Visible Language
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The quarterly concerned with all that is involved in our being literate.

Sharon Helmer Poggenpohl
Guest editor

Graphic Design: Computer Graphics
A Special Graphic Design Education Issue

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Introduction to Special Issue on Design Education

graphic design

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B R I D G I N G T H E G A P • • • •

It is becoming all too easy to describe ourselves as either computerphobes or computerphiles. Given the attitude and hype surrounding computer developments, it is difficult to dispassionately evaluate its impact and significance for graphic design both now and in the future. The computer can be viewed as simply another tool at our disposal, but it would be a mistake to take it at face value. The computer represents a challenge to traditional design practice and to design educators as they prepare the new generation of visual communicators.

Designer and design educator alike have largely stood on the sidelines watching computer technology develop. It has been easy to be critical of the new medium; the colors are too brash, the typography too crude, and the image quality too coarse and lacking subtlety. We have been silent while computer scientists, electrical engineers, and mathematicians have explored and defined the visual world as presented by computer.

There are many points of entry for computer use, from fairly simple word processing applications to use of existing visual programs for design, to a deeper concern for the creation of graphic design programs that maintain or enhance visual quality and are compatible with the designer's process. Our reluctance to deal with the computer is becoming a handicap not only for our own performance but for communication within the visual culture in which we live.

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Creative use of the computer requires a strong and consistent background in visual fundamentals including the building and exploring of visual vocabulary and an intellectual systems understanding of the visual world. This visual understanding is often shortcircuited as students and faculty push to explore more *real world* design problems. Students and faculty achieve an *illusion of performance*; students see samples of typical design projects and then imitate the physical appearance of solution rather than explore the underlying communication problem. Students participate in a subtle and seamless illusion that they are *designing* a solution because the physical result looks like the pattern of solution they have so often seen. A very real product of computer graphics is the transfer of this illusion of communication performance to clerks and others who have no visual training, no knowledge of perceptual dynamics, communication theory, or understanding of the formal elements of visible language; in fact, they have nothing but a powerful tool at their disposal–a tool that will provide them with the illusion of performance directly and painlessly.

There have always been naive graphic communications (some are quite charming, even refreshing), but never before has it been possible for the uneducated to create authoritative-looking graphics. At a highly computerized newspaper advertising department, I observed individuals composing ads on sophisticated digital equipment. They were working (at least in theory) from a designer's sketch. The operator could stretch, condense, or change type size in very small increments to force copy to fit. These changes in size or letterform proportion were not global adjustments but local changes. The operator had little, if any, visual training, but was in control of a powerful tool. The designer, on the other hand, was trained visually but had no sense of the production tool that would finally shape the visual idea. The design and the problemsolving of spatial structure needs either to be more carefully and compatibly designed and specified by the designer or the typographic operator needs to understand the visual values of the designer.

Movement and understanding need to occur in both directions: the production specialist needs to understand visual structure and the graphic designer needs to understand and use new technological possibilities. An example of the latter is a presentation by John Miles of Banks and Miles in London. He understood the space-saving potential of digital technology with its ability to make very small incremental changes in type size, proportion, and set characteristics. Combining this technical knowledge with visual sensitivity to space, rhythmn, gray value, and legibility, Miles designed a format for the London telephone directory that saved an impressive amount of space. Neither legibility nor appearance were sacrificed. The final result was both an economic and a visual gain.*

The language of visual possibility is changing. Visual concepts that were formerly difficult to impossible to do are becoming routine. Visual processes formerly done with meticulous care by hand are now machine programmable. Eventually, someone will write a history of computer graphics in terms of the 'linear era', the 'planar era', the era of three-dimensional modeling, the multiple time-space era, and so on. We are retracing visual history with a new tool.

Computer graphic information abounds. There are seminars, conferences, and papers that present specific ideas, but without some general framework, it is difficult to integrate the ideas. Many of these events are merely opportunities to sell the latest equipment or to show a sophisticated visual application. The focus is pragmatic–what is it/what can it do? Design education requires another focus–what does it mean? We need another perspective on how computer graphics impact on design practice and how it can be integrated into design eduction. This is the thought behind this issue. It is organized as a forum within which various educators and practitioners share experience and opinion.

In order to provide good, reliable information, I sought out three design schools that met two requirements: they must have a strong undergraduate program in graphic design and they must have had computer graphic equipment in their department for at least a year. The undergraduate program is important in that these programs have the most impact on the profession. Equipment in the design department is critical because this avoids the intellectual and territorial barriers that exist between design and computer science. The three participating schools are: the Institute of Design, Illinois Institute of Technology, Chicago; the University of Reading, Great Britain; and the Rochester Institute of Technology, Rochester, New York. These schools are widely separated geographically. Philosophically, they represent divergent points of view. All have made a serious commitment to thoughtfully approach and integrate computer graphic capability within their programs.

This issue is a cookbook of sorts, a 'how to do it' and 'what to look out for', but more importantly, it addresses the broad question 'what does it mean.' The first section of this issue unfolds as an interview.** The interview is an opportunity to share experience, argue, and resolve differences. It serves to underscore the issues these educators are concerned with and the emerging role of the new technology within their departments. They explore what the computer can do technically, conceptually, creatively and practically.

Graduate design education is increasingly seen as an opportunity to develop research, break new ground, and try out a more risky idea. Several graduate programs actively contribute to the development of computer graphic studies from a design perspective. Selected thesis articles form the next section of the journal, providing another perspective on the new technology and its typographic and communication planning applications. Two of these are products of the Visible Language Workshop (VLW) at M.I.T. under Muriel Cooper's direction. Muriel Cooper was perhaps the first graphic design educator to grasp the importance of the computer for design and communication process. The VLW is an interdisciplinary, hands-on workshop for research, education, and design performance. Both thesis articles from M.I.T. address computer translation of visual thinking and design process.

Another thesis article, from I.I.T. examines the possibilities for dynamic (in time) typography with the computer.

Following the thesis topics is a carefully wrought computer graphic proposal for the Rhode Island School of Design. This article, excerpted from the complete proposal, demonstrates in a formal way the issue identification and position-taking needed to present a clear statement to direct the future of design education.

Finally, this issue presents a perspective from a graphic designer with 12 years of experience in publishing, who has a recent graduate degree from M.I.T.'s Visible Language Workshop. She has made a successful transition from the traditional practice of design to the practice of design using the new technology in the context of New York publishing. Her work explores computer graphics not only as a production tool but as the vehicle for a new architecture of information. The design problems with which she is engaged are possible because of the computer.

This issue examines design WITH computers; computer graphics as a new medium with its own unique style and visual appearance, as a production tool that eliminates hand work, and as a creative tool for the generation of form, the development of information in time, or the generation of visual systems. On another level, it explores design with the computer in a more general sense, as information management, design networks, and its corollary the design database.

Design FOR the computer is also touched upon in terms of computer-aided instruction, digital typography, the design of manipulation programs for form exploration, and screen design for information transfer and management.

Both design with and for the computer are played off against design and education philosophy. Attitudes toward creativity, visual sensitivity, hand skills, problemsolving, design process, analysis and synthesis, and visual systems are turned over and examined in the new framework of computer possibilities. Our task is to begin the dialogue not of what it is, or how to do it specifically, but what it means.

New opportunities are apparent in the changing context of design education and practice. Designers can choose to become tool producers by participating in the design of visual communication application programs, or by helping to develop computer-aided instruction. They need to develop more objective and clear ways to manage design processes, to access appropriate information, and to address larger categories of communication problems. By making these choices, the designer transforms his role in communication. These opportunities present the designer with a significant challenge; to redefine the role of the designer within an expanding sphere of visual communication–to bridge the gap.

*Presented at a Monotype Corporation Seminar in London, September, 1984.

**The interview was conducted blindly; the anonymity eliminated dominance of any one person by virtue of institutional or personal prestige. The questions were posed, answers received and co-ordinated; new queries made and returned to the participants. There were three rounds of feedback prior to publication. In the final round of feedback, identities were restored to the participants. This process is a kind of modified Delphi technique as developed at the Rand Corporation for the purpose of improving a group's ability to make a forecast and find concensus. This technique replaces volatile face-to-face interaction with an exchange of information and opinion via questionnaires or on-line computer communication.

I had hoped to telecommunicate with participants in the United States. This was possible only with the Institute of Design, I.I.T., which gave me an account on their mainframe for the purpose of working on this issue. Without the word processing support available on my *Apple*, this interview, with its feedback cycles, would have been an unreasonable task.

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Three educators from different universities, the Illinois Institute of Technology, Chicago, Illinois, the University of Reading, Reading, England, and the Rochester Institute of Technology, Rochester, New York, discuss their experience with integrating computer graphics into their graphic design programs. The following "conversation" took place during a period of seven months. The discussion moves between practical and philosophical issues and between a specific graphic design education perspective and a more general design perspective.

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ComputerGraphics

Graphic Design: Computer Graphics

What Do They Mean How Do They Fit?

- Charles Owen
- Roger Remington
- Michael Twyman
- **Sharon Poggenpohl**, editor

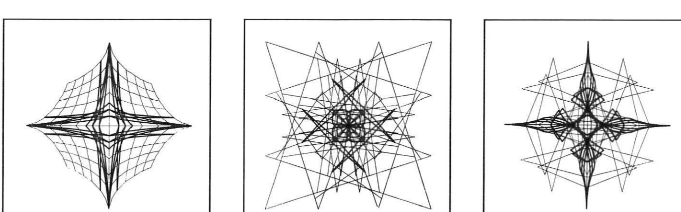
Sharon: First, let me introduce the three of you. Charles Owen (Chuck) represents the program at the Institute of Design, Illinois Institute of Technology, where computer graphics have been taught continuously since 1970. Chuck has written many computer graphic programs, some dating back to the mid '60s. Roger Remington, along with his colleagues James Ver Hague and Robert Keough, represents the program at the Rochester Institute of Technology. Their experience covers six years and includes the recent addition (1984) of a graduate Computer Graphics Program. Michael Twyman represents the program at the University of Reading, where theoretical involvement with computer graphics began around 1968 and "hands-on" experience became available in 1979.

What prompted your department to develop computer graphic capability?

Michael: The move towards computers was prompted by our seeing them as an inevitable partner in the business of graphic communication. But I'm not sure we thought the thing through very carefully in the late sixties and early seventies.

Chuck: For us, the move to computer graphics was a natural move to include graphic capability with the other computer techniques that were under development in the school. Computer graphics have always been considered as a means to an end–a better way in many cases to present or explain a result.

Roger: Personal and professional interest by key faculty together with support by administration stimulated our development of computer graphics. The Graduate Computer Graphics Program has met with a high degree of interest and was immediately at capacity enrollment.



An image in a grid is used to generate unpredictably new forms. **Illinois Institute of Technology:** Charles Owen, Deform program.

What were the basic problems in determining a strategy for developing computer graphic capability within your school?

Roger: It was not so much a problem of strategy as it was a matter of obtaining hardware–even dealing with the diversity of hardware available. We did need to develop a more homogeneous conceptual attitude. Some of the basic problems were no resources and limited local and national faculty. The strategies included developing faculty, space, administrative support, hardware/software, and curriculum. The facilitation of two major national conferences on computer graphics at RIT enhanced our development.

Michael: Lack of funds and our own ignorance of the field, in that order, were basic problems for us.

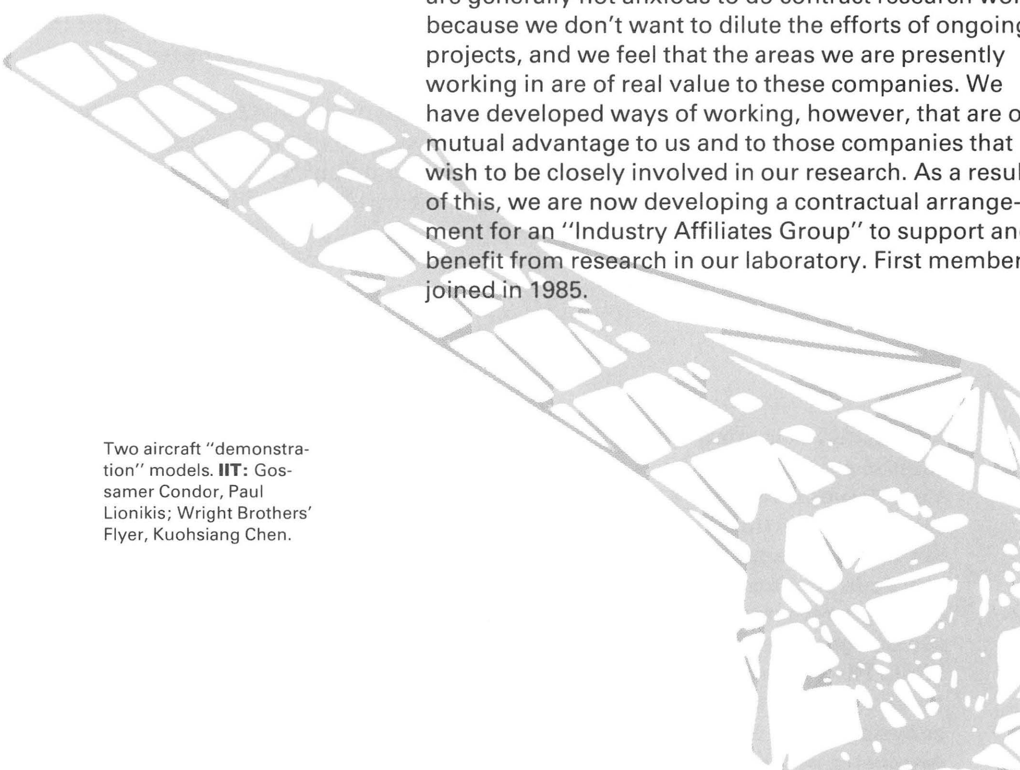
Chuck: I can't say that there have been any problems, primarily because we didn't sit down with the intent of introducing computer graphics broadly and all at once. The capability came naturally with faculty members that wanted to work with computers and the good fortune that computing power was made available campuswide in a very open way. What difficulties we had obtaining computer graphic capability came at a time when plotters were the only real option. We overcame that problem by treating it as a campuswide need.

Access to computing tools is a necessity. Your departments were selected to participate in this issue because you have succeeded in getting computers in the design department. While I don't want to dwell on equipment, securing good, often expensive computers is not easy. What has been your experience in getting hardware and software donations? How do you get your leads? Are there no strings attached?

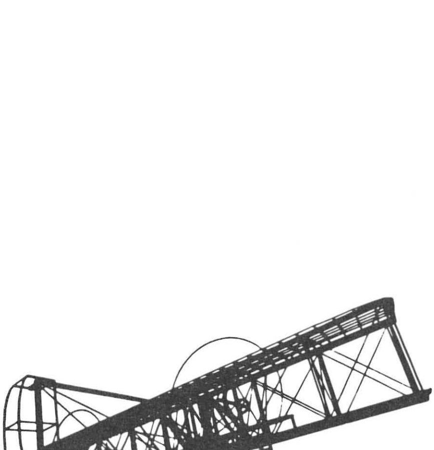
Chuck: We have had approximately one million dollars in equipment and financial grants. Each company is different in its approach to donations. Small companies have more difficulties than large ones, particularly when their product is an expensive one, but some large companies have such complex policies that they are as difficult to deal with as the small ones. In general, all companies want to know that their donations are going to be used effectively; and most want some tangible return for their largesse (Hewlett-Packard and IBM are notable exceptions here).

We had to create the justification for a company to become involved with us, either because our record of achievement was worthy of a philanthropic donation or an association would simply be good business. This meant that we had to be doing things that a company was interested in. This covered a wide range of possibilities. On the basis of fifteen years of work in the field, we put out our first proposal in 1980 to Hewlett-Packard. In the proposal we explained that we felt that the work we were doing had a wide range of application in disciplines employed by HP, well beyond the product and visual communication fields we cover with degree programs. We also showed a number of benefits we felt they would enjoy from an association with us. After a year of presentations and discussions, we received our first major grant from HP, which inaugurated the Design Processes Laboratory. Donations from Digital Equipment Corporation and Amdek Corporation quickly followed. Contributions in both equipment and cash have continued annually since 1981.

What we do with companies varies widely. We are generally not anxious to do contract research work because we don't want to dilute the efforts of ongoing projects, and we feel that the areas we are presently working in are of real value to these companies. We have developed ways of working, however, that are of mutual advantage to us and to those companies that wish to be closely involved in our research. As a result of this, we are now developing a contractual arrangement for an "Industry Affiliates Group" to support and benefit from research in our laboratory. First members joined in 1985.



Two aircraft "demonstration" models. **IIT:** Gossamer Condor, Paul Lionikis; Wright Brothers' Flyer, Kuohsiang Chen.



Michael: There isn't the tradition in the UK that there is in America for computer companies to make donations. Despite numerous overtures over a long period we have been singularly unsuccessful in attracting gifts of equipment.

Roger: You must define what you want to do. Our Genigraphics contact was made slowly through a series of meetings–building an understanding, rapport, and credibility between faculty and the contacts. The Artronics conference held at RIT proved to be a good place to find more connections and leads. Computer companies (Apple, for example) make large donations to educational institutions, but it is important to have special strategies in the approach to these organizations.

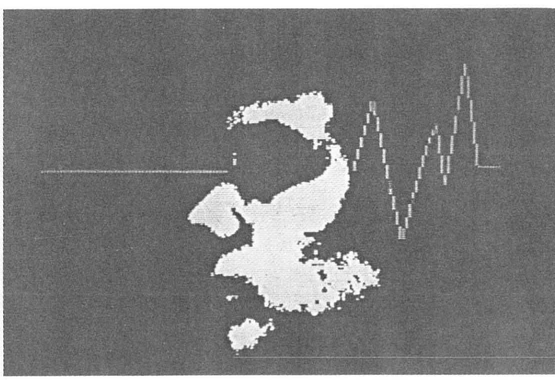


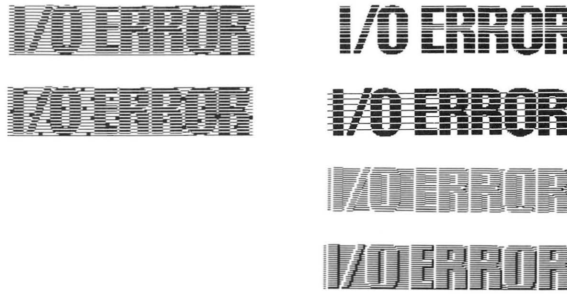
Image scanning, 2D drawing, and other computer graphic manipulations. **Rochester Institute of Technology:** Robert Keough, instructor.

Based on your experience, what are the essential elements to consider prior to acquiring hardware?

Michael: What we want to use it for. In an educational context I would say the following: capability, user friendliness, compatibility with other systems in the institution, and quality of graphic image.

Roger: Software is more crucial than hardware. First, consider your objectives in using computer graphics; what do you want to do, then identify the software and find the equipment with which it is compatible.

I/O ERROR

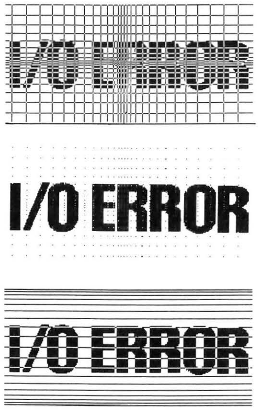


I/O Error, a logotype created for a computer graphics publication at RIT, was created totally on-line. **RIT:** Craig Malmrose, MFA candidate.

