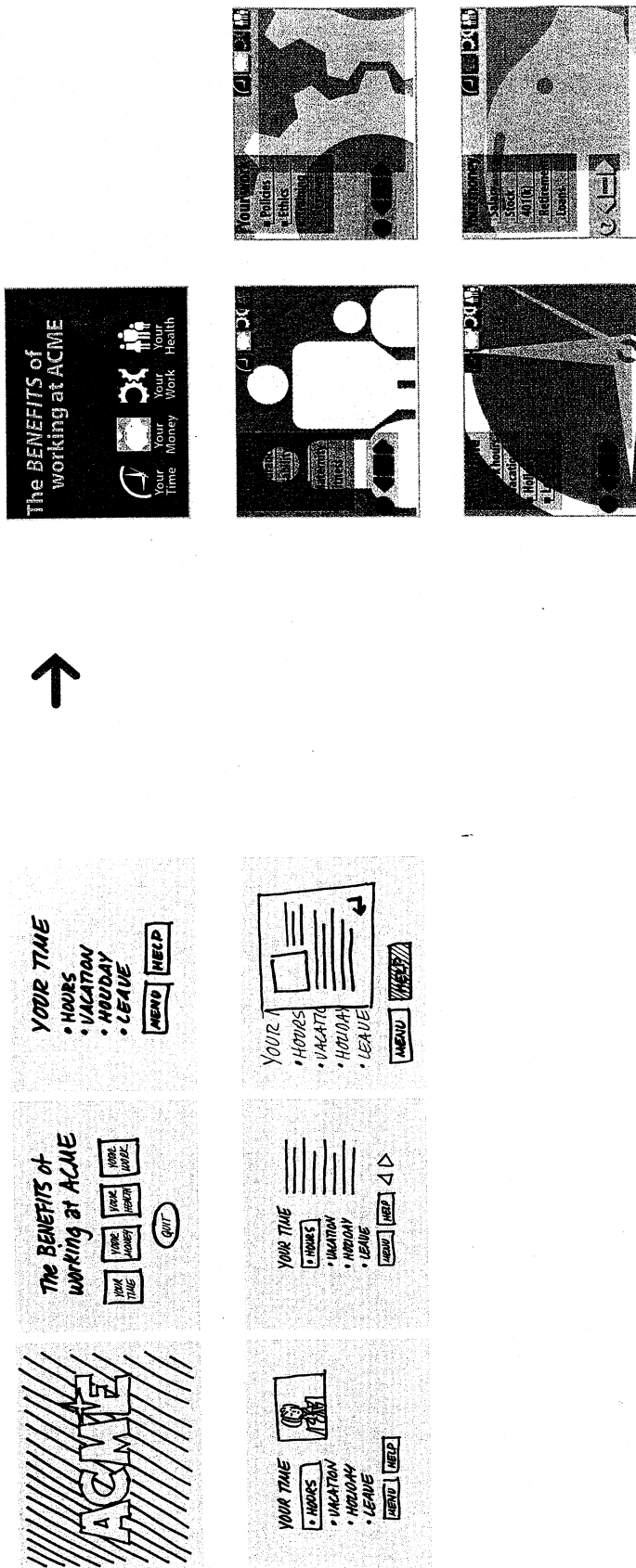


Putting it all together

At some point in the process—it doesn't matter when—you begin to integrate the pieces of the interface into a prototype. The prototype is the final step of presentation design, but integration can begin at any time.

Integration means bringing all the interface elements together, using the authoring tool, to create a functional framework or shell for the product. As the content is developed and the design elements are integrated, the shell progressively replaces the conceptual framework represented by the flowchart and storyboard.

The sooner integration into the authoring tool begins, the sooner it becomes possible to solve the inevitable problems that arise when pieces of the project are brought together. At first, the shell can simply be a place to store elements as they are completed, and needn't be highly interactive. It's helpful just to see everything come together in a way that indicates how the real screens will look and behave.



The integration process is also where give-and-take occurs between design and engineering, as it becomes clear that some design features are too hard to implement, or cause product performance to degrade. Here's where the designer's knowledge about digital media can make a significant difference in avoiding and solving problems.

As the elements are integrated and the prototype screens take shape, it becomes evident whether the flowchart, storyboard, and presentation design work as intended. Where do they break down? How should the breaks be repaired? This is the time to fix links that lead nowhere, confusing directions, ambiguous choices, and anything else that couldn't be spotted on paper.

Building the shell means using the authoring tool to mock up each frame in the storyboard:

- creating a place in the shell to represent each screen
- importing the content, graphics, and media
- adding the navigation links to and from each screen
- creating at least some of the interaction

In every design decision, choosing simplicity will pay you back in ease of production, better performance, and ease of use.

The prototype

A prototype is a preliminary, incomplete, on-screen version of the product. It does not need commercial-quality refinement; the degrees of detail and interaction built into it can be scaled to fit your resources. How far it makes sense to take the prototype depends on how it will be used.

The scenarios on the facing page describe three possible next steps. The project may not have formal approval yet, in which case the next step would be to get it approved. The project may be ready to try out on real people, so the next step would be getting it ready for user testing. Or the project may be ready to go into production, in which case its expenses are about to rise dramatically, requiring more long-range preparations.

No matter what the next steps are, be prepared for the likelihood that almost every aspect of the project will continue to change and evolve. Your project goals are your compass; don't lose sight of them. In every design decision, choosing simplicity will pay you back in ease of production, better performance, and ease of use.

What's next?

Sell the idea

If the project hasn't been formally approved yet, you may have had little or nothing to spend so far, on a prototype or anything else.

The goal in this case is to create just enough material so you have (and can convey convincingly) a good sense of what would be required—in time, money, and people—to do the job well.

If the goal is selling, the prototype might include:

- a detailed description of the project, including your best efforts at a flowchart and content inventory list
- a proposed budget and schedule
- if you have the resources to create it, a paper storyboard that outlines the planned interactivity
- again, if you have the resources, a set of design sketches or screens that show possible directions for the visual design

Test the design

Audience research becomes user testing when you can stop asking people what they think about an idea and let them try the real thing.

To get the most out of a usability test, it's more useful to have one complete section of the project working well than to have bits and pieces of the entire thing. The goal is not to walk the test subjects through the prototype (that's a demo, not a test), but to turn them loose with it and see what they do: what they manage easily, where they get confused, what they try that doesn't work, where they simply give up.

If the goal is testing, the prototype might include:

- a main menu that shows all major topic areas (even the non-functional ones)
- for each functional topic, a fully implemented path all the way through to the most detailed level of content
- worst-case screens (that is, those likely to cause users the most difficulty), so you can ask for comments on possible solutions
- alternate designs, so you can ask which one people prefer

Build the product

A pre-production prototype needs to describe the product well enough that people on the project team can use it to get to work. All basic decisions about content, organization, navigation, interaction, and design have to be spelled out in the prototype so they're available to everyone on the team.

If the goal is building, the prototype might include:

- all project management documents including a schedule, budget, and tracking chart that shows major deadlines and interdependencies (for example, video digitizing can't begin until video is shot)
- descriptive documents including the complete flowchart, detailed paper storyboard, and design sketches or screens
- an incomplete but fully functional interactive prototype, created in the authoring tool, that takes the detailed storyboard to the desired level of production quality

5 Case studies

Ter afsluiting van dit diktaat volgen een tweetal beschrijvingen van ontwerpprojecten uit de praktijk. Het eerste artikel 'Social Trends and Product Opportunities' geeft een overzicht van het Philips 'Vision of the Future' project, dat ook in hoofdstuk 1 Context aan de orde kwam. Interessant is om te zien op welke wijze de trends en ontwikkelingen uit de context uiteindelijk zijn vertaald in concrete producten.

Het tweede artikel 'About the Doors of Perception 1 CD-ROM' beschrijft hoe het materiaal van de Doors of Perception conferentie is verwerkt tot een zeer inventieve en vernieuwende CD-ROM. Een uitstekend voorbeeld van de wijze waarop nieuwe media kan worden ingezet voor het geven van nieuwe betekenissen en verschaggen van nieuwe perspectieven. In het artikel komen een groot aantal van de eerder in dit diktaat beschreven uitgangspunten, overwegingen en ontwerpelementen terug binnen het raamwerk van een reële ontwerpsituatie, waarmee het een goede illustratie vormt van de inhoud van dit vak.

Bronnen Lambourne, R. et.al., *'Social Trends and Product Opportunities'* in: Pemberton, S. et.al., *'CHI '97 Conference Proceedings'* ACM Press, New York (1997) pp. 494-501

'About the Doors of Perception 1 CD-ROM',
<http://www.mediamatic.nl/Doors/Doors1Rom/aboutthecd.html>

Social Trends and Product Opportunities

Philips Vision of the Future Project

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ABSTRACT

This paper describes a project that was carried out by Philips Corporate Design (PCD) to explore ideas for products and services which could be part of our future in the year 2005.

It discusses how a socio-cultural tool was used together with technology forecasts to arrive at the creation of scenarios that describe future products and their contexts. The concepts were then communicated to a wide audience in the form of short film clips. The project involved many people from a wide range of disciplines.

Keywords

Future, design process, socio-cultural forecasts, interaction design, industrial design, film making, scenario.

INTRODUCTION

The Vision of the Future project was initiated within Philips to explore how future products may be in ten years time. Traditionally, new products have been introduced mainly through technological innovation. Today, however, to make products and services which come closer to meeting peoples needs and desires, we need to redress the balance, looking more carefully at the increasingly complex relationship between people and technology. The broad aim of the project was to explore what people will perceive as useful, desirable and beneficial in the future in order to provide future possibilities for Philips.

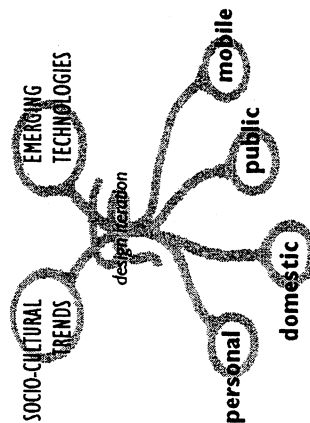
It was not our intention to create a vision and categorically say 'this is what our future will be like', but rather to raise questions and issues about our future, and to propose ideas and solutions that will enhance people's lives.

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CHI 97, Atlanta GA USA

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In January 1995 Philips Corporate Design was asked to direct the project and to provide the design input within a time frame of one and a half years.



scenarios in 4 domains of life

SCOPES AND OBJECTIVES

The project addressed social cultural developments only in societies which lead in the adoption of new technologies, such as North America, Europe, Japan and Australia.

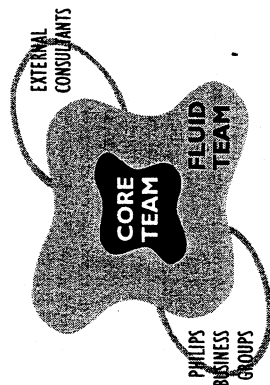
As well as the broad aim of exploring what people will perceive as useful, desirable and beneficial in the future, based on socio-cultural analysis and design, the more specific objectives of the project were:

- to demonstrate Philips commitment and ability to make a positive contribution to the future by offering products, services and software that enhance the quality of people's lives.
 - to further stimulate the imagination and creativity of the Philips community as a whole.
 - to explore the opportunities provided by merging technologies and the significance of socio-cultural developments in determining how they can be used.
 - to show the benefits of shifting from the model of quantity and complexity towards a greater focus on quality, simplicity and customer satisfaction.
- Our intention was to explore issues of physical product, user interface and context together in order to create products which satisfy user needs.

PROJECT TEAM

The project, within PCD, was made up of a core team of five designers who worked full time on the project. They had the responsibility of guiding the project and ensuring that the goals and objectives of the project were met.

In addition to this, a larger team, called the 'fluid team', contributed to the project on a part-time basis. The fluid team consisted of: product designers, interaction designers, graphic designers, human factors specialists, exhibition designers, and experts from the film industry.



Structure of the project team

PHASES OF THE PROJECT

The project went through several phases which, although synchronous, had large overlapping periods. The phases were:

- Research
- Creative sessions
- Filter and validation
- Design development
- Communication

RESEARCH

Extensive research was carried out prior to the creative process to ensure that the path the project followed was based on peoples' needs and desires.

The research was carried out in two areas: socio-cultural trends and trends in technology.

Socio cultural trends

In order to gain an insight into how people will live in the near future, two forecasting institutes - Trends Lab, Milan and the Research Institute for Social Change (RISC) - were commissioned. Their conclusions provided the team with valuable input for the development of concepts and ideas. The information that was received from them described emerging 'sensitivities'; new attitudes, preoccupations and

concerns within society. The sensitivities that were identified are described below.

Subjectivity

In the present age, more than any previous age perhaps, people are searching for identity. Recent developments in society, a falling away of certainties and the destabilisation of monolithic power blocs and sources of authority have created in many people a sense of doubt about their own position. In addition the rapid pace of modern life is leading many people to take time out to reflect on what the 'true' values of life - specifically their own life - might be.

Sociability

In order to truly be ourselves, we need other people. The traditional source of reaffirmation and support has always been fragmenting steadily over recent decades. Families are becoming fragmented to the extent that relatives are moving, not only away from home, but often to another part of the country or world. Naturally, through the medium of telecommunications (phones, faxes and e-mail), people are trying to stay in touch, but, in the future we will see the emergence of products which link people living far apart in more satisfying ways than are currently available.

Exploration

A sense of curiosity and exploration has always been an important part of the human spirit, but the manner and the extent of its expression may vary from period to period and from culture to culture, depending on the prevailing social, political, economic and technological circumstances. Today, technology is offering us ways of exploring a new world - that of 'cyberspace', the 'virtual' world - as well as finding out more about our 'real', physical world.

Connectivity

People are increasingly viewing the world as a place in which all the various parts are connected. Improvements in satellite links, the advent of digital broadcasting, the emergence of cellular telephony and the rapid growth of computer networks are heightening this sense of being connected. And, for businesses, global markets are making it necessary to take into account activities outside their home territory.

Ethics

The search for new rules and values is becoming apparent in various fields, from politics and business to the environment. In many countries around the world, political and judicial authorities are conducting campaigns against corruption. And many people and companies are responding to appeals made to their personal responsibility to respect the environment and are actively working to conserve energy and minimise waste. The individual and the family are becoming more proactive in their own ethical codes and values. With developments in the fields of communication and networking, there is a need to stimulate the creation of new rules which support these developments.

Holism

Holism deals more specifically with the search for environmental balance, with the trend towards seeing ourselves, the natural world and the man-made environment as one. We are increasingly becoming aware that treating the environment carelessly in one country can affect the health and well-being of the inhabitants of another.