Chuck: Maintenance should be included in the fundin established to buy a system; a maintenance contract with the supplier or manufacturer is just about a neces sity. Another problem is who is going to take care of the equipment, develop new uses, and teach students the nuances of use. Too often this is the faculty—perhaps a serious mistake. Faculty should have overal charge, but staff should be hired to operate, supervise and provide day-to-day help for students. Staff suppor frees the faculty from myriad annoyances that detract from true faculty responsibilities. It also prevents territorial restrictions that can develop, whether intentional or not. Security may be a problem, depending on the school—especially now that so much power can be put in a small box. I remember visiting a campus in the 1970s when the design department's computer had been stolen just before I arrived (it was returned when the students who had taken it couldn't program it well enough to use it!). Expectations can be high, so preparation should be done to make sure there is something that can be done with the computer/s when they arrive. Some software is available, but so much of it is either trivial or awkward for design use that a real effort may be necessary to find startup programs. Writ ing your own is a good answer, but I'll come back to that later.

Michael: We cannot afford to pay maintenance contracts even on the equipment we have at present. If we entered into contracts there would be nothing left for anything else. The more general point about care of equipment is certainly worth emphasizing. We try to "make do and mend" with the help of our Computer Science Department and Computer Centre.

Security is also a problem, but only in relation to breaking and entering. We aim to create an environment in our Department that rests on trust and responsibility. I hope this will always be so!

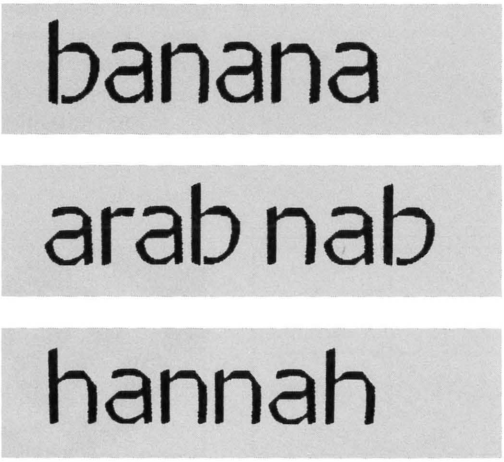


Chuck: Let me be more specific about maintenance and address the security problem too. For our costly equipment, we have maintenance contracts which tend to run 5 to 10 percent of the purchase price, so we do not have contracts on everything. In some cases, where we have multiples of equipment (low-cost items), we either fix it ourselves or cannibalize parts. Our laboratory manager is extremely good at trouble-shooting and repairing equipment, fortunately!

Security has not been a problem. We have most of our equipment in rooms that have to be entered from other rooms–so there is no easy "grab and run" path. We treat the laboratory as a resource for the school and work hard to provide as much access as possible; there are students around most of the time. In three years of operation, we have had only one case of damaged equipment, and that was accidental. One theft of a modem turned out to be a "loan" when we passed the word among the students that it should be returned.

What materials, people, and conceptual understanding are important to getting started in computer graphics?

Michael: Any start in computer graphics is best made in relation to some real communication problem. Some things about design–and some of the most important–can only be learned by designing. I would therefore try to create a situation in which the role of the designer in relation to computer communication is brought out in some way. I get rather tired of the use of computer graphics as a plaything.



An original typeface, designed and digitized using a type drawing system developed by Richard Southall. **University of Reading:** Jonathan Coleclough, student.

Roger: Take a practical approach: first develop formal visual design skills, then develop an open, receptive attitude toward computer processes and equipment, and then, as technology gets more sophisticated, develop more emphasis on basics.

Chuck: The key is people. With good people, all is possible. First you need a designer who knows computing and can write application programs. He will get something going, even if it means using the general university system and other laboratories. Eventually, he will find the means to get the right equipment and software (if he doesn't write it himself).

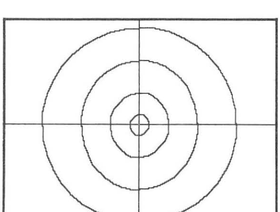
A system can start small with a microcomputer and a plotter for output. Students can learn to program in the general university classes. If no equipment is available for the department, the general university system usually will have some form of graphic output.

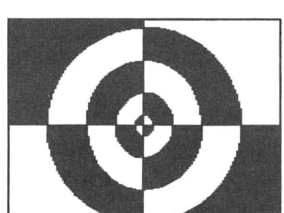
Programs are hard to find as yet, but drafting is a possibility and paint programs abound. A major difficulty may be the shallowness of some of the software (paint programs do get old after a while). This is where a good faculty member and some persevering students may be able to contribute by gradually building up some software to do the things of greater specialized interest.

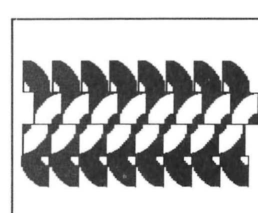
In general terms, what impact has the computer had on your department?

Roger: The new technology has generated a high degree of student interest from freshmen to graduate majors. Computer activity is expanding within the college to include the foundation program. The Graphic Design curriculum has a mainstreamed computer graphics emphasis from sophomore through senior years. Typography is a major focus in the middle years with seniors having greater access to the equipment and flexibility in its application.

Our objectives are threefold: to integrate materials taught on different levels, to use the tool both as a





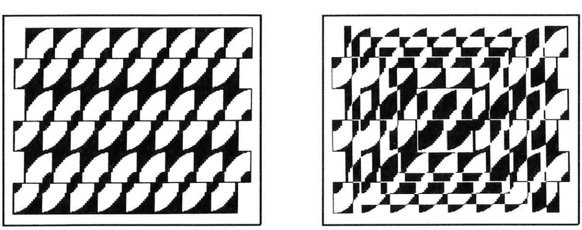


complement to traditional skills and for its unique capability, and to be responsive to changing needs in the field.

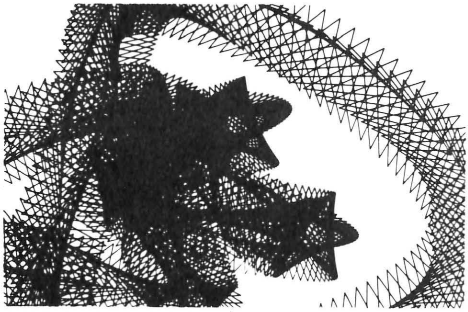
Michael: Over the last few years the impact has been considerable. It can be calculated not so much in terms of what equipment we have acquired and what we have actually done, as in terms of forcing us to rethink our position on a number of issues. In particular, it has sharpened our commitment to study graphic language across technological boundaries and reinforced our belief in the importance of the intellectual and managerial aspects of design. In practical terms the impact has led to all students being given hands-on experience of terminals and the design of information on them the first year of their undergraduate course.

Our major educational objective is to develop logical methods of working. There is also the more general issue of demystifying computers....In terms of vocational objectives it is clear that all those intending to involve themselves with typography must have an understanding of computers as they relate to text-handling systems.

Chuck: Because we began 20 years ago, the impact in development has been subtle. In the beginning there was general resistance among students to using computers–we had to require courses or really sell them to recruit students. Over the years there has been a gradual increase in the use of computing in courses. The university began requiring all students to take a programming course in the early 1970s, and slowly but surely we have added computing capability in a number of courses. Undergraduates now may take nearly a dozen design courses that in some way use computers, all the way from canned processes to program writing and actually building microcomputers for design applications. In essence, it has been an evolution rather than a revolution.



Software package with an "electric" cut and paste operation creates repeat pattern from original design. **RIT:** Norm Williams, instructor (Freshman).



A program for studying forms of motion created in two dimensions. **IIT:** Cross, Charles Owen; Star, Marshall Chanzit.

How can designers adapt or prepare themselves for the new design environment?

Roger: Professionals need to look to new opportunities for continuing education. We need to spend more time on conceptual skills, and idea generation. There needs to be an attitude of openness and acceptance; without this it is hard to receive the benefits of new learning and growth. These benefits–cost saving, doing a job better, and better communication–are elements for which a good design firm looks.

Chuck: How a designer prepares himself depends on his age. Students coming through the high schools today are learning to program computers. For them, the issue is what next now that they know how to program and use a computer. For designers who left school before the computers arrived, there are more barriers to remove. I think that the "fear of computers" is not as great a bugaboo as we have been led to believe, but there is the problem of learning to use equipment that younger people with less seniority already know how to use. For senior designers, the problem is similar to that of managers generally–being a neophyte in public is difficult. A good solution is getting a personal computer and using it at home to come to grips with the major ideas; the cost is justifiable for the increase in word processing productivity alone.

Fortunately, the software available for designers is still not significant, so anyone choosing to learn about computing today is not far behind. On the other hand, the lack of software is in part the result of the failure of the design community to become involved in producing its own. There is a great need for designers who are expert programmers and able to think about these problems of design in ways that can be translated to software. Preparation of this kind has the potential for real financial reward in the next decade.

When will there be a sufficient library of graphics software for the designer to use the computer fluently? Have you any ideas for making graphics software more readily available now?

Michael: This is a crucial issue and it is why I believe the sort of people we take in our course (typography students) should be taught programming. Clearly it will be years before the software on the market caters for all the needs of the community. Market forces will lead to the satisfaction of the most widespread needs, and government might satisfy some others, but traditionally–and I don't see this changing–graphic communication has been concerned with countless minority needs. It seems to me that many of these will only be satisfactorily sorted out if dedicated designers take the trouble to write software or modify existing software to meet their standards. The alternative would be for some charitable institution to put up the money for such work to be done under the direction of the designer. The sorts of things I have in mind relate to niceties of spatial distribution. It has been hard enough to secure them in traditional printing/publishing; I can't see them being considered in minority areas of the new technology unless some designers become directly involved with software development.

Roger: We are optimistic and 1990 sounds good to us. There are already collectives. We need to interact with existing software and re-market their products. Economically speaking, widespread use would cause prices to decline. Right now everyone would like a Sci-Tex at the cost of a MacIntosh.

Chuck: Exactly! If you have the money, there are some fine systems available today. For the graphic designer, the Sci-Tex system will do most of the things done in composition and production, allowing an operator working at a terminal to combine photographic images with type and images created manually and scanned in or painted in directly. Graphic arts procedures are incorporated in the system and the output is plates ready for printing. Other systems for CAD are equally good for product designers, engineers, and architects. The problem is cost. Hardware to do high-quality color work is still expensive, and sophisticated software is also prohibitively costly at this time. The good news is that capability is going up while costs are coming down. For the first time, hardware/software packages within reach of the small office were offered in the

summer of 1983. These packages offered color graphics in the medium resolution range with plotter output and software to do two-dimensional drafting for ten to fifteen thousand dollars. Paint programs are also available at low cost. Programs specifically written for graphic and product designers still do not exist–or are well hidden (we have a few for sale that we don't advertise, for example). Part of the reason for this is that there is no perceived market yet.

Software companies have not seen a design market because it hasn't existed. Few designers have experience with computers; many still do not trust computers; and, except in larger corporations, few have had the money to spend for a system that might be able to help significantly. Given the opportunity to choose a potential market, the software companies have chosen to develop graphic programs for applications in areas where their efforts would be rewarded economically. What we can probably expect to see, since our applications require their own special development, is the same kind of evolution that took place in the special areas of science and engineering; important steps will be taken first by designers programming (or specifying programs) on their own. The software industry will expand on these when they see the market interest.

A potential supply for programs exists in the universities as researchers develop new software. Two graphic programs were extended to commercial use at our school last summer, and a third is nearing completion. These are specialized to the creation of certain classes of images–something that designers can do better for themselves than others can.

As we discuss software, we bump head-on into the question of whether graphic designers should learn to program. What do you think?

Roger: It is beneficial but not necessary. It is essential if you wish to develop your own software. It assists in logical thinking and makes a more capable designer.

Michael: There is some mild difference of opinion on our staff. My response relates specifically to our students, who are supposed to have a strength in typography. I would not argue the point in relation to all graphic designers. But I do believe all our students should have some instruction in programming for the following reasons:

1. Some involvement with programming leads to better understanding of what computers are about.

2. Programming provides a good training in clear thinking and therefore has some general educational benefits.

3. There is a need for typographers who can write software.

However, I don't believe all our students will become skilled programmers. There should be sufficient instruction in the field for objectives 1 and 2 to be achieved. Some students will wish to go further than others and the hope is that they will satisfy objective 3.

Chuck: This is relevant only to the generations over 20 years of age (or, to be more conservative, those over 14). High schools are teaching programming and many colleges and universities are (as we are) requiring all students to learn to program. For those who never learned, the question has to do with how much they wish to be involved. You don't have to know how to program to use graphic programs, and software will continue to improve to make it easier for the novice to be rapidly productive.

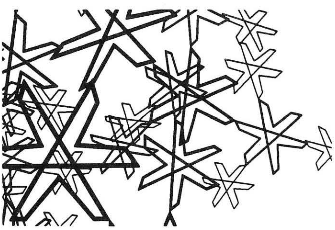


Fig. A

Michael: Your comments might be true in relation to America, but they do not apply equally to the UK. We do not find many students entering our course with programming skills.

Chuck: It is true that all cannot become highly skilled; however, it is very important that some designers become expert programmers to become involved in design applications research and the creation of design software. Finally, since it's fun and creative people do the most creative programs, why not?

Fig. C

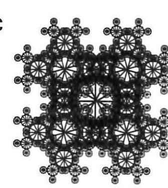
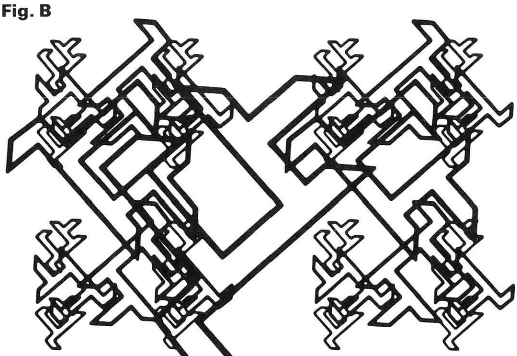


Fig. B



Complex forms developed by "growing" images with seed forms and rules for reproduction (Growth). **IIT:** Fig. A, Alonso Miranda; Fig. B, Constance White; Fig. C, Christopher Nemeth.

Let's take a closer look at some of the philosophical issues surrounding design education and the computer. For example, what do you think is legitimate use of the current technology?

Chuck: I would like to say all things are legitimate, but that would have to presume high quality hardware and software. Most schools do not have enough good equipment to justify a great amount of time with computer graphics. To the extent that students learn about computing and have some appreciation of computer graphic possibilities, low-quality systems are appropriately used. If an inordinate amount of time is spent with equipment of this kind, however, something else in the curriculum must be sacrificed–unwisely. If the equipment is good, then more time can be used well because issues of sensitivity can be brought in that will not have to be taught in other courses. Legitimacy, in other words, is not so much an issue of content as it is an issue of quality.

Michael: There is a lot of sense in that. It worries me that our students will be exposed to such "low-level" devices (for a few years at the very least) and so run the risk of becoming immune to their visual infelicities (in particular, their crude letterforms and letterspacing). It is all a matter of amount of exposure and counterbalances. We introduce students to computers as design tools and communication devices; but at much the same time we involve them in setting type by hand and looking at examples of fine printing and inscriptional lettering, to introduce them to images of visual quality. At a later stage, as output devices improve, this dual approach may not be so necessary.

Below: An example of inscriptional lettering (from a 19th century French manuscript) is contrasted with Neuland, a typeface designed by Rudolf Koch and digitized using a type drawing system developed by Richard Southall. **Reading:** Marcus Cole, student.

Right: Nine modes in which an artificial intelligence program under development (Walter) will be able to help the designer. **IIT:** Charles Owen.

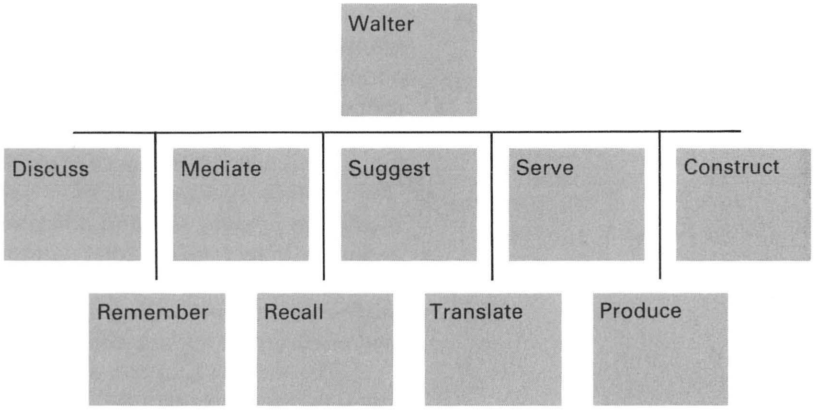
We can push this idea a bit further. When is it not appropriate to use the computer?

Roger: The usual design criteria of time/cost effectiveness and capability to communicate what you need to say visually apply; it can be evaluated like any other tool. It is not appropriate when it cannot solve a particular design problem.

Chuck: It is probably not appropriate to use the computer extensively in foundation training. There are some very good uses at this level, but it may be unwise to eliminate too much of the hands-on media and material experiences. Otherwise, it is not appropriate when there are better ways to do things or it is too hard to use the computer. These are not permanent conditions, and it is part of our responsibility to remove them by improving computer-supported processes and inventing new ones.

Faculty and student research (at the thesis level) are our primary means for exploring new computer uses. Most Masters level theses are involved in this effort, and our "Walter" project provides a means for structuring the relationships among them.

"Walter" is a major faculty research project. It involves the design of an artificial-intelligence based system to act as a research and production assistant for the designer. The system will discuss problems, suggest and provide design tools, remember and recall information, mediate conversations with other designers over computer conferencing link-ups, translate data from one form to another, help the designer to build new computer tools and aid in the visualization of concepts.



What specific design skills does the computer sharpen?

Roger: It tends to sharpen all skills, especially the ability to examine a visual problem more rigorously because of its time-saving drafting aspects.

Michael: I suppose it might sharpen the analytical skills of the designer, but it may also lead to a neglect of the human relationship aspect of designing. I start from the premise that design has to do with human needs. Effective design usually involves a lot of interaction with people as part of what has aptly been called the "twig gathering" stage of the exercise. This is a prerequisite for entering the analytical and synthetic stages of design. Design also involves getting feedback from people at various stages. My fear is that these essential stages in designing, both of which involve people, might be undermined by a kind of "electronic umbilical cord." There is no reason why this fear has to become a reality, but in my view it will do so unless we recognize a potential problem and do something about it in terms of defining these human stages in designing.

Chuck: Assuming the full range of computer use, programming as well as use of programs, the use of computers seems to sharpen design skills related to analysis. In the area of sensitivity, I don't have enough evidence to make any real judgment. One hypothesis might be that because the computer permits the fast generation of alternatives, sensitivity would increase through continual exercise of judgment. There is the counter hypothesis, however, that sensitivity decreases with distance from the end media.

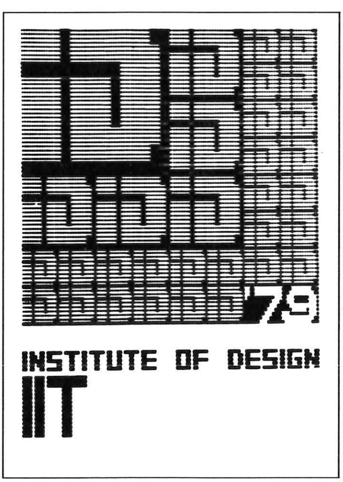
In what ways does the design process change because of the new technology?

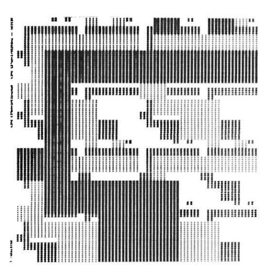
Michael: This is the fundamental question for the educationist. Clearly the basic issues and some of the procedures stay the same. The problems are not going to change simply because we have computing facilities; there will still be users of different kinds to consider, different circumstances of use, different communication objectives, and different constraints of cost and time. In fact the greatest danger might well be that we begin to lose sight of what designing is about simply because these exciting new tools have come along. We must remember that they are only tools.

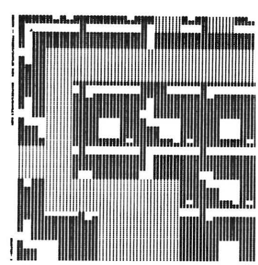
There are, of course, areas where computing is going to affect procedures. The most significant of these relates to client participation in design, such as the author undertaking the initial keyboarding, scholars doing their own "graphics." The reduction in the mark-making aspect of designing is going to lead non-designers into thinking that there is nothing to it and that they can "do their own." Quite apart from this, the new technology is going to change the very structure of the design world since the most sophisticated facilities are not going to be available to all. This is an issue that has to be addressed both in global terms (the Third World) and in relation to small design practices in the industrialized world.

Roger: The process does change; the designer can focus on process and conceptual development. In a sense the removal of traditional hand skills which are now present in the equipment, speeds up the idea development process leaving no time-outs for mental rests. It also changes in terms of practical things such as faculty attitudes about buying into a more systematic approach.

Chuck: Considering just the graphic end of the design process, an obvious change is the ability to generate alternatives easily and revise them rapidly. The ease with which this can be done, incidentally, creates its own problems of how to select and direct the process of alteration effectively. Emphasis within the design process can shift to issues of meaning, concept, and purpose with major gains possible in the quality of the work.







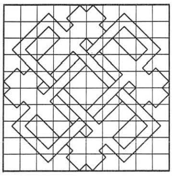
A "poster" program uses the computer utility as a printer. Gray scales are created by overprinting characters on a standard line printer. **IIT:** Poster, James Montague; Images, Charles Owen.

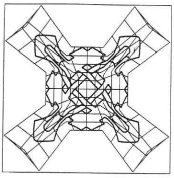
Michael: I'd like to take up the idea of "speeding up" raised by all of you. This has undoubted benefits of the kind you outline, but I also believe it presents some dangers. It seems to me that there is some value in having "gestation periods," that is, intervals between stages of designing to allow critical judgment to take place. Such stages often occur naturally in hand work, and are not at all inconsistent with this use of computers. But it may be necessary to build into design procedures stages that recognize the need for decisions to be taken in a more relaxed way. Ironically, the very fertility of computers in terms of throwing up variant approaches adds to the load (and probably slows down designing) at the decision-making stage.

I'd like to push further with these ideas. Can we equate quantity of experience—many quick images that we edit—with the quality of more slowly making careful visual decisions because we are well aware of the energy invested in the images?

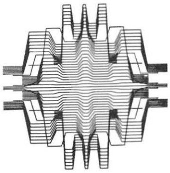
Chuck: We have both possibilities with a good computer system. On the one hand we can generate variations automatically, using algorithms to vary parameters (numbering in the hundreds for sophisticated form-generating procedures). Editing, in this case, is selection; but it could include subtle manipulation of parameters. On the other hand, visual editing systems that mimic or extend hand operations make it possible for the designer to take infinite pains in direct alteration of the image.

Maybe the issue really concerns the incubation that occurs when the process must extend over time. We tend to take all the time we can under any circumstance. Using a computer doesn't change the time I spend, but it does let me cover more possibilities and work with them in greater depth. If I have more time, I usually gain greater insight, and the ability to generate variations tends to prevent fixation.

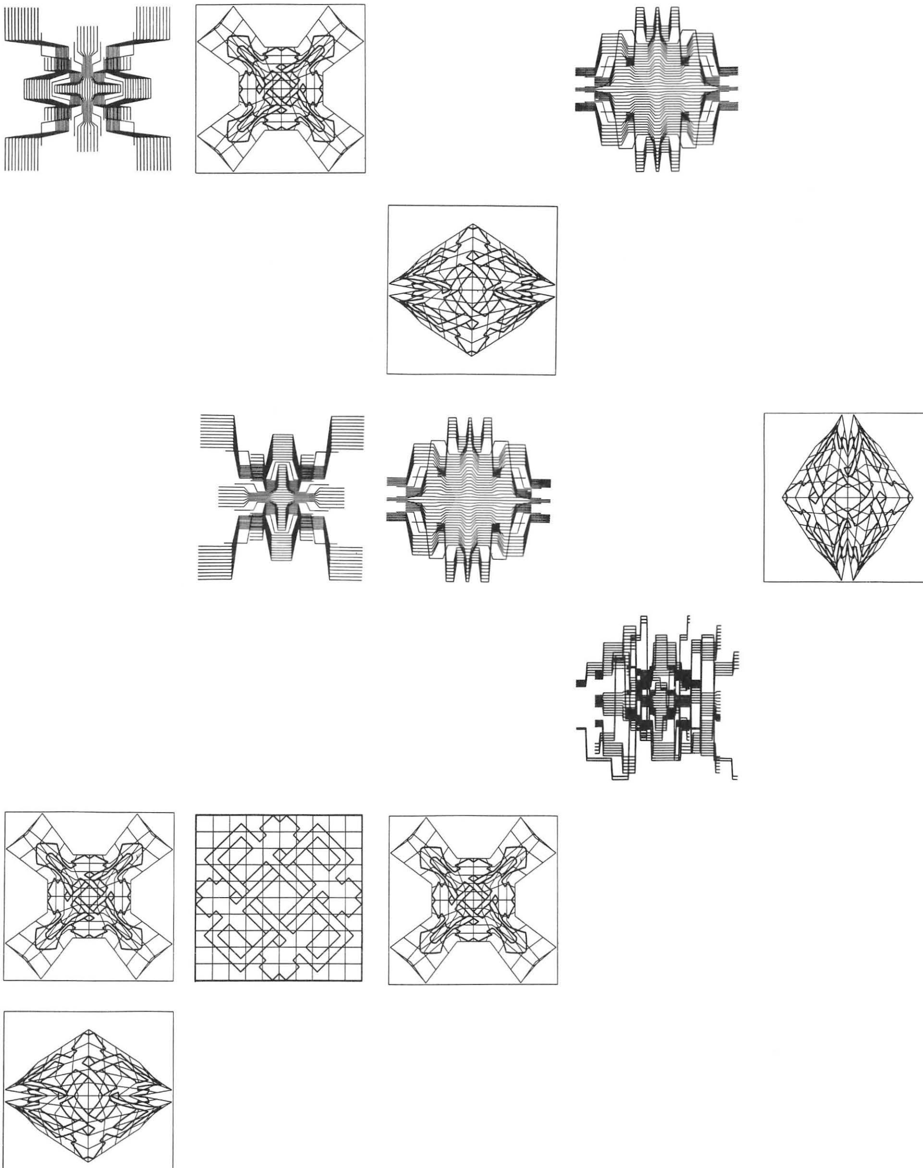


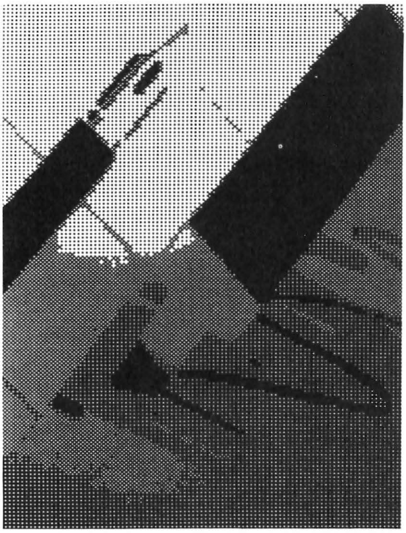


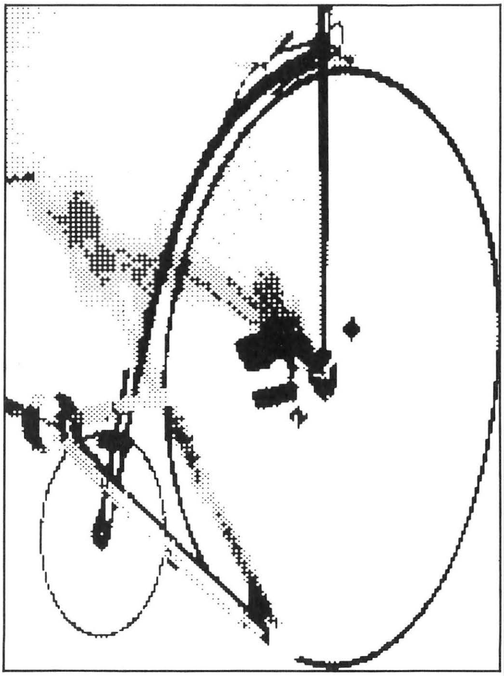
Subtle manipulations of two images using Deform.
IIT: Charles Owen.



Michael: Speed may well be an advantage at the exploring of alternative stage of design, but consideration of alternatives and decision-making take time and will often involve getting reactions of the target audience. This stage is not at all conducive to speeding up, though there will clearly be a temptation to apply the same notions of efficiency to it as to the exploring of alternative stage.







A video signal was used as input and manipulated.
RIT: Robert Keough, instructor.

What new sensibilities does a designer need?

Roger: Visually, none. Concepts of organization remain the same. Existing problemsolving skills need to be sharpened....Certainly an openness to technology and what it can and cannot do is important. The designer must be able to outthink the designated function of software.

Michael: Designers will probably need better developed visual sensibilities. The reason for saying this is that they will have to make visual judgments without quite the same support as they have had in the past from "traditional values." Experience has shown that appalling decisions can be taken by people with computing and related skills who do not have their visual sensitivities sufficiently well developed.

Chuck: There are some good analogies here to what designers have been faced with through the development of photography and even the general explosion of materials made possible by modern materials science. When anyone can "take a picture," what makes a good photograph? When you have a wealth of materials to choose from, what is the "right" material? What is the proper form for plastic? We have already seen the endless, eye-watering bombardment of "computer art"–still so apparently awe-inspiring that no one has had the nerve to ask the obvious questions: is it art? Is it good? Designers are, once again, going to have to look deeply to what determines good design. Sensibilities are developed through deep knowledge; the ability to judge resides in experience enlightened by the insight of understanding. Because it will be so easy to generate images without thought, it will be a thousand times more important to be able to "de-generate" them with thought.

Michael, would you agree that computer limitations begin to function as value limits and that without visual training the user accepts these limits rather than search for a new approach or a more refined manipulation of what is presented?

Michael: Yes. I have made the assumption that present constraints in computer use impose "value limits" as you call them that are different from the "value limits" of traditional communication technologies. Our sensibilities when using traditional technologies have been shaped by years of experience (both individual and collective). In the field of computing, visual judgments will have to be made in relation to issues for which there are no real precedents and no accepted values. In my view, only someone with well-developed visual sensitivities will have the understanding and confidence to challenge and to change "value limits" in order to improve graphic communication.

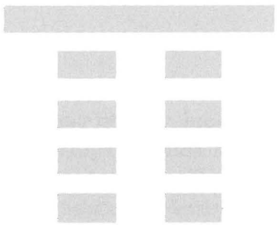
Do you think the computer and its graphic capability are compatible with virtually any visual communication problem? Will it replace the traditional drawing board and hand skill operations?

Roger: Yes, virtually any visual communication will be programmable and eventually it will replace traditional operations, i.e., technical skills, but it will never replace the creative dimension.

The computer has a tremendous value as a production tool. Methodologically speaking, our undergraduate program will need to be reshaped to coincide with this opportunity. In a few years, with the availability of computers growing (in reference to demand and price decrease), a majority of the public will have computers. Seven or eight years ago microcomputers were barely hitting the market and today, with the capabilities of the MacIntosh, it is hard to predict what the next ten years will be like, particularly given the interest in artificial intelligence and the decrease in cost.

Michael: We are running a three-year British Library–funded project on this particular issue as it relates to what we call verbal graphic language. In short the answer is not yes but no! At the moment the lack of characters (foreign and other sorts) and alphabetic variants (italics and bolds) is a distinct drawback, so too is the inflexibility in spacing and the low resolution of most systems. No doubt all these problems will become less acute as the technology improves, but I imagine there will still be the overriding problem of inflexibility of format.

Sample from an alphabet for use in Greek word processing. **Reading:** Pauline Key-Kairis, Lecturer.



Τώρα πρέπει να δούμε πως είναι
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I do not believe–and I write this sitting in the garden–that traditional handwriting or drawing skills will disappear. Apart from anything else, there will be the very natural human desire for variety and, rather less worthy, a nostalgia factor. There already seems to be evidence of a "campaign for real writing" both in America and the UK. But of course there is going to be much greater use of computers in relation to ordinary communication.

Chuck: It is hard to say anything so absolute as "the computer will replace all interactive graphic media," but there is clear evidence in the developments of the last twenty years that we will be able to do many graphic tasks with computer help–and do them better than before. Certainly, the pencil and pad in a conducive environment will remain the medium of choice for "of the moment" concepts and idea transfers over lunch... The computer systems will have their major impact where other structured processes now exist–the drawing board and work table certainly are easy targets. The most challenging (and interesting) applications for the design professions will be those where the computer can interpret, suggest, discuss, and otherwise act as an intelligent assistant in the early formation stages of concept development.

It would be a mistake to underestimate the ability of the computer graphics industry to improve quality in image. We can expect super-fast processors and enormous memories within the next few years–and at accessible prices. Monitor resolutions are already available at the 2000 by 2000 level and higher quality output devices appear every year. The question for quality is only "when?".

Michael: It is important to distinguish between the originators of graphic messages and the recipients of them when answering this question.

The computer is probably going to be very effective in relation to the former–though sometimes at a cost. The cost may be fully offset by other advantages arising from the computer's facility to do other things, but this will not always be the case. And though the argument that costs will continue to come down is a fair one, I find it hard to imagine a world in which computer costs will come down to such an extent as to be competitive with pencil and paper.

As far as the recipients of messages are concerned, it is not simply a matter of costs. Until something of the flexibility of the book is achieved on screen I cannot see many traditional carriers of information being discarded. The codex is an exceedingly flexible device that allows for a good overview of its content and speedy access to any part of its database through effective contents lists, indexes, and so forth. No amount of "windowing" will give such flexibility. Furthermore, the whole issue of the use of computers has to be seen in much wider terms. I happen to believe that the hand skills involved in drawing and writing in longhand are valuable generally in an educational sense. What better way is there to teach certain skills and coordination of hand and eye?

Will hand skills be diminished and does this relate in any way to lower visual standards?

Chuck: Hand skills will be diminished. Nobody likes to produce badly crafted work when, but for a change of tool, the work could be well crafted. I think that we have to ask what the fundamentals really are. If hand skills are necessary to develop mind skills and sensitivity, then they are truly fundamental. If they simply represent the tools of the trade, they should be replaced with better tools when these become available.

We admire the craftsperson for what he is able to accomplish within the limitations of his tools. We admire the designer for what he is able to accomplish, period.

I am not sure what that means in the long run. There is a special learning activity that takes place in working directly with simple materials and media–we use that premise in our foundation program. If, as we assume, the understanding of subtlety and nuance develops most surely from direct experience, then we may have problems. This is an area where research could be helpful. After all, what we really are after is the inventive mind and the discerning eye. If we can't develop these without extensive hand skills training, we need to know it.

Michael: I believe hand skills are fundamental to *all* learning. Things can be experienced through the development of hand skills that cannot be learned so effectively in any other way. We shall certainly aim to keep such activities going in our institution, but we may have to recognize that they are going to be less important in some areas of professional design.

Are there inherent limitations in the visual character of computer-generated images? If so, what?

Michael: Of course, I believe this will always be so. It is so with printing even after 500 years, and I can't see it will be any different with computer-generated images. Any output device imposes constraints in terms of resolution, luminosity, colour, etc. However good the technology, it is reasonable to assume that there will always be a need for quicker and cheaper forms of it. Newspapers could be printed in fine screen litho on good quality paper, but they are not precisely for these reasons.

Roger: Size and screen resolution together with color limitations are very real. However, hard copy in the future will be indistinguishable from traditional means.

Chuck: There is no theoretical limitation to the character of computer-generated images that I am aware of. In the last ten years we have seen major strides in the development of algorithms to render lighted scenes accurately. Last year, for example, saw papers published on penumbras, umbras, motion blurring, and new procedures for "growing" grass, mountains, and other natural features. Besides increasing sophistication in processes for constructing nonexistent environments, there are quality increases in techniques for entering data directly: better "paint" processes, improved scanning processes for digitizing data directly from the world of graphic representations. Output quality has also improved as a result of hardware with greater screen resolution and algorithms for smoothing edges that otherwise might appear "stair-stepped." Considering what is already available, it is hard to imagine any ultimate limitation. What is difficult or expensive today will very likely be easy and cost competitive tomorrow–that has been our experience and there is no reason to suggest otherwise. If anything, we have been conservative in predicting progress.

Have you identified any change in formal visual considerations with computer graphics?

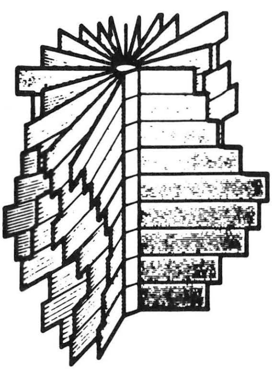
Roger: Yes, coarseness; the designer must work to use this built-in deficiency in the imagery. The designer must take into account the screen size, number of colors available, and light conditions; all of these have impact on message and receiver. Also, the component of time which is much stronger with computer equipment–things are occurring over time as an integral part; time becomes a design element.

Chuck: Disregarding the proliferation of "computer art" represented by spirograph clones and manipulated video noise, there seems to be a distinct turn to complexity in the selection and rendering of images. This probably mirrors the new opportunities possible in the development of design processes. Because it is now possible, it will be explored.

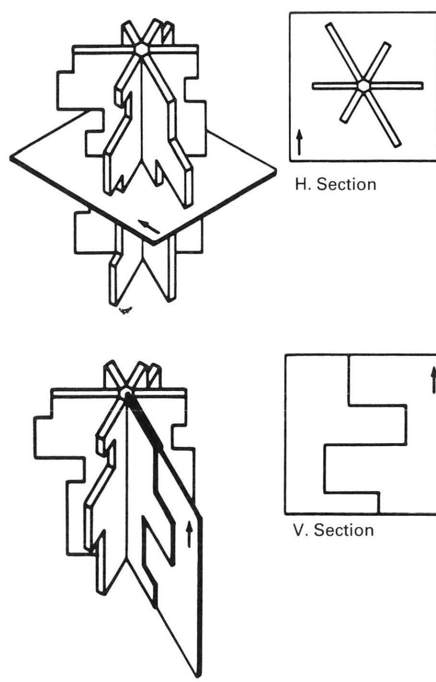
We've explored the visual process relationships but there is also the information access and management issue as it relates to design process....

Chuck: Potentially, these are more far-reaching effects. Actually, the "graphic" part of design is a small part of the overall design process. The computer revolution will really begin to change design process as it develops more capability to act in "intelligent" ways to assist broadly across the entire spectrum of activities that go into planning, design, and development.

We see an immediate focus on the automation of handwork, then an extension of computer support to the thinking parts of the design process–as supports for information handling, analysis, pattern finding, and even conceptualization.



A computer graphic model for analyzing activities. **IIT:** Kuohsiang Chen, MS thesis.



Michael: We have explored this issue with another party. The real problem arises from the fact that designers are not renowned for making use of the available literature of their subject, which means that it isn't possible to demonstrate that there is a market for a design database.

Have any of you thought about or do you know about any design data banks or design networks that are planned or have evolved to support creative interaction and easy access to design information?

Chuck: Many networks are too expensive for casual use. We did some talking with DEC and some other schools about setting up a network two years ago, but the costs as we saw them were too great. We are now considering "Usenet" as a possible low-cost way to network. As one of our Affiliate Group benefits we will begin development of a data bank that will be accessible by members. I don't know of any other design networks in existence or in the planning stage.

Specifically, how are you using the computer? As a creative tool? A production tool? A teaching tool? Other?

Michael: We are using the computer as a creative tool in relation to lettering (through a type design program) and for the design of pages of Prestel and Ceefax–and to a lesser extent for an electronic journal BLEND. It is used as a production tool at a modest level (word processing and interfacing with a photocomposition machine), and through direct links with the institution's mainframe computer and by communication with an external photocomposition service. It is also being used in connection with research statistics and as a means of introducing students to the organization of verbal graphic language.