This holistic attitude is no longer simply reflected in conservation. On the contrary, it is developing into a tendency towards the elimination of all boundaries between ourselves and our environment in the widest sense. It even extends to the mind and the body. There is a growing appreciation that health and well-being depend not only on physical fitness or taking medication. They also require a balanced lifestyle.

Time and Space

These sensitivities were then mapped against space and time relationships in order to create a matrix. Time was considered in two different ways. One is to consider our ever accelerating lifestyle. People have a sense that a lot is happening at once, that they are doing many things at the same time, that they never have enough time and that they are constantly struggling to keep up with the demands of modern day life. Another contrasting way to look at time is to consider the moments when time seems to stand still: moments of rest, meditation or wonder. These are the moments when we become aware of our relation with the past, our heritage, and when we see ourselves as part of a continuing tradition.

Likewise space can be considered in two ways. Firstly we can consider a person's own personal space, one that is familiar and comfortable. This trend is often referred to as 'cocooning', the sense of feeling comfortable in one's own territory. Secondly space can be considered as having no borders. Through telecommunications we are able to communicate, in real time, over vast distances. We can also join virtual communities whilst remaining members of our own physical community. As a result, our subjective experience of distance has changed, and physical borders no longer limit our ability to communicate with people in distant places.

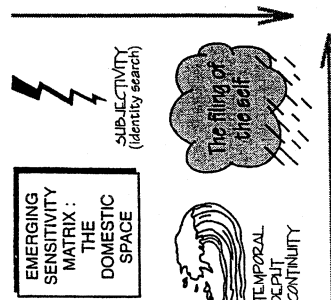
The Sensitivity Matrices

The mapping, described above, produced a matrix for each of the domains of 'personal', 'domestic', 'public' and 'mobile'. The matrices were then used as a tool that helped us to focus on particularly interesting areas of social change.

MAJOR DRIVING FORCES FOR THE FUTURE									
EXPERIENCE OF PEOPLE		people		link		balance			
time	space	subjectivity	sociability	exploration	connectivity	ethics	innovation		
TEMPORAL DEPTH									
TEMPORAL ACCENTRATION									
SPATIAL LOCATION									
SPATIAL DURATION									

A matrix and its parameters.

As an example, one matrix, which describes the domestic space, is shown below. Unfortunately the contents of all the cells in the matrix cannot be divulged in this paper. However, one cell is shown which is the product of mapping temporal depth (the moments where meditation and quiet thought become possible) against subjectivity (the search for the answer to the question 'who am I?'). The result is a cell called 'the filing of the self'. This provided the context for a workshop discussion leading to ideas such as 'the interactive family tree' which is described in the results section of this paper.



The tool proved to be quite complicated and difficult to use at first. But, after a certain amount of perseverance we were able to use the tool effectively. The reason why we needed to learn to work with the tool was that forecasters speak a language with which we were unfamiliar and had to learn to understand. The time that we spent understanding the tool has been worthwhile as it is now used for other projects which look towards the future.

Technology Trends

There are many emerging technologies that will affect our future lives. For this project, however, we decided to concentrate on the technologies that we saw would

have the most realistic chance of success and the technologies that Philips is currently involved in. Our research into technology trends was twofold. Firstly, we gathered information from different business groups and Philips Research Labs within the company in order to gain an overview of the technologies that were being developed. Secondly, external research which focused on technology projections in Germany and Japan was studied. Our concern was not only in technologies that would be mature by the year 2005, but also in technologies which would begin to emerge at that time. The most important technologies that we considered were: improvements in computer power, software agents, voice recognition and synthesis, virtual reality, smart materials (e.g. liquids which increase viscosity in response to a stimulus), active plastics, remote-source lighting (allows light to be transmitted), light-emitting foils and polymers, global networks and telecommunications.

CREATIVE SESSIONS

The creative process began by having a series of two workshops in which 30 people participated from the disciplines of product design, human factors, interaction design, cultural anthropology, sociology, engineering, exhibition design, graphic design, and video and film.

The first workshop involved the group familiarising themselves with the socio-cultural tool and the technology forecasts. The total group was then divided into smaller groups of five people who concentrated on particular user needs that were identified using the socio-cultural tool. At this stage the socio-cultural tool was more prevalent than the technology forecasts because we wanted to ensure that our ideas were biased towards people and not technology. Each subgroup was led by a 'facilitator' who helped to record ideas, ensured that the group remained focused on their area of concentration and made certain that each group member's ideas were expressed.



A 'facilitator' and his group.

A simple paper template was created that allowed participants to record their ideas simply and consistently. On this form, participants were asked to

fill in the following sections: a title, the sensitivity and time/space relationship to which the concept related, the scenario summarised in six lines of text, the user benefits and the technologies involved.

This form proved to be very important because it ensured that not only a product idea but also its context and potential users were thought about and recorded. This was very useful at a later stage in the project when film storyboards had to be created. That fact that all the ideas were recorded in a standard format also meant that each idea was considered equally during the stage of the project where ideas had to be filtered.

The second creative workshop followed the lines of the first except that the participants were by then familiar with the socio-cultural tool and technology forecasts. The members were as a result able to generate ideas more swiftly. The two workshops each lasted for five days and resulted in the creation of 300 scenarios which described products and their context of use.

FILTER AND VALIDATION

The next phase of the project was to filter the ideas with the most potential. In order to do this a number of filters were created which addressed the scenarios and asked the following questions:

Would a given scenario provide people with genuine benefits?

Would it fit Philips major areas of competence and interest?

Would it be technically feasible?

Finally there was a 'sixth sense' or 'gut feeling' filter whether an idea was good or not.

As a result of this phase the original 300 scenarios were filtered down to a more manageable 60.

Validation

Once the ideas had been grouped they were presented to a group of experts who were able to validate them. Some ideas were at this stage discontinued whilst others were altered following their advice.

DESIGN DEVELOPMENT

After concept generation, a smaller group was selected to further develop the ideas. This group consisted of product and interaction designers who, as the products developed, tried to work together as much as possible. In reality this sometimes proved to be difficult since more product designers were available to work on the project than interaction designers. The aim at this stage of the project was to design physical models and interface simulations.

Due to the large number of diverse products that had to be designed and the number of people who had to work together on the project, it was decided to define both

interaction and product design philosophies. Generating a product and interaction philosophy was the starting point of the design phase. If we had not carried out this exercise, each product would have been isolated in its context and would have been a one off.

Interaction Design

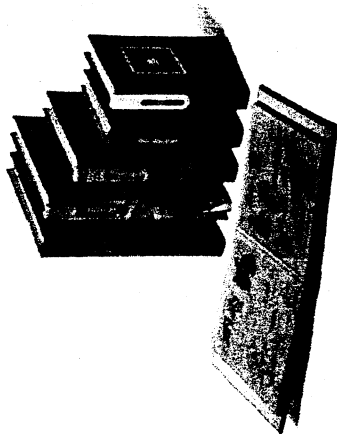
For the interaction design part of the project it was necessary to show that in the future people would interact with products and services in many different ways. This is due to; demands for personalisation and customisation, the requirements that products should be usable in different contexts and that products be easily utilised by different users. This makes future products and services richer in interaction styles. The context of the project, which was to create an impression of the future and not its details, did not allow us to pursue the interaction design of each product in depth. Instead we tried to find a way of creating an impression of what interaction with products in the future might be like. We tried to incorporate natural modes of communication in our interfaces, such as speech, writing and gesture. We were also very aware of emerging software developments such as 'learning systems'. We attempted to show how these systems would be interacted with on a domestic and personal level rather than on a work level, which is the usual focus of research. One example of this can be seen in the 'living room heart' concept which is explained in the results section of this paper.