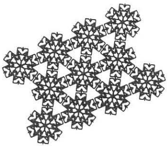
Roger: We are primarily using it as a creative tool and also for training in career opportunities. In terms of the Genigraphics (as a creative tool), we have gone beyond its original purpose as a slide production system; we are using it for layouts of all kinds, as an idea generator, for information design and medical illustration within the contexts of package, product, and graphic design.

Chuck: We aren't using the computer as a teaching tool, although we have some masters' thesis work in progress on topics of computer-aided instruction. Typesetting is done by computer and all thesis project report word processing is done on computers. Computers are used for information handling in the research stages of projects, and computer graphics programs are used to generate patterns and transformations in design classes. A three-dimensional program is used in the technical drawing class to work with perspective and other viewing conventions. In the computer graphics class, graphic programs are the subject, with student work focused on learning to program well enough to be able to write their own application packages. In a course devoted to control technology, students learn microprocessor programming and actually design control applications–writing machine language programs and breadboarding the electronics for sensors and actuators. Most masters' level theses include sophisticated applications programs.

While we offer the opportunity for extensive involvement with computer graphics, it would be very unlikely that we would offer a degree with that title. Since we view computer graphics as a part of the designer's tool kit, we see its study as associated with that of other tools for design. Computer-supported design, for example, is a higher level concept which includes computer graphics as well as other means for using computers in design.

Some design teaching is inefficient from a faculty-use standpoint because some course work such as visual training, once introduced, needs to be pursued on an individual basis. For example, letterspacing needs to be internalized through experience and observation, as do color studies.

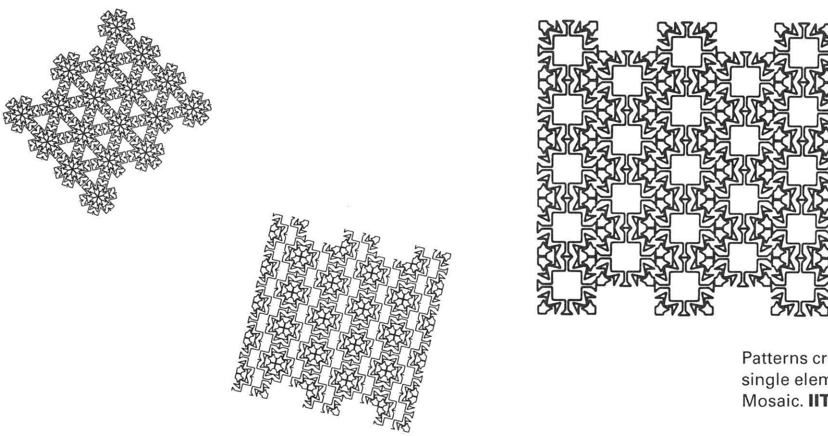
At the University of Delaware, I've seen a letterspacing program used as visual sensitivity training; likewise at Brown University, I've seen an Albers-like color study program used for visual training.



Are you using or do you intend to design supplementary visual or intellectual skill drills using the computer?

Michael: Our character design programme is useful from this point of view. In a somewhat different vein, we have just been wired up with a local area network and are now using this for notices and messages, and are toying with the idea of using it for timetables, simply to involve students more with terminals on an everyday basis for accessing information.

Chuck: We aren't using the computer for skill drills, but have written programs that can be used to create certain kinds of graphic construction. A program called Mosaic, for example, can create patterns that use the symmetry operations of rotation, reflection, and translation, and can work within square, triangular, and hexagonal tesselation fields. In the basic two-dimensional design class, this program can be used to experiment with the nature of pattern. Other programs do other things–transforming one form into another, or "growing" complex organic forms from form elements, for example. The speed with which the image is generated lets the student go through extensive experimental explorations that would simply not be possible with drawing or collage techniques.



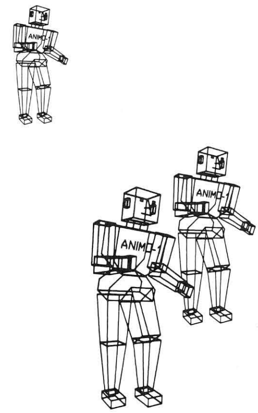
Patterns created from a single element using Mosaic. **IIT:** Huver Hu.

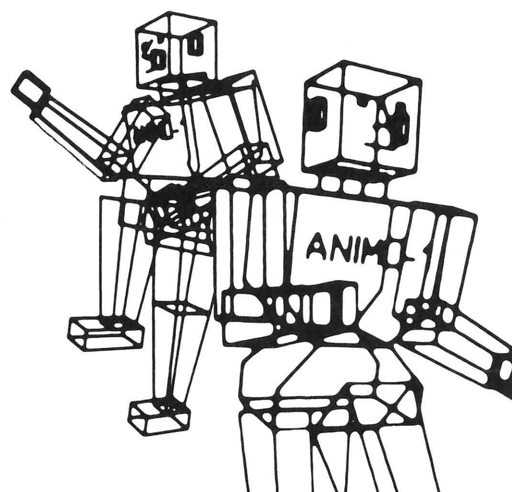
How do you introduce computer graphics to your students?

Michael: We are just moving into a new phase in our teaching of computing and our arrangements are a little uncertain. In the past, first-year students have been introduced to our Prestel simulator and have designed simple pages of information on the screen. Now that we've our own local network, students will be required to spend more time doing similar things by using typographically low-level terminals. We have sufficient terminals to make this a class-based activity. These first-year students will receive instruction in programming as a by-product of this experience. We now integrate computer studies with our other teaching.

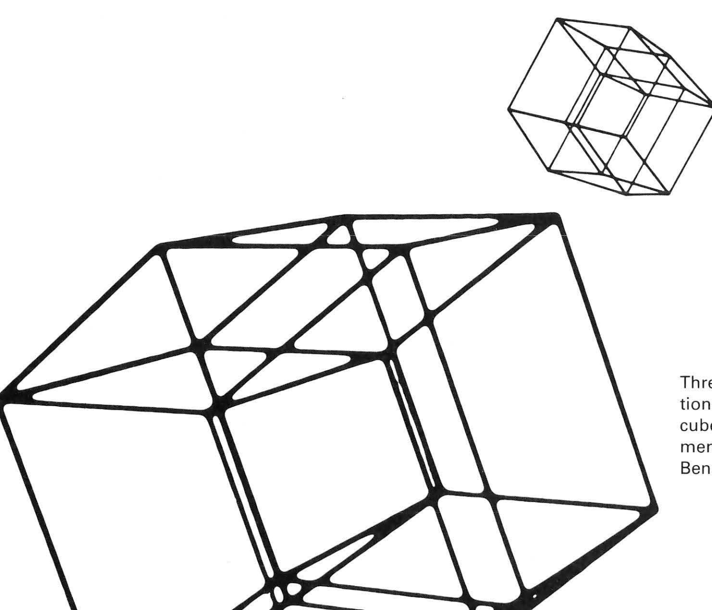
Roger: We provide orientation and demonstration programs. Computer graphics is part of the foundation program.

Chuck: Computer graphics are introduced in the second semester in projects taught as part of the technical drawing class and the basic two-dimensional design class. Students take a computer programming course in the first semester along with the first class of a two-semester trigonometry, analytic geometry, calculus sequence, so some of the theoretical elements have been discussed and all students are familiar with the esoterics of talking to computer equipment. In the third year, students can take an elective course in computer graphics that concentrates on graphic programming.





An animated robot. **IIT:** Manlai You.

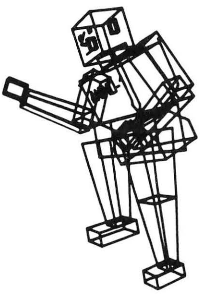


Three-dimensional projections of a four-dimensional cube rotating in four-dimensional space. **IIT:** Benoist Aulanier.

Are there any dangers (visual or intellectual) in the introduction of the computer as a design tool?

Roger: None. The means are out there for making visual swill with the computer as well as with other imaging tools.

Michael: The dangers are more human than visual or intellectual. The repetitive nature of data capture can't be particularly good for people, particularly when done over long periods. This aspect of computing might prove to be as damaging to the human spirit as production-line manufacture. I suppose the use of computers as a design tool might make us lazy in some respects, but it ought also to take us into challenging new areas and make us more able to make the right decisions.

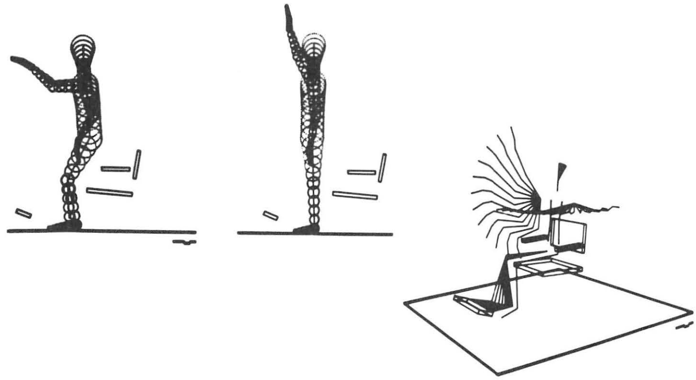


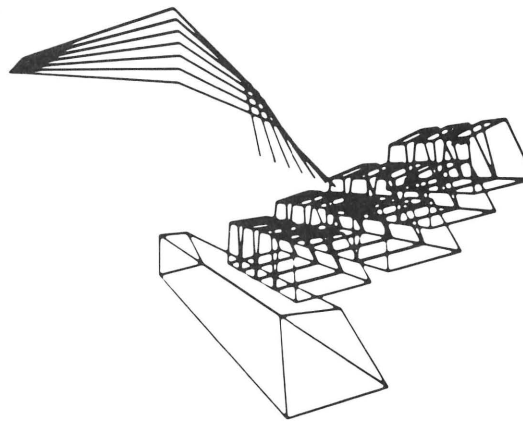
Chuck: Sure. There is always the danger of taking your tools too seriously. I always have some students who come to my class with the certainty that there is nothing that the computer can do for them (they are creative and computers are not). I have to worry about trying to show them that in fact, there are things they can do better with computers. But a much more dangerous student is the one who is prepared to embrace the computer as the tool that will automatically solve his problems. The seduction of the system is that it is precise; with precision comes a lulling of the senses and subconscious surrender to authority. Perhaps, there is a moral here for the program designer–design it to be tentative!

What kinds of research and experimentation related to computer graphics are going on among your faculty and students?

Roger: We are working on interesting and diverse projects: a feedback system that measures physiological response to be applied to understanding visual response, digital typography, interactive graphics programs, also video text and database design, animation, telecommunicating typography, and some experimental instructional programs.

Michael: The only true research at present is related to the British Library–funded project mentioned earlier. This is a three-year project that is looking at what we call the "graphic translatability of text." It's concerned with problems associated with the "translation" of messages designed for one system of production into forms that are appropriate for another system, usually a less sophisticated one. In short, it addresses the ques-



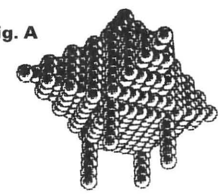


A computer graphic man-model developed to show human differences and their effects on product designs. **IIT:** Alonso Miranda, MS thesis.

tion, "Can the new methods used for verbal graphic language cope successfully with all such communication requirements?" The project falls into three parts: 1) a study of case histories in which problems have arisen; 2) the development of methods of document analysis that seek to identify the characteristics of different kinds of verbal graphic language; 3) testing alternative methods of presenting information on screen and paper.

Chuck: Master's level research very often includes the use of computer graphics or takes an area of it as a research topic. Recent theses include: a study of a means for analyzing complex activities that uses a diagrammatic model to assemble and display information on individual and/or group activities as they change over time; a data base model for human factors information that includes both qualitative and quantitative data and can drive a computer graphic program to provide properly proportioned human figures (using specified anthropomorphic data) for incorporation in a product design test setting; a composition system for working in time with typographic and pictorial elements of dynamic computer graphic presentations; a simulation system for man modeling that allows specific human dimensions to be used and physical disabilities to be represented dynamically; a project planning process for controlling complex design processes involving many designers and different computer graphic design tools; an exploration of "cellular" concepts for rendering solid forms in computer graphics; and a gestural language model for controlling computer-aided design activity by a combination of voice and hand gestures. A major faculty research focus is the "Walter" project mentioned earlier.

Fig. A



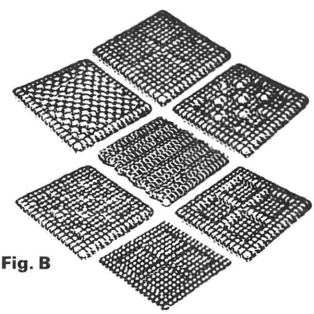


Fig. B

Cellular solids modeling. Experimental forms created in low resolution from assembled pyramid primitives (Fig. A), textures possible at a micro level (Fig. B), and higher resolution forms made with 7,000 cells (Fig. C). **IIT:** Michen Chang, MS thesis.

Fig. C

Are you doing any work on type design or the integration of type and image?

Chuck: Dynamic Information Display examines this in that both type and image are elements of composition in time. In recent consulting work, I developed an integrated typographic model for a computerized type drawing system. The theoretical work integrated weight changes, condensed and extended forms, letter spacing, x-height changes, and width changes with type size. The system specifies a model for digitizing letters and procedures for varying letterforms automatically.

Michael: At a theoretical level the relationship of text and image work station interests us a great deal and has been the subject of research in the Department. Currently we can integrate type and image, but only at the level of Prestel, Ceefax, and BLEND. Two or three members of staff use computers in relation to their research. One, who has recently completed her PhD, used statistical packages in her analysis of graphic language conventions; so too did staff members who investigated the use of multivariate techniques for analyzing features on forms. Our Forms Information Centre also uses computers, especially a relational database for information about forms. Two research students make use of computers. One makes considerable use of a microcomputer for the analysis of data about publications in connection with his research into aspects of seventeenth-century type design. Another (the Project Officer of the British Library–funded project on graphic translatability of text) uses computer-based information systems since they are central to this research.

Roger: We're working on integrating type and image on Genigraphics and Artronic Systems and also on the Apple. Faculty is using the Apple for digital type design and we have one recently completed thesis on the same topic.

Project yourselves five years into the future. If money were no object, how would you expand your computer graphic program?

Chuck: I would like to increase ease of access for students. Ideally, this would mean high-quality graphic terminals located, if not at each student's work station, then somewhere close by. Hard copy output could still be centralized (no one has unlimited funds!). The class structure would not change radically in this format. Students would still learn more detailed uses (graphics programming) in higher level classes, as they do now.

There is always a shortage of work stations–computer graphic work stations are not like lathes or stat machines. If they are being used well, they can be used for many kinds of design activities and are more like personal equipment than laboratory devices. The quality of the system and its vintage are important. A new system is always capable of doing much more than an old one–as opposed to other kinds of equipment that are, perhaps, somewhat better than earlier models, but not radically different. These issues are the primary ones affecting the implementation of computer graphics programs, and both are resolved with a big money bag.

On another level, it is frustrating to see excellent research in theses fail to reach the level of finish sufficient to allow them to be used in the field. The difference between a demonstration program and one tested for distribution is so great that a student cannot be asked to take the additional time required. What is necessary is a full-time development group that can do the extra programming and testing–we would like to expand our efforts here and hope to do so with funds from our Industry Affiliates Group.

Roger: We'd certainly like more hardware at all levels, terminals for all students in class, more interactive videodisc capability, and the ability to send and receive anywhere in the USA and world.

Michael: All students would have their own personal computers on their desks, along with high-resolution terminals. What I'm not sure of is how much use students would make of them–or indeed how much use I would want students to make of them.

What does the future hold and how far away is it?

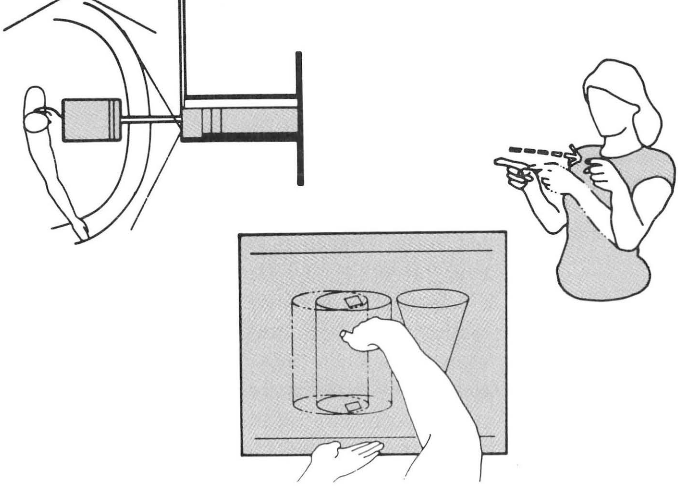
Chuck: The best predictions to make are those far enough away to ensure you won't be here to answer for them. That said, I'll ignore my own advice and say that low-cost, high-quality graphic systems are very close–that within five years we will see a great deal of design done with computer assistance. This is a long step away from today's situation. Crucial to the change will be the quality of software. That is the weakest part of my prediction. If there is a substantial development of research by designers in the software areas, the prediction will be very solid. If not, the change will still take place, but much more tentatively as designers make do with software done for them by others who really don't have the insight required.

Michael: It seems quite clear that graphic design (up till now the preserve of the professional) will be opened up to the lay community as a result of the widespread introduction of computing. And it follows from this that graphic language will develop more as spoken language has developed, that is, more in direct response to the spirit of the times. The use of voice input devices may well strengthen this relationship.

The authority/control/influence of the producers and distributors of graphic language (traditionally the publisher and printer) will therefore lessen or disappear. This will have all sorts of interesting social implications that I can't go into here.

What ideas and experiences, short of hands-on computer experience, can help graphic design students prepare for the future?

Chuck: The computer places a premium on the ability to think. Designers who do repetitive work that could be automated will find themselves out of work. The best service that design schools can perform for their students is to teach them design as problemsolving/ project finding. While traditional design skills are important, they will become more important in the future as formative experiences than as primary job skills. The ability to think out a graphic problem as a problem of communication requiring insight, invention, and, perhaps, the integration of other disciplines cannot be automated.



A gestural communication interface for controlling model development in computer-aided design. Cameras in the workstation enable the computer to recognize the location of the designer's hands in three dimensions; voice commands and gestures control the form-making process. **IIT:** Christopher Nemeth, MS thesis.

Michael: There is no real substitute for hands-on experience. We have organized courses of lectures on computers for nearly fifteen years, but the real understanding only dawns as students become involved with computer facilities within the department. Nevertheless, I feel some overview in the form of theoretical classes is still needed. Other approaches to learning, exhibitions, demonstrations, and above all, reading journals, are useful.

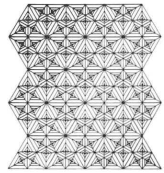
What should graphic designers do to influence how computer graphics possibilities develop?

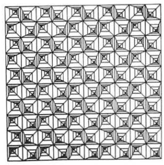
Michael: I wish I knew. Over the last ten or more years I have spent a considerable amount of time trying to explain to computer folk why I believe the typographic designer has an important role to play in computing as it relates to communication... I wish I had been more effective. Only now does the computer world seem to be waking up to the fact that messages need to be designed if they are to be effective.

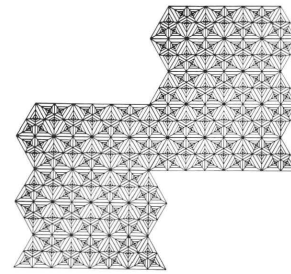
What we have to do is quite simple. We need to come to terms with whatever technology is around or projected in order to influence its development and use. At the other end, we have to educate ordinary people to be able to discriminate between graphically literate and graphically illiterate messages so that they can influence the course of events. Since most manufacturers still seem to think they can do without the skills of typographic and graphic designers, I suspect the public lobby is going to prove the more effective of the two approaches.