We were also very aware of different users and proposed contexts of use that products would have. For example, domestic products, such as the living room heart, can be used in two ways. When the house is full of people and the noise level is perhaps high, a user would interact with the heart using a touch screen. Alternatively, when a user is alone, simple speech, or gestures can be used for interaction.

Product design

A simple harmonious design language that would be appropriate throughout the different types of products (for example 'children's products' to 'medical systems') was developed for the physical products.

Extensive use was made of visual metaphors, relating the designs to familiar objects, for example, watches, books and picture frames. However, for some new products there were no obvious metaphors, and for these, new original identities were created. The figure below shows a range of interactive books, which combine the traditional intimate and personal qualities of books with interactive touch screens. This approach is typical for the project, in that we chose to visualise an interface both in terms of a screen and a dedicated physical product, rather than as an application that can be used on a traditional desktop computer.



Interactive Books.

Towards the end of the design development phase we had to begin to think about the communication of our ideas. It had been decided at the beginning of the project that we would make film clips in order to show the products and services being used in context.

COMMUNICATION

In order to attain a realistic description of ideas which are not yet realised the medium of film was used. By using film we were able to not only show new products, but demonstrate them being used by ordinary people in realistic, future contexts.



Short films were made, each lasting between 30 to 90 seconds. The films show fragments of a day in the life of the people who will use one of our products or

services. This technique helped us to illustrate that our Vision of the Future was not one of science fiction, but one of normal progression in which the products around us may change, allowing people and their personal values to remain the same.

Five different film studios were selected from three countries, namely: Italy, The Netherlands and England. The purpose of working with several different film makers was two-fold: firstly no one studio had the capacity or resources to make all of the film clips in the time frame that was required (2 months from initial brief to finished films). Secondly, it was important to maintain the attention of an audience throughout the entirety of the film clips. A variation in style, provided by the different film studios, was therefore important to keep the whole viewing dynamic and fresh. We were also aware that our final audience would be extremely varied, from Philips executives to children as potential users.

Also, the different styles of the studios enabled us to pair particular products with film makers who had an affinity for the product area. For instance, sometimes it was necessary to create drama for some stories whilst others required a much more sedate approach.

THE RESULTS

This section highlights some of the designs showing the range and diversity of the concepts that were developed. The project resulted in 60 concepts that were communicated in 45 short films and about 180 different product models and simulations.

Interactive Family Tree



This multimedia family tree is an interactive picture frame which brings together existing archive material: videos, photographs, letters, names and dates with current information about the family. It organises all the material and presents family relationships. This is received and updated, through the 'family network', from other family members who have a similar device. It can also act as a reminder for birthdays, anniversaries and special occasions.

Home heart and wands

The home heart and wands replace current black box interfaces that we have in our homes today. The heart controls all entertainment and services in the living room. It is operated through a touch-screen display or by using a personal Wand, a small rechargeable hand held device which works through voice commands. The Heart also controls all major multimedia activities in the room and also the management of home functions such as lighting, temperature and security. Through the recognition of patterns learnt through use over time the Heart helps users to filter what information they need, such as preferred television channels, videophones and favorite 'video magazines'.



The 'Living Room Heart' and a 'Wand'.

Emotion Containers

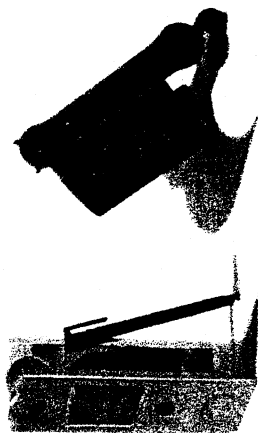
These multimedia products are designed to be given as special presents. They have a small screen, a loudspeaker and a scent compartment. Emotional Containers come in various versions to allow people to choose the one they feel would be most appropriate to give. The products are made of rich materials and are meant to last and be cherished by the recipient.



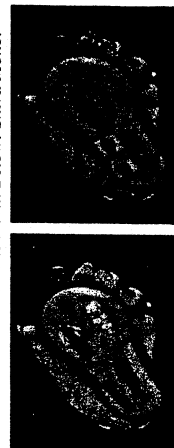
Emotion Containers offer a more sensory way of giving. They are attractive on two levels: as objects in their own right, and as carriers of messages of special significance. The future could be that you're watching an old movie 'Casablanca' and you remember your best friend with whom you went to see the movie many times. Instead of calling him up and leaving him a message, you send him 30 seconds of your favourite scene from the movie.

Shiva

Increasingly we are having to accomplish many tasks simultaneously. Contemporary life is characterised by our constant need to access information and be in touch with each other. Named after the many-armed Hindu god, Shiva is a multitasking tool which integrates communication information gathering and information. Rather than creating one uniform Shiva (or Personal Digital Assistant) we tried to show that in the future several would be available to suit diverse users and their lifestyles. Each one differs both in visual design and interface style, from the business person's Notebook which incorporates a videophone and a pen controlled business-like interface, through to the voice controlled agent interface of the Shiva Mono and the more playful, sinful, Shiva Devil.

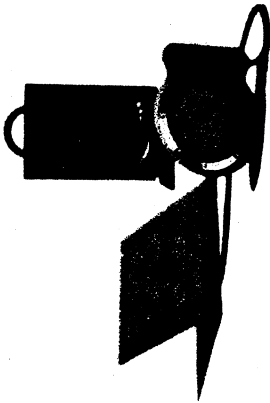


Above: Shivas Notebook & Devil. Below: Shiva Mono.



Mobile Diagnostics

As vital diagnostic equipment such as magnetic resonance scanners become smaller, they will be made as portable units. This allows diagnosis and treatment of patients in the field or in the ambulance, saving valuable time. A network link provides ambulance staff with direct access to experts and medical data from their home base. These mobile units may also be able to treat and release some patients on the spot, relieving pressure on hospital facilities and cutting the costs of unnecessary hospitalisation.

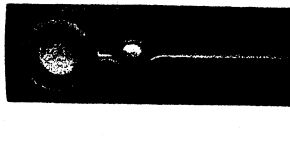
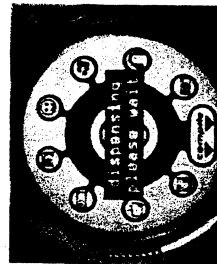


The mobile Scanner.

These 'mobile hospitals' can also act as self sufficient units, traveling to remote places to provide assistance in the cases of emergencies or to provide periodic screening facilities.

Multimedia Dispenser

Having access to vast databases of archive material and operating in a manner similar to today's vending machines, multimedia dispensers will allow people to record a personal compilation of sounds and video clips on a chip which is dispensed.



Payment for the selection is made with a credit smart card. At concerts these dispensers can be used to give audio and video recordings of performances you have just seen, together with the current 'audio-video' albums from the artist.

THE NEXT STEPS

In order to ensure that the project is communicated to a wide audience and feedback can be obtained and conversations about our future started, the project is presented in the form of: a book, a permanent exhibition in Eindhoven, The Netherlands (shown in the image below) and an Internet site (<http://www.philips.com/design/volt/>).



The exhibition

CONCLUSIONS

WERE THE ORIGINAL OBJECTIVES MET?

In carrying out this project, Philips has demonstrated its intention to explore the creation of products which enhance peoples lives. This is now beginning in many of the Philips business groups.

Through the communication medium of the book, exhibition and internet site the project has reached, and will continue to reach, a wide audience within and outside Philips. With the help of the information that was gathered in the project and as a result of feedback on the project, the Philips Business Groups are much better equipped to focus their future developments activities.

It is certain that this approach helped us to find new opportunities to develop products which would not have been dreamed of had we taken a purely technological start-point. The next step, which is inherently more uncertain, is to develop the concepts as real products, or as input to the development of real products.

The socio-cultural tool helped us to clarify what the important aspects of our future will be from a user point of view. By having this clarified vision of the future we were able to explore ideas on a more human, rather than system, level.

LESSONS LEARNED

The project had taken one and a half years to complete and had directly involved more than fifty people from within Philips Corporate Design and numerous external alliances. Some of the lessons learned in carrying out such a project are mentioned below.

Multi-disciplinary team

Many people have stressed the importance of working in multi-disciplinary teams in product development. Although working in multi-disciplinary teams is a pre-

paper, it is also very difficult. When we started the project, people from different disciplines (for example interaction design, screen graphic design, product design, World Wide Web (WWW) design, human factors, exhibition design, film directors) did not have experience in working together. Project team members therefore did not always have a clear and concise picture of who needed what information, when and in what form. It is very important to define a clear goal and iteratively and continuously describe and discuss roles and deliverables of the different team members from the beginning of the project. Furthermore, the team has to realise that it has to learn to work together and that this will be an evolutionary process with successes and failures along the way.

Testing of concepts

It is difficult to use the concepts that have been developed as stimuli to obtain feedback. At the moment a number of projects are being carried out in which the concepts are evaluated. One of the problems encountered is that the concepts are sometimes too detailed and 'finished' to evoke the sort of qualitative and 'rich' user responses in which we are interested. In future projects we need to think more about the requirements of the presentation material that we need for obtaining feedback. One of the evaluations uses the WWW as a medium. The advantage of this medium - besides the fact that it is easy to reach a large number of people from different countries and cultures - is that it is a medium that stimulates visitors to give feedback and to interact with the concepts that are presented.

Communication is the key to everything

It is difficult to carry out a project such as this in a large corporation that is organised in a large number of relatively autonomous Business Groups. The project described in this paper was carried out by a group of people from one corporate department (Corporate Design). A lot of effort has and is put in communicating the goals, process and results of the project to people in the different Philips Business Groups. 'Selling ideas' within a large multinational company such as Philips can be very difficult. It is therefore very important to develop and plan communication about the project and make the communication an integral part of the project. The Vision of the Future project is therefore communicated as well via the WWW, a book, an exhibition and 45 short film clips.

ACKNOWLEDGMENTS

The authors would like to thank all the Vision of the Future project participants and in particular, Govert de Vries, Irene McWilliam, Ron Oosterholt, Ian McClelland and Elizabeth Denby-Peirce for their support and advice in the preparation of this paper.

In this article we describe the editorial-, design- and production process of the Doors 1 interactive proceedings

About the Doors of Perseption 1 CD-Rom



Introduction

In November 1993, the Netherlands Design Institute and Mediamatic organised Doors of Perception 1 (Doors 1), a two-day conference in Amsterdam on the design challenges of interactive media. The conference was part of the ongoing Doors of Perception programme of the Netherlands Design Institute. When afterwards we were discussing the possibility of publication, it seemed only natural to produce the digital 'proceedings' of the conference. This was the first full-blown CD-Rom project by the Design Institute as well as by Mediamatic. We've made a lot of discoveries during the six-month production period and we're writing this text to share some of those insights with you. It's the story of how we did it and why. We'll do this by briefly reflecting on the contents of the Doors 1 conference, the issues dealt with and the questions that have been posed. We'll then outline our goals in making this multimedia CD. The second part of the article will consist of more general remarks about how we got started, the editorial production team and its needs and problems. Finally, we'll discuss some of the design considerations that led to this final product.

About Doors 1, October 1993

Organised by The Netherlands Design Institute and Mediamatic, Doors 1 was a groundbreaking conference at which leading thinkers from the fields of graphic and industrial design, architecture, information technology, philosophy, computer science, business and media assembled to consider the cultural and economic challenges of interactivity, the role of design in turning information into knowledge, the challenges of 'smart objects' and 'smart space' as computing and communications increasingly permeate the environment, the need for an ethical and cultural response to the \$70-billion-a-year 'digital gold rush' which is sweeping telecommunications, computing and consumer electronics, and the role of design within new forms of industrial organisation, such as the 'virtual corporation'.

Issues of interactivity are not only important in the physical world. Telecommunications and cable companies continue to invest tens of billions of dollars each year in 'Superhighways of the mind' — high-speed information networks that will deliver exponentially-expanding volumes of digital text, data, sound and images. As the volume of information available to us increases, sifting out the good from the bad, the desirable from the useless — in short, turning raw information into useful knowledge — becomes ever more difficult. It also becomes a question of design.

The questions that dictated the contents of the conference included: What is 'interactivity' and how can it be designed? How, for that matter, can interactivity design be taught? What methodologies and skills are needed for what is, by definition, a multi-disciplinary activity? The interactivity designer has a whole arsenal of new tools, including sound, light and space, but how do interactive or digital tools differ from physical tools?

Goal: Doors 1 CD-Rom

The primary goal of this CD-Rom was to capture the conference in its most attractive and valuable aspects. Apart from fulfilling the most mundane expectations one can have of conference proceedings, namely an overview of who spoke and what they said, we decided that we wanted to capture

something of the atmosphere of the event, the issues, the opposing points of view. The latter are especially hard to grasp in a conventional proceedings format. Each presentation remains imprisoned in its own rhetorical context. But as our proceedings were going to be interactive, surely we had to do hypermedia.



Our second goal, given the nature of the subject, was to come up with some innovative uses of the medium. We talked extensively about how we had perceived the event and how we might fit all these perceptions into some coherent structure. Along the way we had to abort many of our early conceptions; many ideas emerging from the first meetings proved to be either ineffective, unrealistic or impossible to merge into a consistent structure.

It was - and is - tempting to use every little trick the medium allows, but in the end designing multimedia is not about the fun of adding time, space and sound alone. It is about connections between all these tools, the effects generated by the connections, and the consequences which every single decision and solution can have for content and style and vice versa. It is actually quite easy to assemble an intimidating pile of heavy-handed effects: what is difficult is to select the best possibilities from an endless array of options, to make decisions which show a sensible and attractive consistency, and to keep design simple and lucid.

In this project it was of the utmost importance to find the right balance of editorial, ergonomic and aesthetic ingredients. Another knife-edge we had to balance on was the one between accessibility and challenge. If you make your interaction too accessible, you risk losing the users' attention. We decided we should not insult our users' intelligence, and therefore to make our interface a bit more complex and powerful, at the same time sacrificing some of its accessibility for novice users. We assumed that people interested in the subject, and in multimedia generally, would spend more than five minutes trying to figure out how the CD worked.