Roger: Graphic designers must deal with software developers and provide an understanding of design needs. Professionally, the AIGA (American Institute of Graphic Arts) should get closer to the computer industry. AIGA seems stuck on its print heritage. As we establish consulting opportunities, and place our students in computer positions, we have impact by infiltrating their ranks and by enhancing design credibility in the long run.

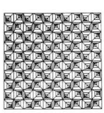
Chuck: We must get involved. The computer graphic hardware companies just discovered design a few years ago (they actually are not sure yet what the difference between an artist and a designer is). By becoming involved in developing graphic programs and working with those who incorporate graphic standards in programs, designers can have a major influence on the







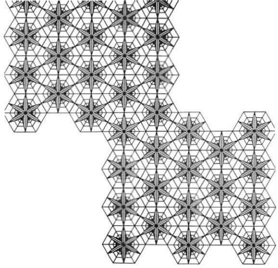
way computer graphics evolve. This may mean more education for some. Learning to program takes longer than learning to use a system, but both are short-term tasks. Graduate design programs are beginning to offer opportunities for those interested in working with computers–this may be the most direct road for those willing to spend the time.

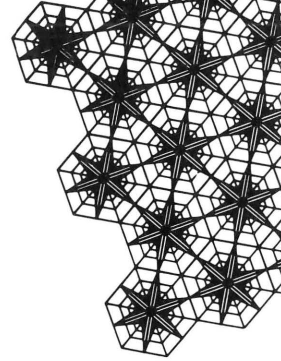


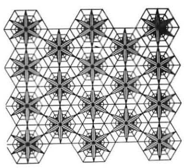
Ultimately, though, to influence you must communicate. Designers must begin to participate in the journals and conferences that deal with computer graphics. The Association for Computing Machinery (ACM) sponsors a conference annually through its special interest group for computer graphics (SIGGRAPH), and the National Computer Graphics Association (NCGA) also has an annual conference. These are the two largest (and most prestigious) conferences; other associations also have special computer graphic sessions in their conferences. Both NCGA and ACM have journals also, and a number of journals and trade magazines now are published solely for those interested in computer graphics.

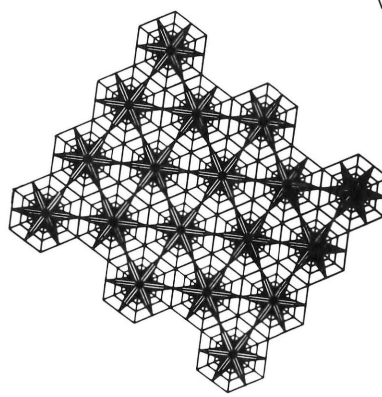
Michael has suggested that the designer's sphere of influence may diminish as a result of the new technology. As this conversation comes to its end, please comment on how graphic design can redefine itself in order to preserve and perhaps extend its influence on visual communication.

Michael: I didn't mean to imply that the designer's influence will diminish, merely that his role will change. If graphic language does develop more along the lines of spoken language, then clearly the designer's role will be lessened at the level of the individual message; an originator's involvement with computer graphics and initial capturing of text must lead to





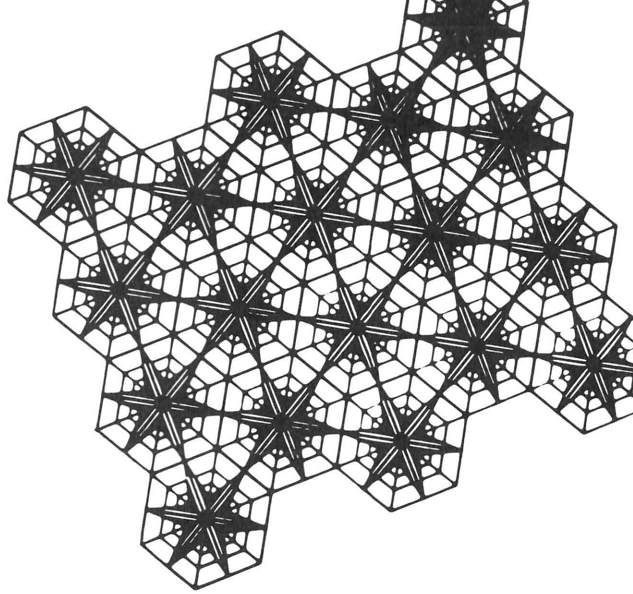


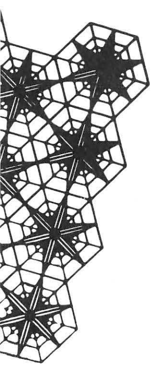


Mosaic patterns. **IIT:** Soon-Jong Lee.

a lessening of the designer's involvement at this level. However, I think it is likely–and certainly to be desired–that designers will become much more involved when whole message systems are devised. I have in mind the design of graphic systems in which broad approaches to the design of messages are established, covering such things as the treatment of verbal and pictorial language. Such broad approaches would need to be established (preferably in connection with, or in light of, national and international standards) if communication is not to break down under the strain of individual variations resulting from the greater graphic power given to individual communicators.

In such a scenario the graphic designer would be less involved with the design of "one off" messages and more concerned with overall "graphic frameworks." In many instances, he would lose responsibility for making detailed decisions about particular messages. And this might present problems for those designers who like to have total responsibility for the design of assignments they work on. On the other hand, it seems clear that the involvement of the designer with "graphic frameworks" will lead to a need for a broadening of design skills to include management and editorial skills.

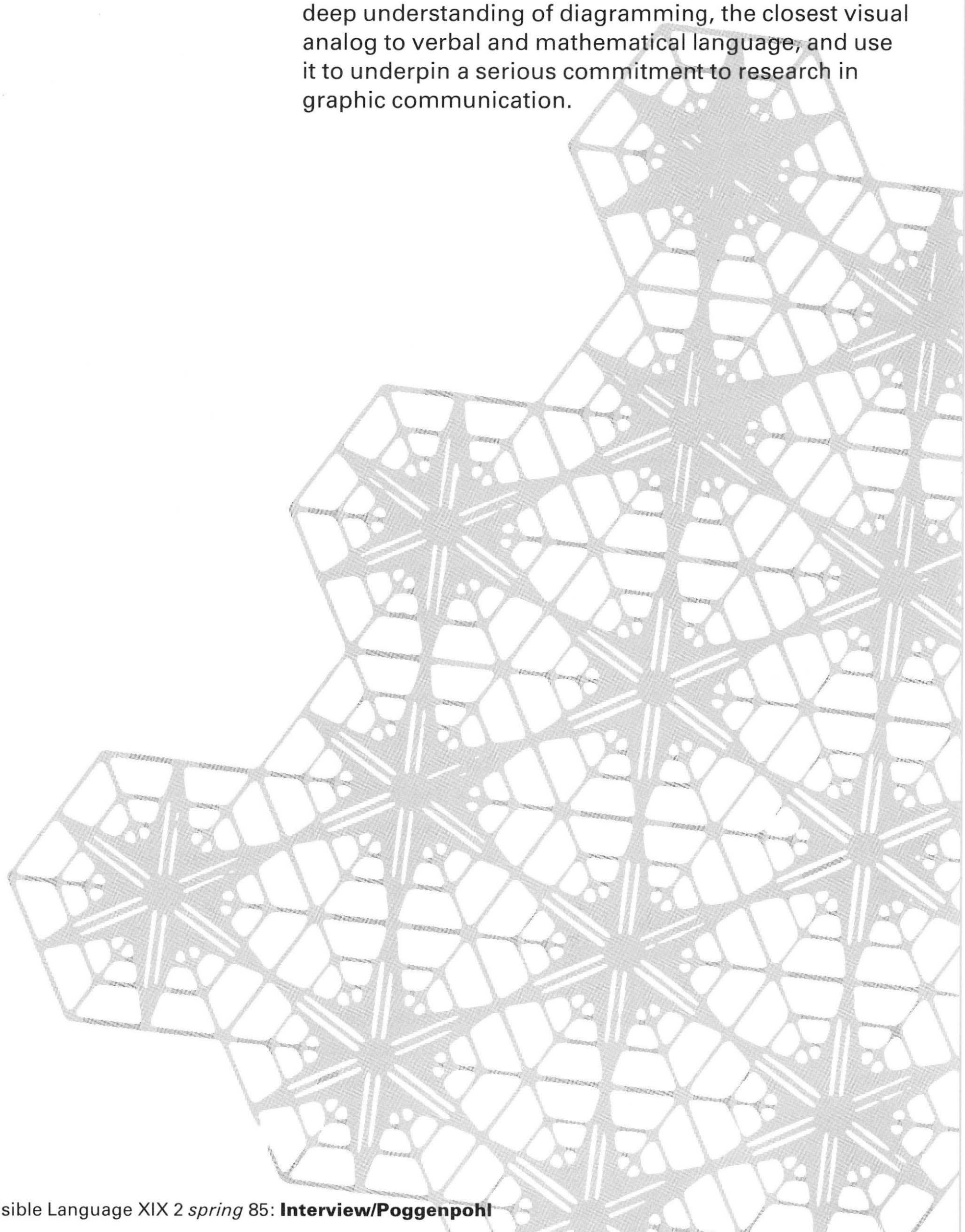




The role of the design manager merges imperceptibly with that of the educator, particularly today when graphic and typographic design skills are not widespread in the computer community. If graphic designers are to enhance their influence on visual communication, it is clear to me that they have to do so through education. They have to educate the community at large in relation to graphic language so that they demand better designed messages than they are getting now from computer systems, and they have to educate the computer world to respond to that demand. I can appreciate that some graphic designers will see a professional risk in all this, but I don't believe they should feel threatened by such a proliferation of design understanding. A good graphic or typographic designer will always be able to contribute something of value to the transformation of messages so as to make them more effective for others to use.

Chuck: I have a vision of monks all across Europe closing up their inkstands and going off to the fields as the news of the Gutenberg press passes from town to town....we have to remember that the problems of graphic communication transcend any specific media. In fact, the advent of computer graphic processes and the new channels of communication that are appropriate for them raise more questions than they answer.

To the extent that graphic design is a hand skill, it will be replaced. To the extent that it can be taught as a set of rules, the rules will be incorporated in expert systems. There will always be graphic design artisans–just as there are still a few craftsmen who can do fine hand lettering–but the future for graphic design is on the high road of visual communication. This means designing the rule systems instead of using them, designing systems of communication instead of individual communication pieces. It means greater involvement with the ideas of visual language, finding ways to raise visual communication, to use an analogy, from the equivalent of primitive speech to that of literature. Quite probably, this means that we must develop a deep understanding of diagramming, the closest visual analog to verbal and mathematical language, and use it to underpin a serious commitment to research in graphic communication.



• Rochester Institute of Technology

Hardware

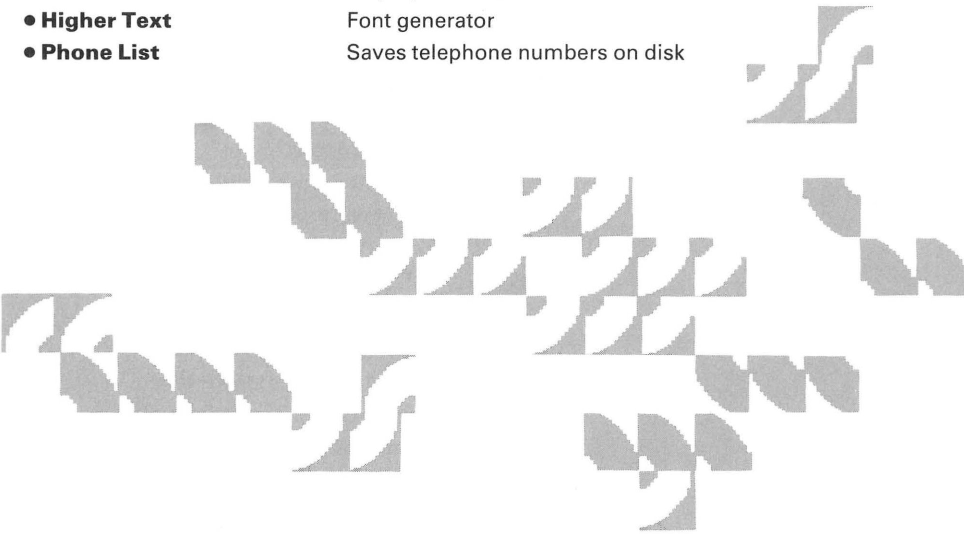
	Quantity/Type
1	Genigraphics 100C
8	Artron 2000 Units Image Grabber Slide Recorder and Polaroid Film Recorder
11	Apple II+ and IIe Units with Disc Drives, Monitors, Joysticks, or Tablets
1	Image Grabber
3	Epson Printers
1	Tektronics Plotter
2	Apple Plotters
3	GIGI Terminals
6	Dec Pro-350 Units
1	Omni-tec 2000 Typesetter with 3 Workstations
3	Autographics Units

Software

Key ○ Commercial
● Homegrown

Name/Origin	**Functional Description**
○ **Micro Illustrator**	2-D image generation
○ **A2-3D1**	3-D image generation
○ **Take 1**	Animation
○ **Image Printer**	Screen dump program
● **Draw**	Sketch using tablet
● **Display**	Displays images on disk
● **Preview**	Displays data on disk
● **Input**	Shape creation numerically
● **Trans**	Shape transformation
● **Symtex**	Symbol and visual texture
● **Intervals**	Line interval creation
● **Grid**	Grids, copyfitting, layout
● **Type**	Manipulate and modify letterforms
● **Body copy**	Indicates copy with parallel lines
● **Quadrasketch**	Symmetric shape creation
● **Gridplot**	Full-scale grid plotting
● **Shapeplot**	Plots shapes from Symtex, Input, and Type programs
● **Inplot**	Plots using Intervals
● **Screenplot**	Plots images from Display
● **AndScreen**	Logical and between 2 images

Name/Origin	**Functional Description**
• **OrScreen**	Logical or between 2 images
• **Ldraw**	Free-hand with light-pen
• **Three-D**	3-D image generation
• **Make Text**	Create text and save on disk
• **Retrieve Text**	Displays text from disk
• **Higher Text**	Font generator
• **Phone List**	Saves telephone numbers on disk



• Illinois Institute of Technology

Hardware

Unless specifically indicated, all the hardware listed here is on-site at the Institute of Design, available for student and faculty use through the Design Processes Laboratory.

	Quantity/Type
	1 Hewlett-Packard 1000F Computer
	1 Digital Equipment Corporation PDP 11/23 Computer
	4 Digital Equipment Corporation VT103 Microcomputers
	1 Digital Equipment Corporation VAX 11/780 (hardwired from another building)
	2 Digital Equipment Corporation VAX 11/750's (hardwired from another building)
	1 Prime 550 (hardwired from another building)
	5 Digital Equipment Corporation GIGI Microcomputers
	1 Hewlett-Packard HP 85 Microcomputer
	2 Compugraphic Phototypesetting Systems (with two text editing workstations)

Hardware

	Quantity/Type
	1 Hewlett-Packard 7970 Magnetic Tape Drive
	1 Hewlett-Packard 120 Megabyte Disc Drive
	3 Digital Equipment Corporation RL and RX02 Disc Drives
	13 Hewlett-Packard 2700 Color Graphic Workstations
	2 Hewlett-Packard 2648 Monochrome Graphic Terminals
	1 Hewlett-Packard Alphanumeric Terminal
	5 Amdek Color IV Monitors
	2 Amdek Color I Monitors
	1 Digital Equipment Corporation VT125 Graphic Terminal
	2 Digital Equipment Corporation VT100 Alphanumeric Terminals
	8 Digital Equipment Corporation VT52 Alphanumeric Terminals
	1 Magnavox Orion 60 Plasma Screen Graphics Terminal with Touch Panel and Rear Screen Slide Projection
	1 Hewlett-Packard Graphics Line Printer
	1 Hewlett-Packard Letter-Quality Daisy Wheel Printer
	1 Digital Equipment Corporation Desktop Graphic Printer
	4 Digital Equipment Corporation Desktop Printers
	5 Digital Equipment Corporation Decwriters
	1 Hewlett-Packard Digitizer
	1 Hewlett-Packard 9872 8-pen Plotter
	1 Hewlett-Packard 7580 8-pen Plotter

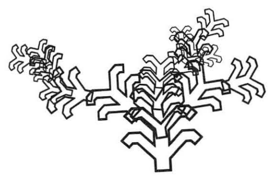
Software

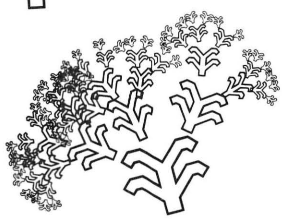
All applications work is done with programs written by faculty or students for the task at hand or for research (frequently thesis work). Some programs have been carried to a production level and are used in classes or for research. Following are some of these.

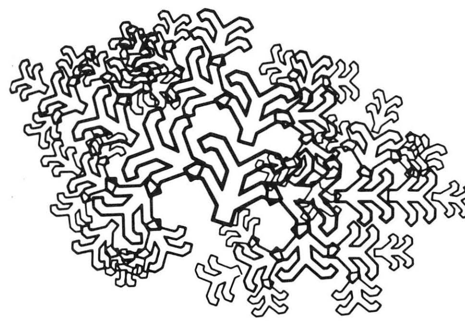
Key ○ Commercial
● Homegrown

Name/Origin	**Functional Description**
• **World**	Draws views of the earth. Perspective drawings of the globe are drawn from a viewpoint located above a point on the earth's longitude. The distance away from the earth can be specified, parallels and meridians can be drawn (or not) in specified frequency, and hidden lines can be removed or left in for a transparent world.

Name/Origin	**Functional Description**
• **Growth**	Grows complex forms "organically" from an original image. The image is treated as a form (most approximately, a cactus), in that copies of itself can "grow" at bud points, and these in turn can have buds, etc. Control features allow the designer to select bud point positions, the number of buds, the number of growth seasons, and the "health" of the organism. The health of the organism is reflected in the perfection of replication. Less-than-healthy organisms have randomly distorted buds, angular variations in bud growth, and failure of some buds to reproduce.





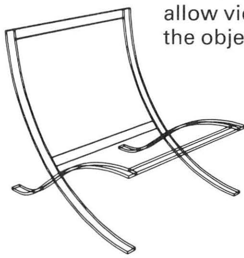


• **Resolv**	Simplifies an image to fit progressively coarsened grids. A digitized image is drawn in the cells of a matrix where each cell has an imposed grid slightly coarser than the previous cell. The points of the image are forced to lie on the grid lines, and the resulting versions of the image are increasingly simplified as the number of grid lines in a cell decreases.
• **Deform**	Produces variations on an original image by the application of Cartesian transformations. An image is digitized in a grid and "operated on" by profile curves independently multiplying x and y coordinates.
• **Xform**	Transforms one given image to another. Original images may be placed anywhere in a two-dimensional field of square cells and appropriate transformations will be calculated and drawn with regard to each cell's position relative to the given images. The field becomes an "animation matrix" with any path from one given image to the other recording the "in betweens" for that path.
• **Mosaic**	Creates two-dimensional patterns from an original image. A module is constructed from the image element by selecting rotations and/or reflections and filling a four-cell square. One image can be used to create patterns in all the regular tessellations of the plane and, with module variations using combinations of element rotations and reflections, can produce patterns of great variety.

• Illinois Institute of Technology (continued)

Software

Name/Origin	**Functional Description**
• **Graphx**	Draws wireframe views of three-dimensional objects and scenes. Entities are described as sets of lines from lists of lines and points entered to delineate all objects in a scene. Manipulations include rotations, translations, variable angle scaling (the effect of changing camera lenses), and various kinds of projections including perspective, orthographic, isometric, and stereo. Presentations may be constructed by drawing in sequence images that are "built up" by adding, subtracting, or switching entities. Windowing procedures allow views to be made from any position, outside or inside the object or scene.



• **SDM**	Measures the "semantic distance" between concepts rated by subjects in studies of perceived meaning. A recent program designed for the Magnavox Orion system shows concepts to subjects as slides rear-projected on the Magnavox plasma screen. Subjects rate concepts on bipolar scales like good-bad, ugly-beautiful, etc., using a touch panel on the screen. Accumulated data can be shown at any time as profiles comparing the concepts on the scales.
• **Relatn** • **Vtcon** • **Simlar**	These are not graphic programs but programs designed to manage information, help structure complex problems, and assist the designer with complex problem-solving tasks.

• University of Reading

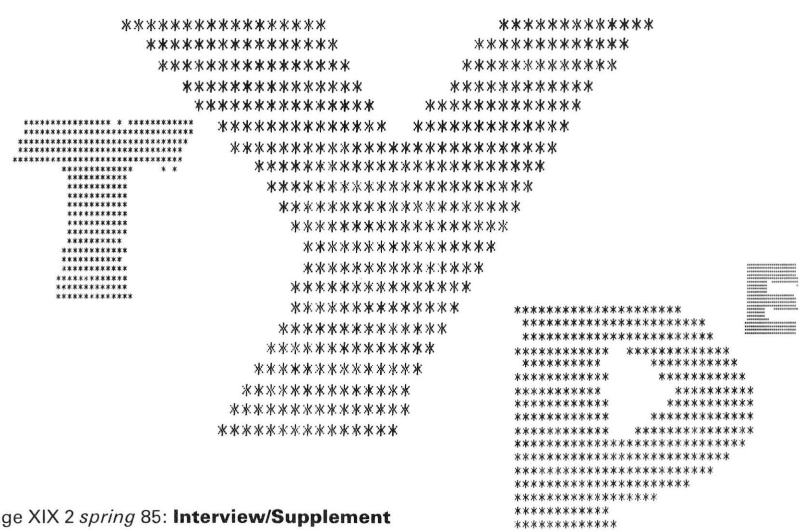
Hardware

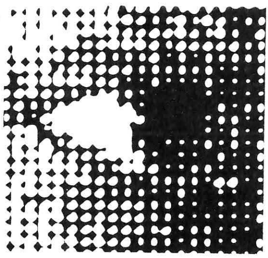
	Quantity/Type
	Clearway network linked to University mainframes **4** lines to department, **5** shared lines
	TV910 Terminals **4** lines in department, **4** shared lines
	DEC Letterwriter 100 Lineprinter **1** shared line
	1 Acorn System 4 **1** Acorn Atom **1** Decwriter
	1 CRTronic Typesetter
	1 Datalogic RDS-220 Wordprocessor **1** Daisywheel Printer **1** Formscan Interface for WP and CRTronic
	1 Cortex Micro with 3 Disc Drives **1** Kaga Taxan KP-810 Dotmatrix Printer
	1 Apple IIe with 3 Disc Drives **1** Torch Microcomputer **1** Epson Dotmatrix Printer **1** Integral Colour Printer
	1 Linotype APL Terminal (modified Apple IIe)

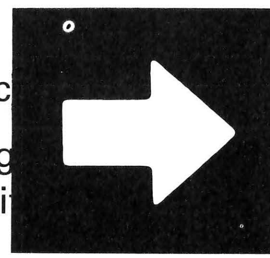
Software

Key ○ Commercial
● Homegrown

Name/Origin	**Functional Description**
● **Screen Type Design**	
● **Forms Design**	
● **Prestel Simulator**	
○ **Owltel**	Viewdata package
○ **Wordstar**	Word-processing package
○ **Blend**	Electronic network
○ **Dbase II**	Relational database







"A well designed system makes everything relevant to a task visible on the screen."

Scripting Graphics With Graphics: Icons as a Visual Tool

Dorothy Shamonsky

Abstract

This paper describes a system for scripting and editing graphic procedures with graphic representations or *icons*. The icons are small bit-map images that carry with them information about spatial placement, list placement, and pointers to procedures. Two interactive graphic software packages have been written, one for creating icons and one for scripting with icons. Icons can be created in two ways: (1) making bit-maps from frame buffer images and (2) drawing by grid filling. Icons have been created with pointers to a series of image transformation procedures. Scripts can be created in two ways: (1) by storyboarding icons or (2) by playing out a sequence of graphics and recording the list of events. Scripts can be edited, saved, played, and re-edited. All interaction is done with puck, tablet, menus, and visual cues. A historical overview of computer icons is presented, using several key systems as examples.

Introduction

Suppose you could write a paper, then immediately get an outline of what you have written. You could choose to edit either the paper or the outline. Any change in one would effect the appropriate change in the other. Scripting graphics with icons is similar to this situation. It is a way of visualizing both the actual sequence and the structure of a sequence of visual events. In other words, it is a visual editing tool.

Text-editing on computers has achieved a high level of fluidity, while creating graphical events on computers, such as computer animations, still depends primarily on verbal rather than visual planning methods. Visual planning for videodiscs and electronic books depends largely on traditional methods of book design with pencil or paper. This can be awkward and ineffectual when what you, as a visual designer, are planning for is electronic, intangible, and has an immense number of variables. The computer tools have not caught up with the possibilities of projects that the technology affords.

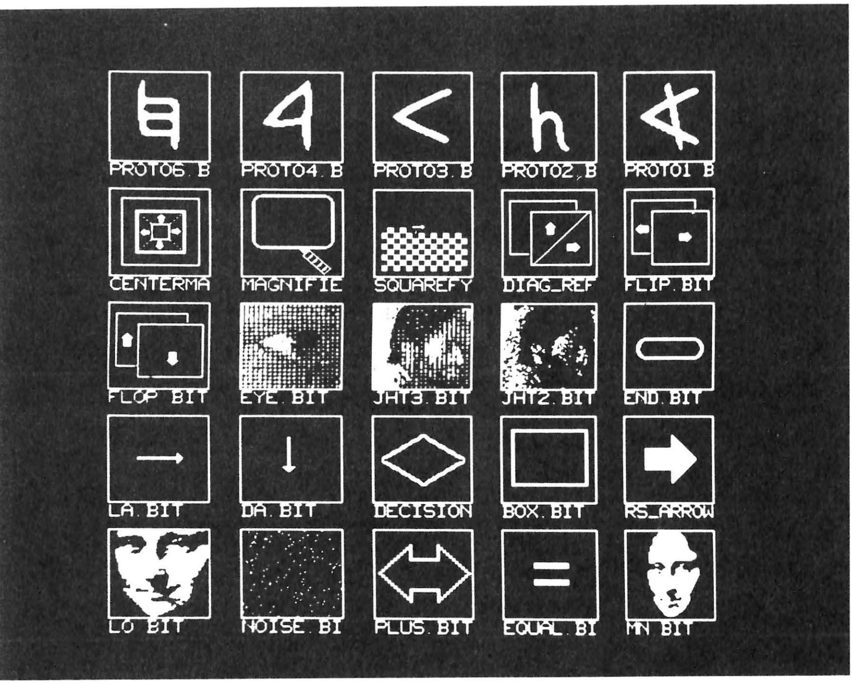
A storyboard is an example of a noncomputer visual editing tool. It consists of a rearrangable series of key images and is used in film, video, and animation to plan the story or define the sequence of visual events. It provides a method of planning a film or animation without actually editing cumbersome footage of film or videotape repeatedly from one position to another.

Visible Language XIX 2 (Spring 1985), 226-242

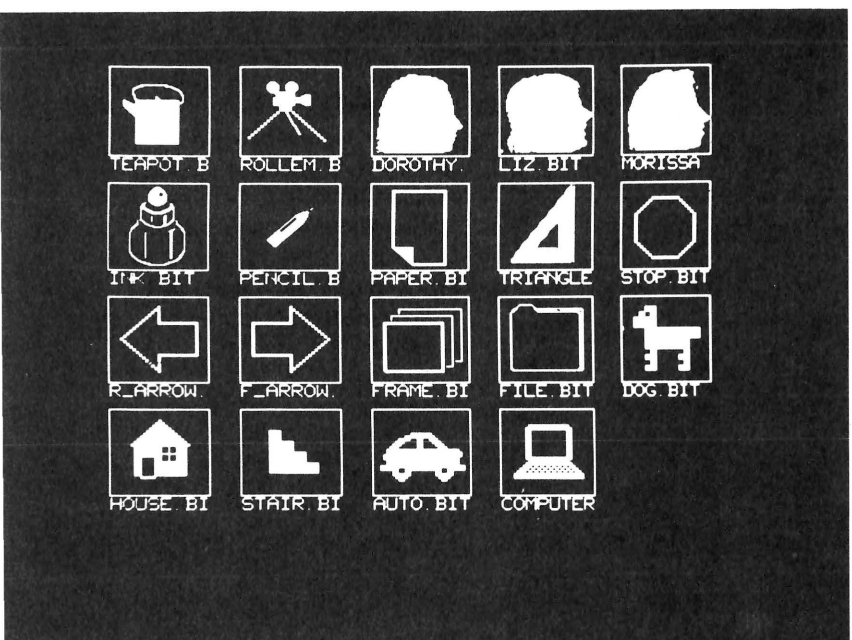
Author's address: 21 Spring Hill Terrace, Somerville, Massachusetts USA 02143

1
The contents of the directory of saved icons.

1a



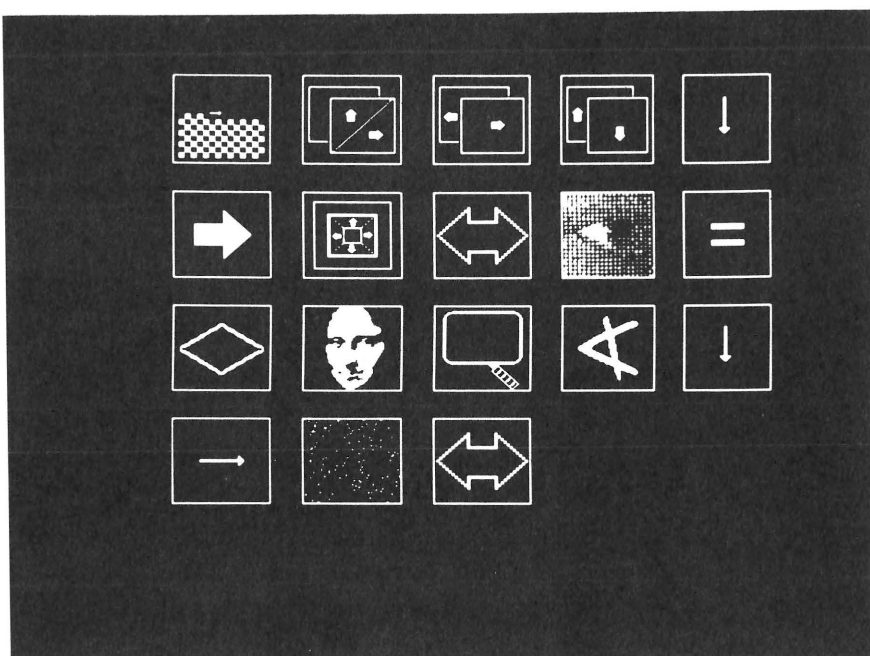
1b

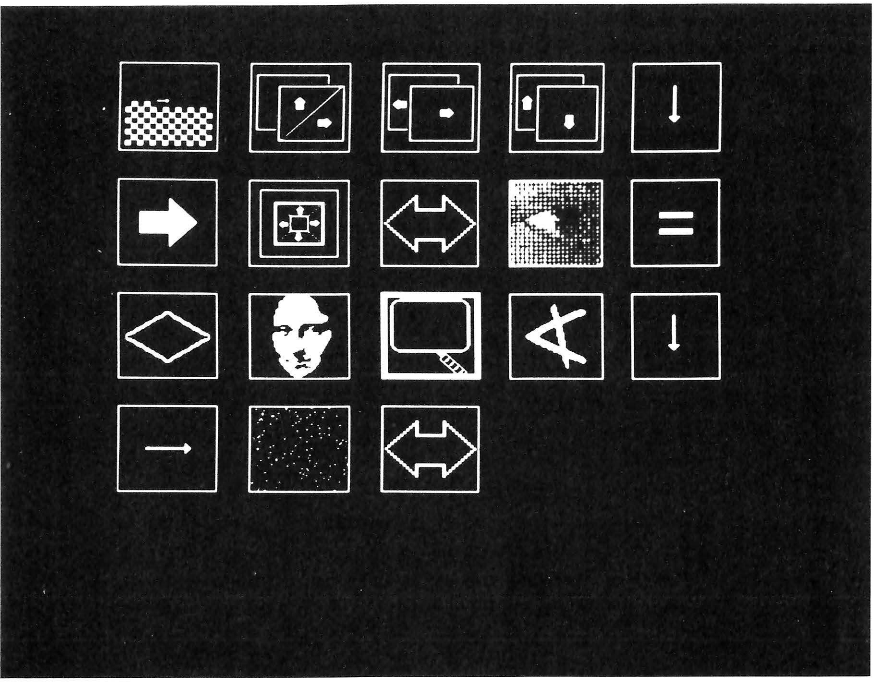


Icon Scripting is conceptually similar to a storyboard (**Figure 1**). Icons **1** are used to define and rearrange graphic sequences around the computer interface *space* when those procedures can not otherwise be *handled* except as names (**Figure 2**). The icons are small (approximately one inch square), bitmap images (1 bit or one color) that represent, in this particular case, simple graphic transformations, such as reflection of one part of the screen to another.

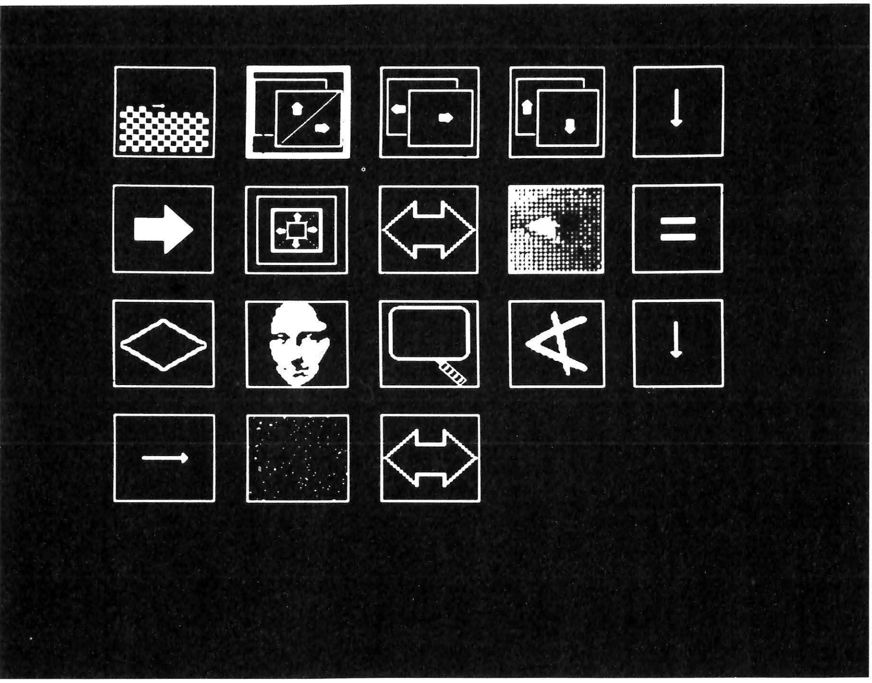
2
The storyboard capability:

2a
The sequence to be rearranged.



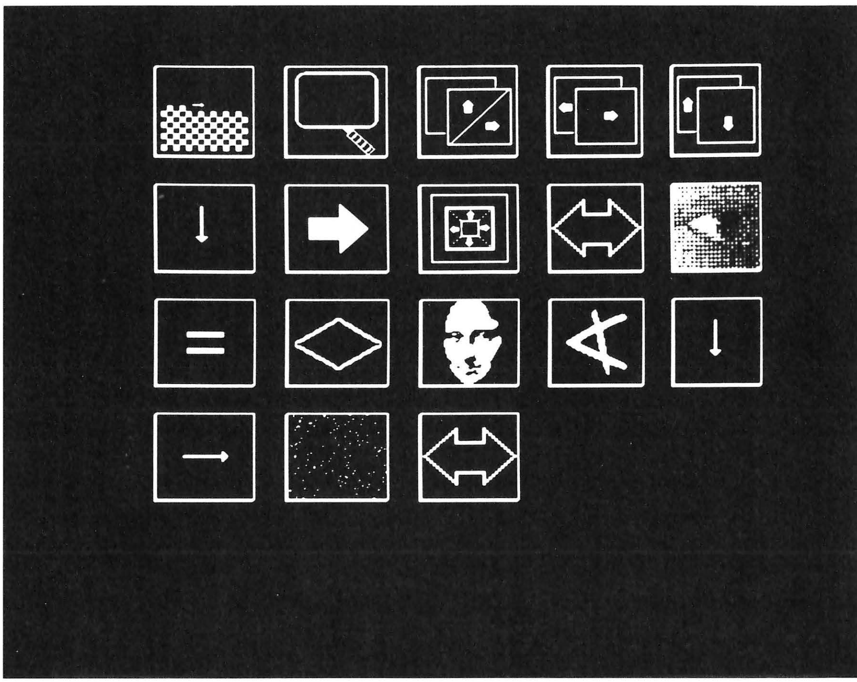


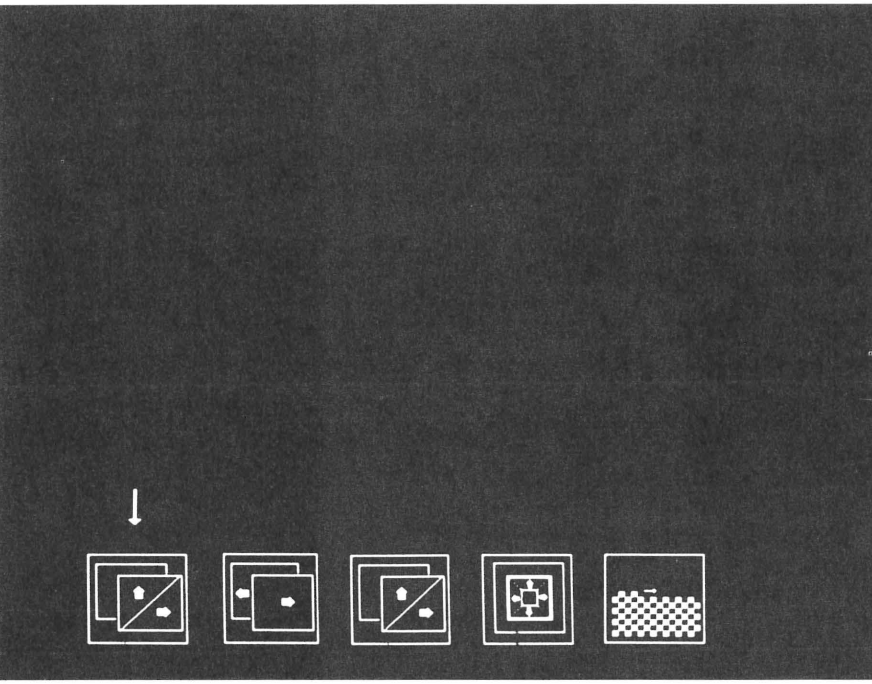
2b
Place this one (the highlighted box)...



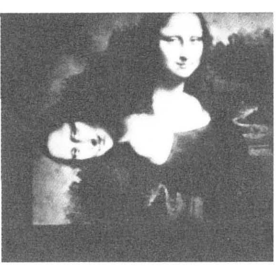
2c
in front of this one (the highlighted box).

2d
The new sequence redisplayed.

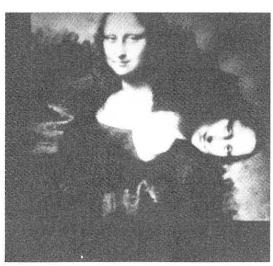




3a
A final script being played.