This conflict between direct comprehensibility and a powerful interface is something that will plague interaction designers for decades to come. Nowadays the average person in Western Europe spends the equivalent of three years of full-time training to become a savvy book user. We learn the alphabet, grammar, analytical reading, and a lot of handy conventions like page numbers, table of contents, index, footnotes, et cetera. After this period of training we are able to pick up a book and almost unconsciously get a very good idea of its structure and the quality and quantity of its contents. We figure out quickly how much time we're going to spend with it to get from it what we want. Usually it's not difficult to decide whether to buy or borrow it. We can do all this not only because of our training but also because the book is a very mature medium. All books work in roughly the same optimised way. And our culture and way of thinking are themselves determined by the way books work. This has been true for more than five hundred years.

For interactive multimedia, this development is just starting. We're trained to understand the world as a linear, diachronically coherent collection of causes and effects. Our media provide us with random access to their content, but we always expect to be somewhere on a line. We know where we are, and if we don't, we have tools to quickly figure it out and restore to safety again.

The non-linear information structure of hypermedia blows the good old order to bits. Time becomes reversible and cause and effect can suddenly switch places. We want that, because we understand that some aspects of our world are more like that. And hypermedia are a very powerful way of dealing with this. But we're just beginning. We still have to develop our tools and grow confident in working with the new media. In a sense, developing interactive multimedia is like making books for children, because we all are children. We are just beginning our schooling. We are actually children designing books for children, because we ourselves are beginning too.

At the moment we are scrambling to invent the interactive equivalents of page numbers, paragraphs, chapters, indexes, tables of contents and footnotes. We are just beginning to develop the aesthetics and rhetoric of hypermedia. We are forced to experiment as designers and as users. There are very exciting times, and they will remain exciting until far into the next century when the best approaches will have emerged and be recognised as such. And when our descendants will learn how to deal with them in elementary school.

So at the moment we cannot afford to design for obviousness. That would limit us to existing conventions. On the other hand, there is no point in pushing development beyond comprehensibility. We must compromise, especially when we are making something that has to be useful for people interested in the content of our products. This places CD-based interactive media somewhere between computer games and location-based applications such as kiosks. Games invariably have a high challenge component in their design. The player wants to master the game, but the time required to master it is actually the whole life span of the game. Once mastered, it becomes uninteresting. Location-based interaction, such as point-of-sale information systems and possibly interactive TV, on the other hand, has to deliver immediately. The user doesn't have time to learn any new skills. Or the advertiser doesn't want to wait for the user to acquire them. In designing this CD we assumed that we could expect the user to spend at least some time familiarising him- or herself with it.

Getting Started: Learning to Speak

The lack of conventions also meant that we had to work much harder during the development of the product. The people who worked on this CD all had experience in some media production field. From within our respective disciplines, we had all been professionally involved in making books, magazines, film and the like. Here, no one really knew what to expect from anyone else.

It is insufficient for a development team to work with merely a strong intuitive notion of the implications of a certain project. The team must fully grasp the entire issue in all its dimensions. It must have concrete and abstract capacities, with each individual member able to exchange, communicate and interrelate all of his or her insights and skills, as well as understand those of members from other disciplines. This way of working led to a blurring, even a disappearance, of the distinctions between traditional disciplines.

In total, nine people have been involved in this project, four of them full time for six months, others for shorter periods or on a part-time basis. 7

main tasks were: information design, editing; image research; screen design; sound design; interaction design; programming; image processing; and production co-ordination. The team members came from various disciplines including art history, journalism, film, computer game design, graphic design, media theory and literary theory.

At the start of production, communication was difficult. The individual team members all started out from their specific disciplines and spoke their own languages. It took a while before we adjusted our individual professional languages to a vocabulary that was comprehensible to all team members. For an 'image person', for example, it is difficult to attend meetings about editorial aspects, whereas the editorially talented person is confronted with a visual language he has yet to learn. And think of the trouble a programmers' language can give non-programmers! Through striving to be teachers and students at the same time, and by devoting a lot of energy and patience to the problem, we finally developed a multidisciplinary language that enabled us to communicate about the project. We feel this is an important achievement.

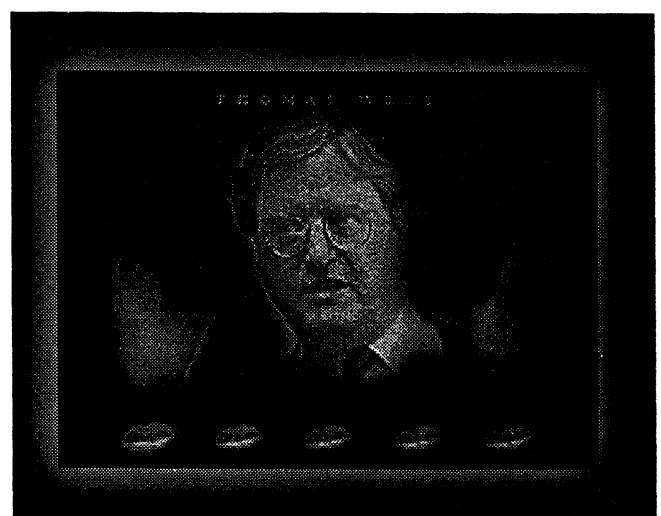
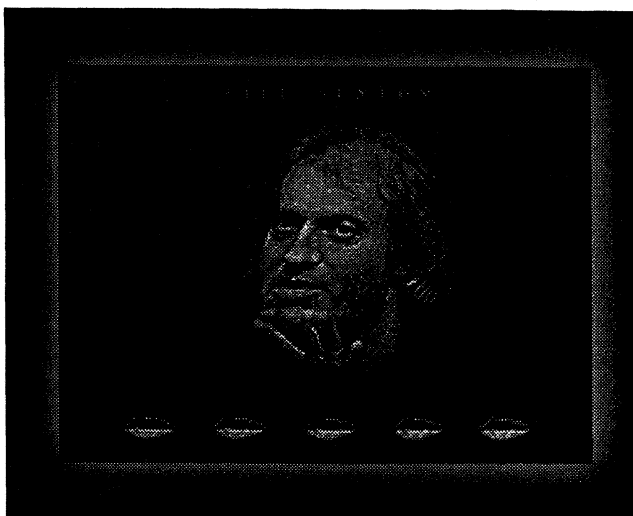
We ended up with a much closer collaboration and exchange of ideas than we were used to in productions for other media. The designers had considerable editorial input and some of the best design ideas came from the editors. Especially at the beginning of the process, we had lengthy meetings with everyone present, discussing our options in depth.

The input of our partner, The Netherlands Design Institute, especially that of its director John Thackara, has been very useful. The 'Vormgevingsinstituut' proved to be the best client we could wish for. Not only did we enjoy John's everlasting confidence and support, but we also profited from his inspiring ideas and constructive criticism.

**General Structure 1:
Speakers'
Documentation**

We ended up dividing the contents of this CDrom into three main categories. One of these is the conventional proceedings. This section contains the raw material that came out of the conference; the texts of the lectures, biographical notes about the speakers, some additional papers. We organised these on a speaker-by-speaker basis, basically providing access to the material in alphabetical order.