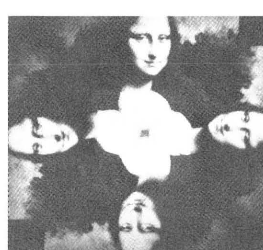


3b Original image



3c Diagonal reflect

3d Flop



3e Diagonal reflect

Each icon carries with it vital information about itself, such as its number in a sequence, its position on the screen, and what procedure it points to. A script can be defined by icons, saved, *played*, and re-edited any number of times (**Figure 3**).

Icon is an accepted computer term to describe a graphic representation on a computer of a real person, object or function. The term *icon*, by definition, is an image, portrait, or semblance, especially of a saint. It comes from the Greek word which means *to be like* or *likeness*. The root of *icon* is also related to the Lithuanian word meaning *to occur* or *to come true*. [2]

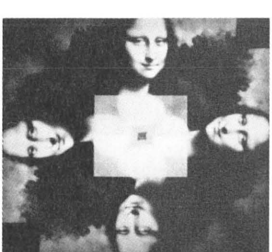
The general distinction between an icon and any other image, large or small, on a computer, is that an icon carries with it information about what it represents. Icons are *live* pictures. You can *pick* an icon and something happens. You can *combine* two icons and they modify each other. To throw something away on the Apple Lisa the user *picks up* the object icon, *drags* it to the trash can icon and *lets go* of it. The object icon then disappears.

Graphics at the Interface

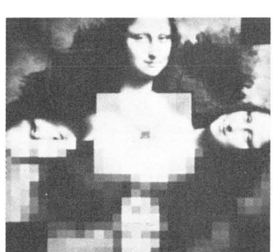
Defining and structuring graphic events on computers with descriptive words instead of pictures, prevents us from using the spatial skills we usually employ in solving visual problems. The sequence of drawings in a sketchpad or a scribbled page of thumbnail sketches are often the methods designers use to develop a visual structure. These methods allow one to see the structure of a piece, keep track of its parts, and visualize the final result.

Computers have eliminated many of these common structural aids or spatial cues because of the limitations of most interface designs. In the past, hardware limitations and high cost presented real restrictions to the use of graphics on computers. These limitations are rapidly disappearing as the hardware becomes more sophisticated and costs continue to drop. Along with these tangible changes, the knowledge and understanding of interface design has improved. Both a cause and result of this has been the inclusion of people from diverse fields, such as educators, psychologists, linguists, and artists, in the design process.

One might say that it has taken interface designers a long time to realize what artists have known all along, that



3f Magnify center



3g Squarify

pictures can tell a story much faster than words. Pictures are often a more direct and universal form of communication; pointing is faster than describing. An understanding of organization and structure is based strongly in spatial cues. "It is surprising how pervasive the underlying notion of spatiality is, even in the symbolic modes of thought." [2]

It is not surprising that images on computers are as important (and popular) as they are in the noncomputer world (eg. signs, logos, photographs). What is surprising is how crucial they are becoming to creating believable illusory environments at the interface. Graphics are becoming the primary tool for creating understandable conceptual environments, with *virtual* objects that function in believable and consistent ways within those environments.

The graphics used are often iconic rather that literal because they need only be *models* of reality. Visually simple, they often carry with them large amounts of information about their behavior in order to act true to their represented reality. Icons are like black box abstractions; as long as the user can read a label, she can work with the icon, as with its reality.

Recent studies have substantiated the use of graphic interfaces by showing that certain interface features evoke a positive response in users. Features that appear most significant to this positive reaction are: (1) visibility of object of interest, (2) replacement of complex command language syntax by direct manipulation of the object, (3) actions caused by the manipulation occur within an understandable space, and (4) reversibility. [3]

The use of graphics in the interface and visual design tools may seem, at first, to be two separate topics. But the use of more graphics on computers demand an availability of intelligent and fluid design tools to design graphic interfaces. Better visual design tools will, in turn, lead to better, more useable and understandable interfaces.

A Brief History of Graphic Interfaces

Ideas for more accessible interfaces using graphics and pointing instead of verbal descriptions originated a number of years ago. In 1963, Ivan Sutherland created a graphical interface, called Sketch-pad, for his doctoral thesis. In his thesis he states:

"Heretofore, most interactions between man (sic) and computers has been slowed down by the need to reduce all communication to written statements that can be typed; in the past, we have been writing letters to, rather than conferring with, our computers." [4]

Sutherland created an interface to produce graphics that used a lightpen to input data. Although not quite like drawing with a pencil on paper, it used embedded visual knowledge and was more direct than verbal descriptions of graphics.

In 1964, another pointing device, the mouse, was invented by Douglas Englbart of S.R.I. (Stanford Research Institute, now S.R.I. International). It is only within the last couple of years that the mouse is incorporated and utilized in software systems as much or more than the keyboard.

Some of the earliest implementations of graphic interfaces were video games. "Pong" came on the market in the early seventies. It requires about thirty seconds of observation to become a competent novice. Its concept is simple: two rectangles acting as paddles are manipulated with two knobs, and a smaller circle acting as the ping pong ball ricochets off the boundaries of the play area.

What is satisfying about the game is the directness of control; the *paddle* responds instantaneously to any movement of the knob. With the simplest graphical elements, lines and rectangles, a convincing metaphorical space is created with metaphorical objects that behave in predictable ways.

Between 1976 to 1978 the Architecture Machine Group at M.I.T. developed a system of organizing and referencing data called Spatial Data-Management (SDMS). It is designed on the concept of reference by place rather than by name and creates a plausible *virtual* space at the computer interface. It used a joystick to move around that space quickly and easily.

The spatial world of SDMS consists of a single plane called *Dataland*. Dataland is a metaphorical desktop upon which rest, in fixed positions, images of objects: letters, telephone lists, reports, etc. It is presented to the user in two ways: in its entirety in an *aerial*, top-on view displayed on one monitor, and simultaneously, a small subsector of the surface is displayed on a ten-foot screen, vastly enlarged and with considerable gain in detail. The relationship between these two views is like a mapping key which places a particular image within a larger picture.

Xerox extended the concept of the metaphorical desktop to a metaphorical office space. In the spring of 1981, Xerox released the 8010 Star Information System. It was a personal computer designed for offices. Xerox devoted about thirty work-years to the design of the Star user interface. Their primary concern was to define a conceptual model of how the user would relate to the system.

A conceptual model is a set of concepts a person learns to explain the behavior of a system. It is a model developed in the mind of a user to enable her to understand and interact with a particular system. The desktop is the principal Star technique for realizing the physical office metaphor. *Icons* are used as the visible, concrete embodiments of the corresponding physical object.

"Star is the first computer system designed for a mass market to employ icons methodically in its interface. We do not claim that Star exploits visual communication to the ultimate extent; we claim that Star's use of imagery is a significant improvement over the traditional human-machine interfaces" [5]

Incorporating many of the interface ideas developed at Xerox, Apple released the Lisa on the market at the end of 1982, and the Macintosh in early 1984. They are personal computers for both office and home use.

Greg Williams, senior editor of *Byte Magazine*, in describing his first encounter with Lisa gives us some insight into its appeal:

"With a few movements of the mouse... I *tear off* a sheet of Lisa Graph *paper*... and give it a heading *Annual Sales*... I then use the mouse to *cut* the graph from the Lisa Graph paper and put it in a temporary storage place called the *clipboard*. I can then *throw away* the Lisa Graph paper I was using. My next step is to *tear off* a sheet of Lisa Calc paper and *paste* my *Annual Sales* bar chart from the clipboard onto it." [6]

Metaphors of the tangible objects are used, being physically moved with actions described as *cutting*, *pulling*, and *dragging*. *Picking* with the mouse button has been extended to more sensual and demanding tasks. These are all illusions which expand the real world model of the computer interface.

Another application of icons has been in CAI (Computor Aided Instruction) systems, which often depend on the creation of the real world model as a learning tool. Icons act as models of component *parts* that can experimentally be put together to create models of systems.

A project, called *Steamer*, done at Bolt Baranek and Newman Inc., Cambridge, MA, is an instructional tool for U.S. Naval steam propulsion systems. A library of icons was created to represent component parts. Each icon carries with it information about what it represents and can interpret user input to affect the state of the modeled component, and in turn, the entire system. For instance, touching a gauge causes it to produce a value corresponding to the location of the touch on the gauge face; increasing one gauge reading might effect other gauge readings in other parts of the model.[7]

Overview of Scripting Software

The goal was to implement a system that would enable a user to interactively and fluidly create a visual script. The scripts need to be easy to edit with direct manipulation as the major mode of interaction. Interaction is with a puck and tablet and all procedures are accessed through a main, tree-structured menu.

The scripts, in that particular case, control a series of graphic transformation procedures, which are programs that currently reside on the computer at the Visible Language Workshop at M.I.T.[8] They are image manipulations such as reflecting part of an image across itself or flipping the image upside down.

To implement Icon-Scripting, I first needed to develop a system to create icons.

Icon Editing

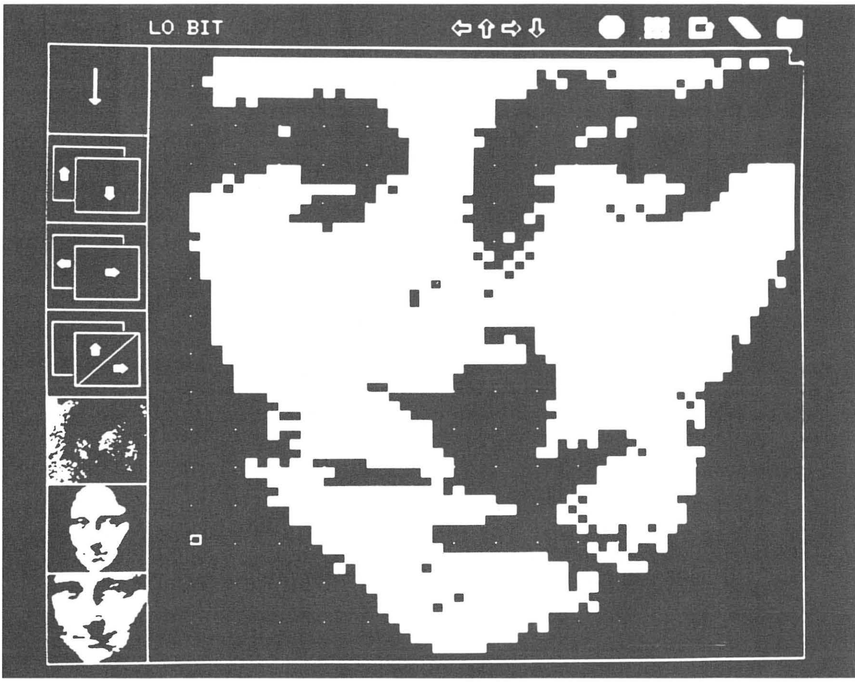
I developed an editor to create, edit, and save icons. Icons can be produced by two methods: (1) making bit-maps from full color images (these have been digitized with a video camera or created with other graphic software) and (2) drawing by grid-filling.

A bit-map (**figure 4**) is an image containing 1-bit of information for every pixel, or a one color image. They are made by reading the color value of every pixel of a full color image to evaluate whether it falls within a predefined range, and depending on its value the pixel is either turned *on* or *off*.

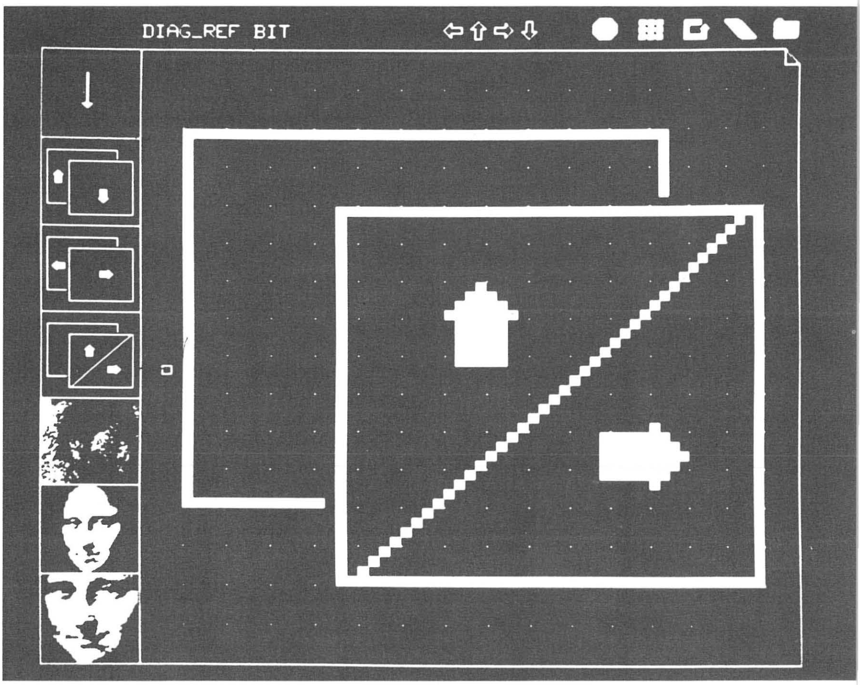
Grid-filling (**figure 5**) is simply filling in or erasing squares on a grid. New icons can be created with this method. It is also the method used to edit previously made icons.

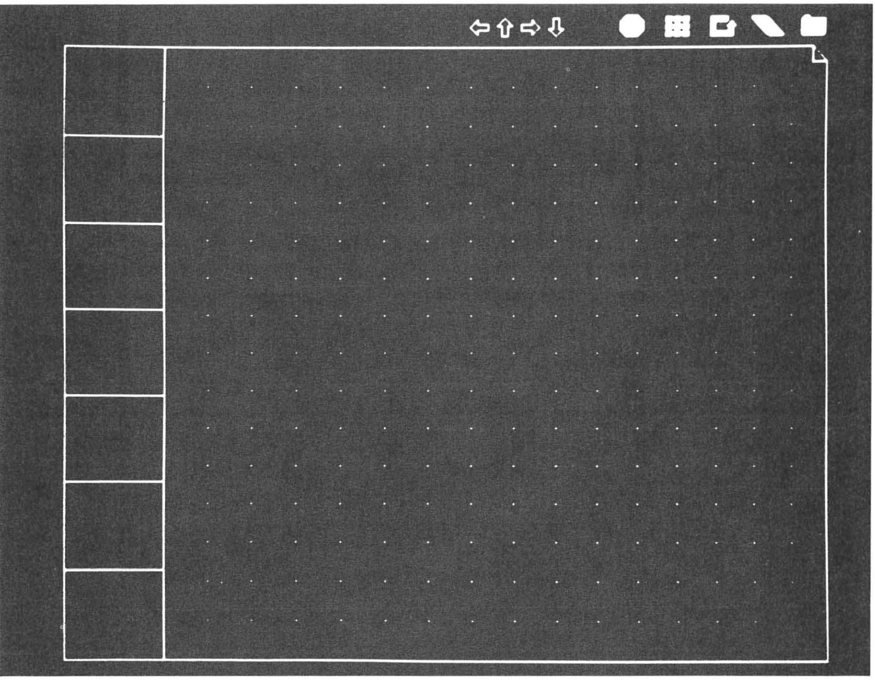
All activity in the Icon-Editor occurs on the overlay planes, leaving the frame buffer free for reference images. Copying an image on the overlay plane from an image in the frame buffer is a useful technique for creating an iconic image from a more complicated, full color image.

4
Bitmap

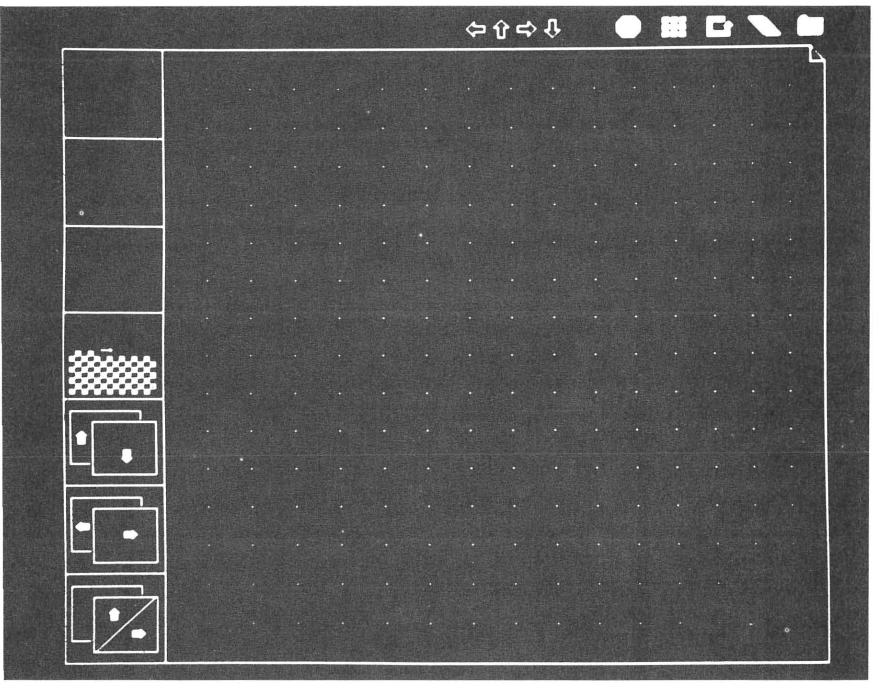


5
Gridfilling





6
Icon-Editing



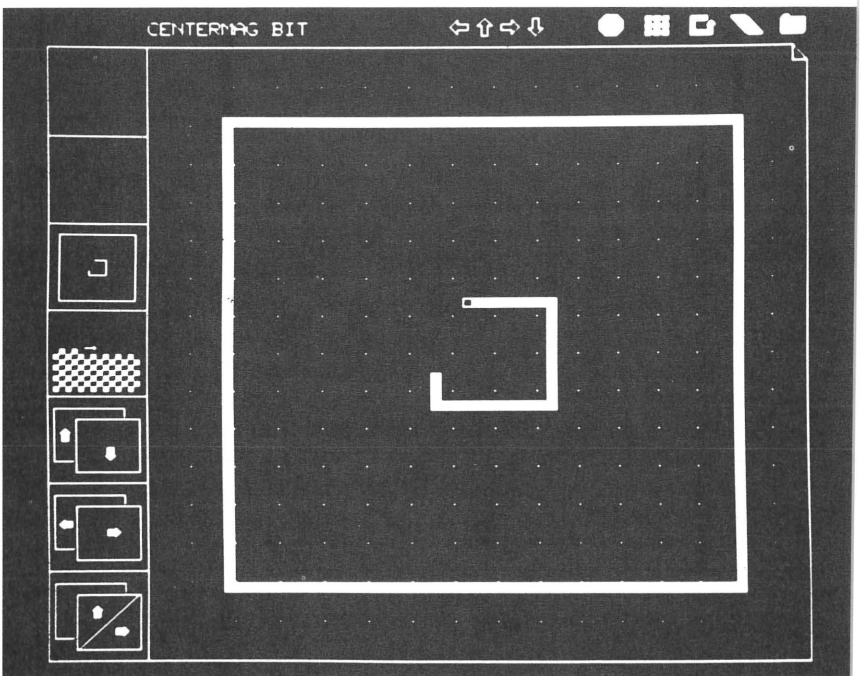
7
Choosing
icons to edit.

The screen (**figure 6**) in the Icon-Editor is divided into three areas: (1) drawing or work area, (2) display area of up to seven *current* icons (left side of the screen), and (3) the function icon menu (top edge of screen). The available functions are drawing, erasing, storing, moving, starting over, and displaying the contents of the icon directory. The name of the current icon is also displayed in the top left-hand corner of the screen.

The process of editing begins with a display of an icon directory on the upper monitor. The user chooses, using the tablet, puck, and cursor, the images to be modified (**figure 7**). Seven or less icons can be chosen. As they are chosen, each icon appears in a slot on the lower monitor. After the selection process is complete, the attention is directed solely to the lower monitor.