In this section we didn't really try to exploit the possibilities of the electronic book. There is no way for the user to make notes in the text, there are no cross-references, one cannot even copy a paragraph and paste it into a word processor. (We did provide the full text in MS Word format elsewhere on the CD, though.) This is not because we didn't think all this would have been useful; we would have loved to do it. But given our limited time and budget it was impossible. There were also design considerations



that made us choose not to use Voyager's excellent Expanded Book Toolk for this part of the CD. Although this authoring tool would have enabled u to implement a much better handling of the text at low cost, it would hav severely limited us in the development of the rest of the interface. We wanted to go further beyond the conventions of the book than the Expanded Book Toolkit would have ever allowed.

When a user clicks on a speaker's face in the Home area, a full screen portrait comes up. This portrait is not just a visual 'cover screen' for information about and from that speaker: clicking the mouth icon at the bottom of this screen enables one to hear a 'musical portrait' of each speaker. Although we couldn't resist the temptation to play around a bit with our honourable speakers' voices and physiognomies, our primary intention here was to provide clear and memorable 'images' of all the speakers. Images work better than names in helping users to recognise speakers when they appear elsewhere on the CD.

General Structure 2: The Auditorium

The second part of the CD is the result of our analysis of the material. We began looking for a way to systematically interrelate all the information v had. Soon we discovered that the material itself was not systematic at all would have been possible to force all the content into some structure, bu this would have led to a very disappointing product owing to the utterly messy character of the collection of talks. We were not the authors of the text. We were confronted instead with the task of presenting the work of very diverse authors, from very diverse disciplines, using a wide variety c methods to present their work.

So after a short period of desperation, we decided to stop trying to be faithful to the material and to the internal structure of each and every presentation. We just took bits and pieces and used them for our own purposes. After very thoroughly reviewing all the videotapes of the conference again, we made a selection of statements that we could juxtapose with others, thus taking opinions and insights offered by the speakers completely out of their original context. With these loose bits w created a discussion that never 'really' took place at the conference. Of course, at first, this idea seemed very irresponsible to us, as decent, academically trained people. But after a while it seemed only natural.

The structure we developed for organising these discrete samples of the conference is, as we have said, that of a discussion. It is a group of peop having a conversation that is very interactive: someone says something, another adds to it or perhaps strongly disagrees. Often someone brings i an idea that is slightly beside the point and others pick up on it, thus lea the discussion in new directions.

The discussion model turned out to be very powerful in establishing connections within this basically incoherent collection of utterances we were dealing with. After testing a few variations we developed a maze of disagreements, agreements and more indifferent relations — the three b kinds of relationship in any discussion. The maze is constructed accordir to a very simple set of rules: each node branches out in exactly these thr directions. After a rather intensive period of fitting all the pieces togethe and again discarding everything that we couldn't fit into the now further evolved concept, we had a system that could be explored again and aga in an unlimited number of ways, always generating a new discourse on fly.

But we had to tweak the concept a bit further. It proved, for instance, rat tricky to avoid short loops in the structure, where one would end up at t same node after a few branches, and at the same time to make it possib explore a certain discussion topic in depth without being catapulted into

new realms right away. There were no rules, just trial and error. We carefully mapped out the structure on paper (computer screens are too small for this; the flowcharts filled a whole wall in our studio), and gradually achieved the right balance. One trick we used was to divide the maze into eight semi-permeable areas centring on specific topics. Limiting the number of branches that connected these areas enabled us to forge relatively long loops without adding too much to the confusion. This also allowed us to create multiple entrances to the discussion which could be labelled with keywords.

Parallel to developing the information structure, we were faced with the challenge of designing an interface that would enable the user to browse in a pleasant and meaningful way. We've included an early version on this disc (Auditorium Sketch). It consists of a simple screen with three buttons. After listening to and/or reading a statement, the user clicks on one of these buttons: No, Don't Know or Yes. Although the interface did exactly what it was supposed to, which was to enable the user to navigate the maze, it proved unsatisfying. Being confronted with such clear choices stopped users in their tracks. They were forced to choose! Also, after having decided where to go, they often remarked that they didn't feel that what they got was exactly a disagreement or an agreement. After expressing an explicit opinion themselves, they expected something that was a very explicit disagreement or agreement indeed. Their expectations were too high for our still rather messy collection of statements. The bottom line was that users didn't enjoy playing — it felt too much like work.

The second prototype (Auditorium Prototype) is very similar to the final interface. We decided we had to present the user with a wider array of less explicit choices. To quickly test this option, which actually demanded a different information structure, we removed the three buttons of the original prototype and replaced them with an icon that the user could slide from left to right on the screen. The horizontal position of the slider would then connect to a richer array of choices that would not feel like the first prototype's 'voting' model.



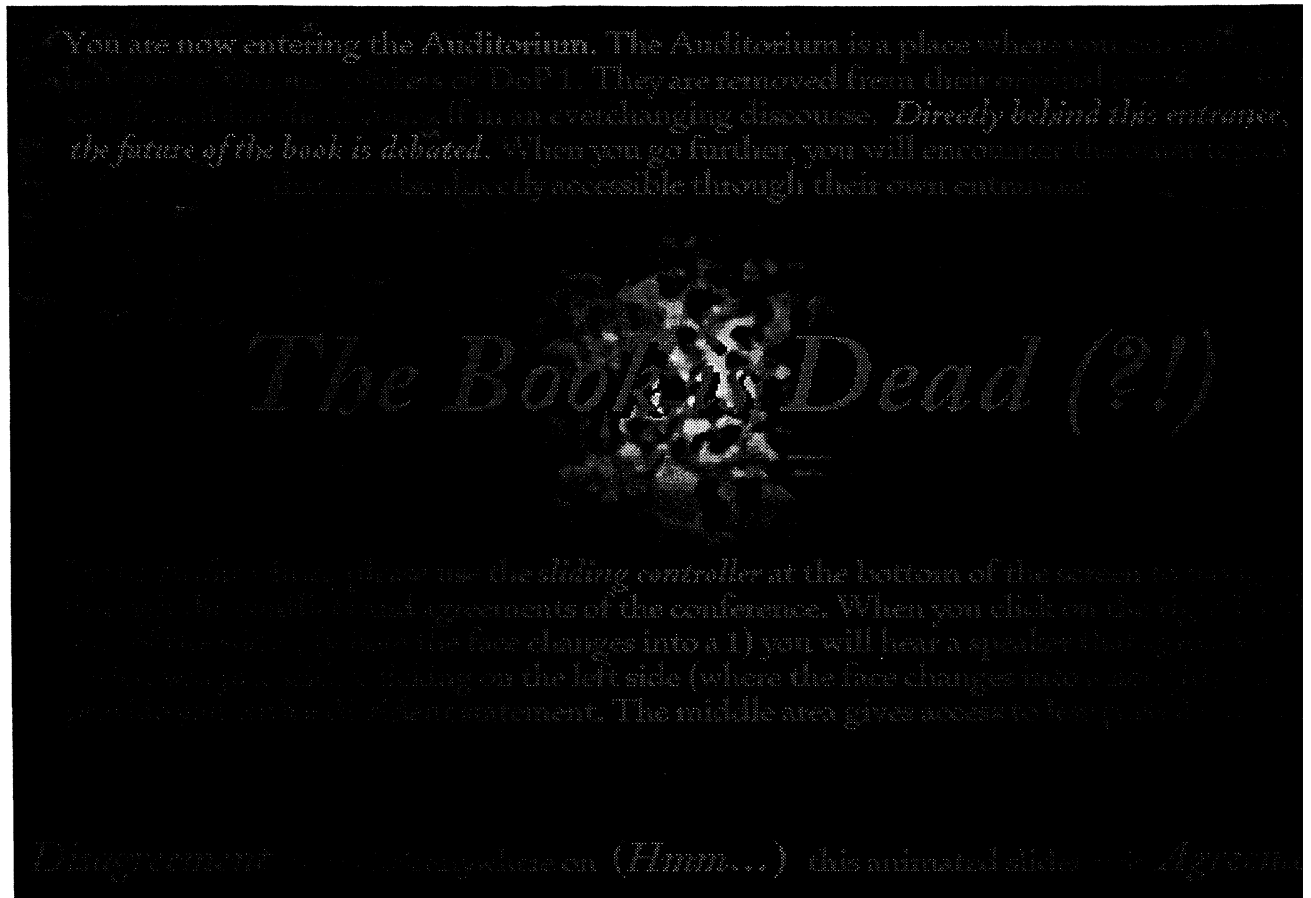
The proportional slider evoked very positive reactions from our testers. They quite liked to play with it. They were no longer forced to choose between things, but only to express their feelings or general attitude. This also made it much easier for them to accept what the system gave them.

We now had to adjust the information structure to provide the necessary multitude of choices. We implemented various solutions, adding more branches and introducing random factors into the mechanism, so that the actual probability of going in a certain direction would change according to the position of the slider.

When we began testing new versions, we discovered to our amazement that users couldn't tell the difference between them. Apparently, relieving them of the chore of continuously making explicit choices was enough to satisfy them. Our attempts to give them more control went unnoticed. In retrospect (and after two weeks of programming) we realised that this conforms exactly to the discussion model we were using in the first place. In real-life discussions, people have an enormous choice of expressions: they can say things, they can grimace, they can make approving or disapproving noises, they can express disinterest or contempt. In short, they feel they have many ways of controlling the situation. But their actual power over what their conversation partner is going to say next is extremely limited. Most people don't have that many different things to say anyway, they merely follow a

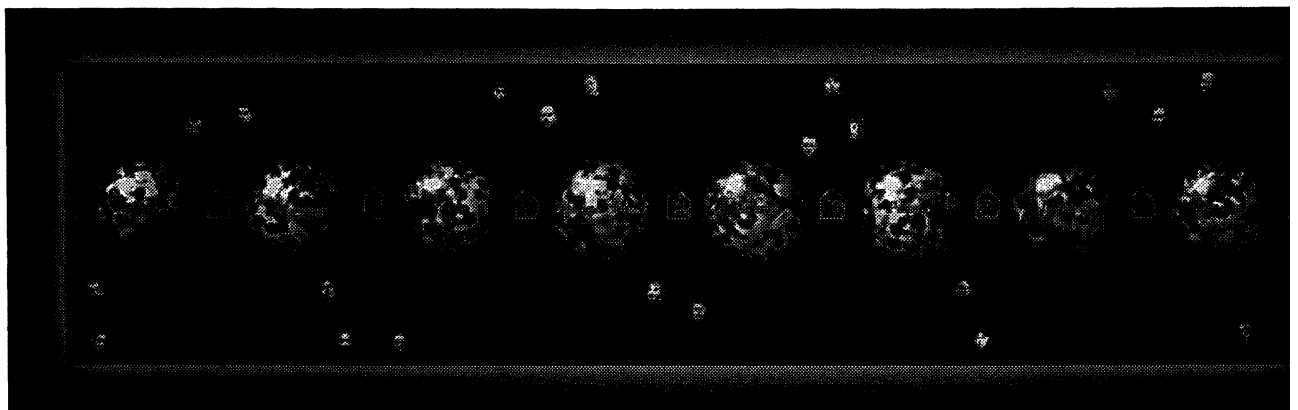
line of thought, and it is often painfully hard to change the direction a discussion is taking. Human beings are used to dealing with the limitations of other human beings, rather than with the rigid logic of a clear information structure. They (well, most of them) like that. They have other words for what we have here called limitations: words like character, opinion or culture.

Upon entering any of the Auditoriums entrances, you are welcomed with an introductory screen like this:



Home Area After deciding on the structure and interface of the speakers' documents and the Auditorium, our main task was to connect the two and provide a good way of accessing them both. For the general interface to the whole CD, we considered the metaphor of the convention centre foyer, or at least some kind of room with doors to the various other parts of the CD.

The first prototype for that room is on the disk (Home Sketch). We used a panoramic image we happened to have in our files. This first rotary interface was very striking, but visually and semantically it had nothing to do with the rest of the CD.

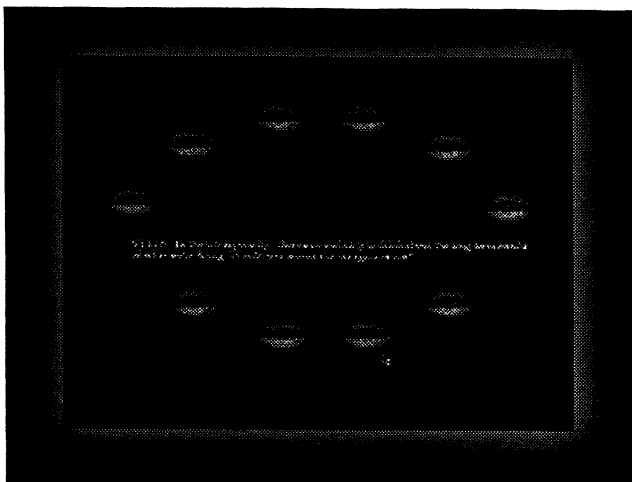


For the second version (Home Prototype) we made an indoor space that was a bit Dungeons and Dragons-like. This space, too, might have been interesting, but we didn't feel it had much to do with the rest of the CD.

So finally we gave up and decided to let go of all the figurative imagery. We went for a very simple and obvious visual index to the CD's contents, with a black background in consistency with the other interfaces.

The individual speakers are accessible through their faces and voices. The entrance to each Auditorium discussion is represented by the image of a group of people and a verbal clue to the discussion theme. And finally, bits and pieces of additional info are each tucked away behind a house icon. The only thing that stayed the same was the rotary device. This provides three times the surface area of one screen so we're not forced to divide the information up into the three categories; everything is accessible from one level. Thus the user has to take fewer intermediate steps to access a particular bit of information.

Connecting the Speakers and the Auditorium



One obvious problem in the whole structure still had to be dealt with: the Auditorium and the speakers' documentation were each very self-contained. The only way to go from one to the other was via the Home area. There needed to be a way to check out a speaker immediately when he or she said something interesting in a discussion. The obvious question, 'Who is this person?' had to be immediately answerable, without requiring a lot of systematic research. So we added a 'This Speaker' button to the Auditorium interface, thus enabling the user to bypass the Home area and immediately jump to a speaker's documentation.

Then each speaker got a screen from which the discussions could be accessed directly. This provides the user with an overview of a particular speaker's contribution to all the discussions and a way to jump back and forth between the two main areas of the CD.

Oops & Home

Realising that the whole thing had become a bit complicated, we decided to add two obvious navigational tools. First, every screen has a Home button at the bottom right hand corner, so that the Home area is always just one click away. Second, there's the so-called Oops button. The Oops button is not really a navigational tool; it's more like the undo function in normal application programs on the Mac. It does nothing more than to take the user one step back, thus providing more freedom to try things out without immediately getting lost. We found this simple approach more effective than providing full-blown backtracking.

(August 1994) last modified 14 march 1996 by WV