To modify an icon the user chooses it from the display area on the left side of the screen, and it is drawn, enlarged, in the drawing area. To draw a new icon the user picks a blank square from the display area (**figure 8**). The user can

8
Starting a new icon.



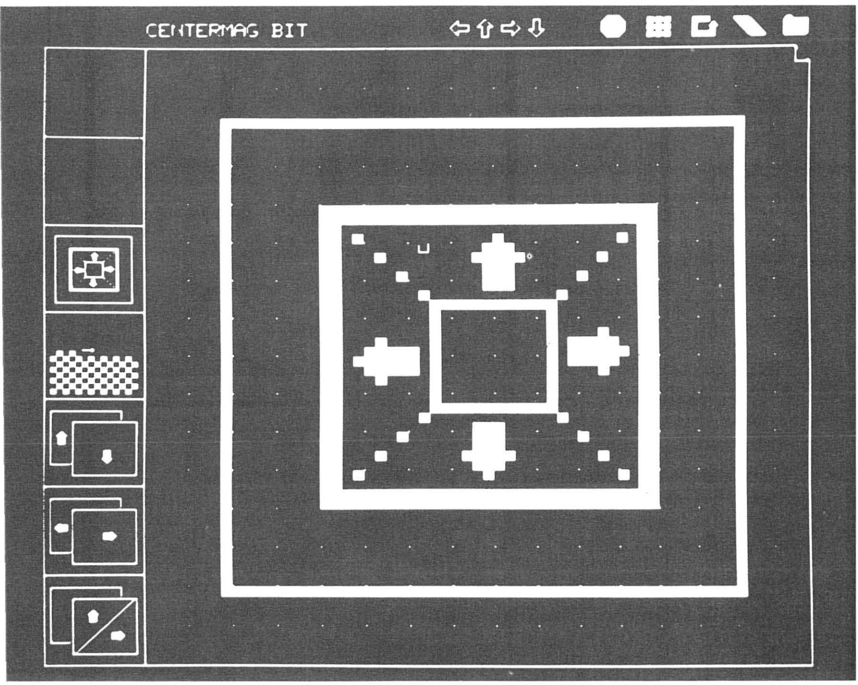
draw or erase squares at three module sizes. Drawing at the smallest module size (a 7-pixel square), 1-pixel changes are made at the icon size. These changes are seen simultaneously in the enlarged version and in the original icon (**figure 9**).

The image can be moved either up, down, left, or right, saved, modified, and resaved any number of times. Erasing is done by toggling the erase icon in the function menu, on or off. It is possible to start an image over by touching the startover icon. The user can return to contents of the icon directory to choose different icons to work on, by touching the return icon.

Icon Scripting

Scripting demands a method to keep track of a sequence of *things*, with the ability to dynamically rearrange that sequence any number of times. I used the conceptual model of a traditional storyboard to develop the Icon-Scripting software. Scripts can be created by two methods: (1) choosing icons from the icon directory, or (2) choosing procedures by name and then later displaying the icon sequence. The sequence of icons can be arranged and icons inserted and deleted. The script can be *played* at any time, and then re-edited.

To initially create a script with icons, the user chooses, using the puck, tablet, and cursor, from the contents of the icon directory displayed on the upper monitor. As the images are chosen, they are displayed on the lower moni-



9
The finished icon.

tor in the order chosen. When the selection is complete, attention is directed solely to the lower monitor. The method used to rearrange icons is to first choose the icon to be moved, then choose the icon to put it in front of. The sequence is immediately updated and displayed in the new order.

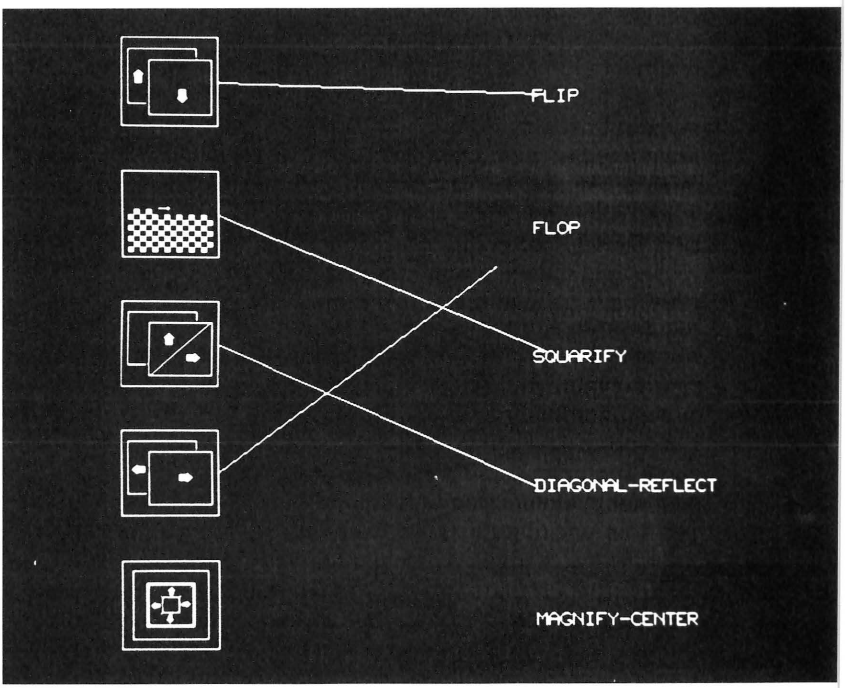
Icons are deleted by choosing *Delete* from the main menu and then pointing to the icon(s) to eliminate. Icons are inserted by choosing *Insert* from the main menu; the contents of the icon directory is displayed on the upper monitor while the user chooses an icon to be inserted and points to the icon in the sequence to insert it in front of. The script can be saved under a script name in the script directory. Scripts can be re-edited by re-storyboarding.

Tying icons to procedures is done in a separate function. Procedure names and icons are displayed together on the screen and the user draws a connecting line between an icon and a procedure name (**figure 10**). Connections between icons and procedures can be made or changed at any time in the printing process.

The second method of creating scripts is to choose procedures by name. The user can *play* the script, display the icon sequence, and proceed from that point to edit the sequence using the methods described above.

This software was written at the Visible Language Workshop at M.I.T., a graduate department and research facility concerned with the application of computers to the visual design fields. The computing environment includes a Perkin-Elmer 3220 32-bit mini-computer and a Grinnell GMR-270 frame buffer for image display with a 512 x 512 pixel resolution. Each pixel contains 27 bits of color information, 8 bits each of red, green, and blue. There are also three overlay planes each with one bit of color information. Each plane can be enabled or

10
Connections to procedures.



disabled individually. When enabled, a plane can be either opaque white or one of six transparent colors. A second black and white monitor with the same resolution is used as an alternate display for one of the planes. This allows uninterrupted image making to occur on the color monitor with simultaneous menu display on the B&W monitor. The input devices include a Summagraphics Bit Pad tablet with a four button puck, and a vidicon surveillance camera which feeds non-composite video signals to the frame buffer. The operating system, MagicSix, supports a multi-user environment with a tree structured file and directory system. The language is PL/1, a subset of PL/1. Both MagicSix and PL/1 were developed at the Architecture Machine Group, M.I.T. [8]

Conclusion

This project could be carried farther in several directions. One is to expand it as an interactive visual editing tool. It is a natural computer counterpart to traditional storyboarding, and would be a useful planning tool for film, video, animations, and electronic documents or books. New features could be incorporated, such as automatic icon creation, and animated icons that illustrate the procedure to which they point.

A second direction is toward greater capabilities of information and data display. In the context of an electronic bulletin board or on-line help directories, icons could tell synoptic stories like a picture language.

A third direction is to expand the concept of visual notation into something that approaches a visual language. Language defines the set of conceptions of, and orientations to the world. Through the adoption of and adherence to particular concepts of and orientation to reality, human beings actually create the worlds within which they live, think, speak, and act.

Computers have begun to redefine language. They have created their own dialects and injected our languages with hundreds of new terms and metaphors. Computer interfaces, through the use of language, create a concept of reality. Like language itself, the computer interface becomes a model and teacher of our own reality. People from many disciplines should have the opportunity to contribute their particular expertise to ensure balanced and broad-based interface design.

Notes

1
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2
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Dr. David Canfield Smith, op. cit.

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Greg Williams, *The Lisa Computer System*, BYTE MAGAZINE, February 1983.

8
Albert Stevens, Bruce Roberts, and Larry Stead, *The Use of a Sophisticated Graphics Interface in Computer-Assisted Instruction*, IEEE COMPUTER, March/April 1983.

Special thanks to Prof. Ron MacNeil of The Visible Language Workshop for his help on this project.

Spatial context as an aid to page layout :
a system for planning and sketching

Morissa Miller Rubin

A page layout system is created that recognizes the designer's current design process and reliance on spatial cues for visual development and decision. This system provides programs to construct, view, and evaluate serial pages simultaneously.

Visible Language XIX 2 (Spring 1985), 243-250

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A system has been developed to enable a user/designer to create a spatial context as an aid in page composition. Its primary purpose is to provide the tools that support a holistic approach to design. The individual parts as illustrated in this system by the pages of a book can be developed simultaneously. This encourages designers to consider unity and pacing in their work. Spatial context describes the area where serial pages are made, arranged, and evaluated. "Placing pages in a context provides a mechanism for making visual comparisons. A spatial dimension makes it possible to have many pages accessible at all times. As pages are designed they can be ordered, stacked and rearranged.

Overview and Design Specifications

Composing page layouts requires both the design of individual pages and the development of a structure for an entire work. Successfully designed books are easy to read because they have a visual rhythm and consistency. Designers faced with complex problems require the ability to make changes on a global level during the design process.

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The first stage of the design process, that of producing a rough plan for the work, requires visualization of as much of the work as possible. Compositions for individual pages can be developed in the context of other pages. However, completion of a page composition requires a more detailed visualization of specific text and images.

Environment and process

Traditionally, a graphic designer works in a tangible space. Studio, desk and tools are an integral part of the design process. Computer graphic systems bring many new tools but more fundamentally bring a new environment for the designer. In creating an environment for designers to implement ideas, it is important to address the established methodologies used by designers. An understanding of their methods, tools and conventions is fundamental to producing a useable tool. The way the system appears to work must reflect the way the user expects it to work and not the way it performs operations.

Comparing and revising work is basic to any design methodology. Working at a desk a designer has a flexible working process. One or more sketches may be developed at one time. A similar position of papers on a desk may refer to an organizational grouping of similar ideas. A designer may spread out a collection of solutions on a desk or pin them up on a wall in order that the sketches can be viewed simultaneously. By increasing the distance from the work a designer is able to view it in an unfamiliar way. Distance provides a way for a designer to gain objectivity and apply established criteria. Distance also provides a larger field of vision so that many parts may be viewed at once.

With greater specialization a designer often becomes dependent on other trained personnel for the reproduction of their work. The ability to design becomes dependent on the ability to clearly describe ideas to others. Conventions have been developed to minimize ambiguity in production specification. Similarly, computer systems require users to describe their ideas through the selection of menu buttons. Designers make menu selections in an effort to communicate their ideas. These selections instruct the computer to produce the work. Advances in technology have made the designer coordinator of various activities.

Designing is a visual process that is greatly aided by tactile experiences. For example, in developing a page composition, a designer may physically move small pieces of paper around a page. The act of pushing the elements around helps to generate more solutions. Originally a designer may have had one idea. In moving the pieces to a secondary position he becomes aware of the intermediate positions. Physical interaction with computer systems is not a "real" experience but rather a simulation of an experience. As designers work in the absence of traditional tools and materials, design conventions may change what are now simulated design experiences.

The Work Environment

Attempts to create user-friendly environments usually begin by simulating familiar experiences and places. However, the kinds of spaces in which a graphic designer works are varied and cannot be literally translated into a computer space. Display devices inherently lack spatial cues. The boundaries of the screen are finite and define a two-dimensional surface. Computer-based information does not have discernible physical properties and yet it can be enormous in quantity and accessed in many different ways. Often informational groupings (pages, chapters, and charts) cannot be displayed at one time. An accepted solution is to divide the data in time, successively displaying screens of information. Unfortunately screen divisions do not always correspond to informational divisions and the user does not have a feeling for their location in the work. Similarly, informational groupings that are recorded on paper may fall on discrete pages; the ability to hold and view several pieces of paper simultaneously compensates for this problem. Spatial references are used to organize large amounts of information.

Proximity, similarity, color and proportion are visual cues which elicit intuitive responses; what elements are important, dominant, or in conflict when combined with spatial connotations.

The appearance of objects close to one another signifies a relationship between them. Depth disparity connotes time or quantitative disparity. For example: the alphabetic ordering of a telephone book is easy to use because of its inherent spatial organization. A user of a phone book is able to quickly locate an entry even though he did not previously know its location.

In a book, for example, there are inherent spatial references. One can feel or see the current location relative to the whole.

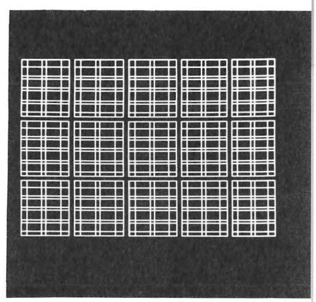
Developing a work space for designers requires a way to view separate pieces of the work simultaneously. The earlier stages of design requires developing several pages at one time. Working on them consecutively is awkward. This system, therefore, has to compensate for having a limited area and large amounts of information to display. Pages are layered in space. Simple shapes are used to represent text. Pages are small in scale; symbolic representations of text and image are adequate in detail.

Communication between the system and the user is based entirely on tablet input.* The physical movement of the puck corresponds directly to events: pages move as the puck is dragged. Choices are indicated through a menu structure which is arranged so that programs with similar functions are located at the same levels. A selection from the menu may be located at the same levels. A selection from the menu may be made at any time and the user has the ability to go to any point (place) in the menu structure. A generalized working process is implied by a left-to-right reading of the menu choices.

Page Definition

Typically the user would proceed by defining a page. The user can choose any location within the workspace for a page and define both its size and proportion. Once a page is defined it can be used as a rubber stamp for subsequent pages. A series of pages of various proportions can be developed. When the best page proportion is determined it can be duplicated for the entire work.

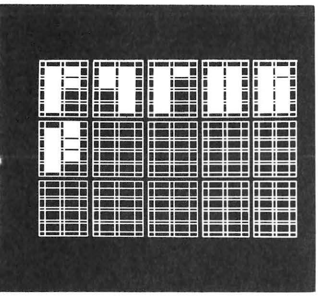
There are two aids that assist the designer in defining page proportions. One option is to define the size of the page based on a set of predetermined standard proportions, 6×9, 8.5×11, 9×12, and European A series. As the user defines the size of the page its proportion will remain locked to the appropriate format. A second option displays the current proportion of the page as the user modifies its size.



Grid Definition

A grid structure can be defined at any point after a page has been made. Users have the option to define several pages first (of varying or similar size) and then apply grids to one or many pages in any order. A page and a corresponding grid can also be defined before defining subsequent pages. There are two procedures for defining grid structures. The first option is a way to make fast, simple grids. A number ranging from one to twenty is chosen and a grid containing n modules in *x* and *y* is placed on the current page. The second option requires adjusting a ruler alongside a designated page. The frequency of the markings on the ruler are determined by the user. As the user moves a slider, the ruler is immediately updated. These increments are then used to create the grid. By pointing to locations on the ruler, lines can be either erased or drawn. Symmetrical and asymmetrical grids can be made. Any grid structure, like any page, can be used as a rubberstamp. A grid can therefore be developed for a book and reused to design every page.

There are several options for making duplicate pages. All of the options require identification of the page to be copied. To place a single copy, the user has to choose a new location for the page. Double spreads can be made in two ways; by reflection and duplication of the first page. A location for the first page is chosen anywhere in the workspace. The four possible locations for the second page are determined by the sides of the first page. The user simply points to the general locations in reference to the first page. The second page is drawn with its grid oriented accordingly. A matrix of multiple copies can also be made. This is useful when the page and grid structure have been developed. Repetitive information, such as a page heading, is automatically copied onto every page.

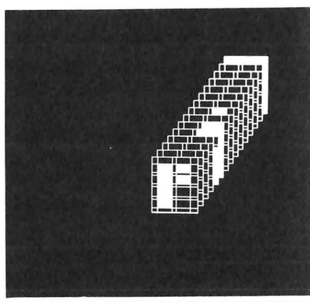


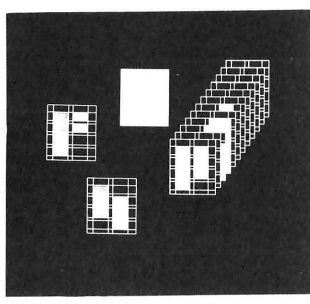
Page Composition
Composing individual pages requires the identification of a specific page. Once a page has been chosen, text areas or image areas can be placed in the predetermined grid modules. A location within the page is chosen and becomes attached to the nearest grid intersection. A box is then stretched to indicate the size of the area. As it stretches, it jumps to the grid intersections. Any number of modules can be enclosed in an area. This allows a designer to quickly map out areas on a page that adhere to the greater grid structure. Text and image areas can be erased by pressing a second button on the puck. The workspace is redisplayed after an area is erased.

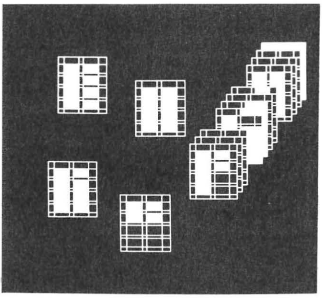
Pages in context
Several procedures operate on the page as an individual unit. These procedures include moving, deleting, choosing, and identifying pages. Such operations can be executed on pages at any stage. Choosing a page produces the mechanism for changing the status of the current page. The user points to pages which become highlighted and unhighlighted accordingly. When the user stops pointing, the last page to be highlighted remains the current page. This procedure is embedded in many operations. It is also available to

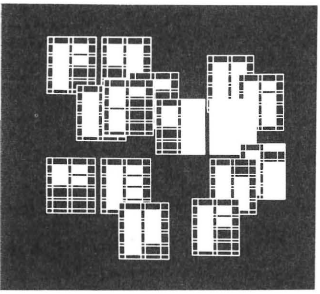
the user as a way to move through the workspace and visually identify existing pages. To delete a page, the user moves through the workspace identifying pages. When the page to be deleted is identified, it is eliminated from the record and the display is updated. The move operation is similar to the delete operation. It first requires identification of the page. By moving the puck, the user can move the page around the workspace. When its new location is chosen, the display is updated. In addition to visual identification, pages can be identified by an associated numerical value. The numeric value represents the page's position in the sequence of total pages. A list of existing page values is displayed. Pointing to the page value causes the corresponding page to be highlighted. For example: a user can inquire, "Show me page five."

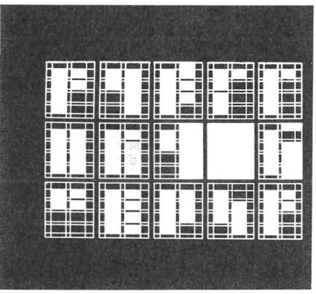
Pages are located by their position in the workspace. The relationship between pages can be modified by moving individual pages. Mechanisms also exist to modify the general characteristics of the workspace. Pages can be displayed in a two-dimensional matrix format. The numerical value associated with each page determines its position in the matrix. A second possibility is to display the order of pages in a matrix on a secondary display. The arrangement of the workspace is maintained and the order of the pages is illustrated. The third method for organizing the workspace involves stacking pages in a linear sequence. Pages only partially overlap so that they can be distinguished from one another. By stacking pages, several goals are accomplished. Pages occupy a smaller area of the screen. This provides more room for a work area. Pages that are not currently being worked on may be temporarily placed aside and yet remain accessible. Stacking pages also shows the page

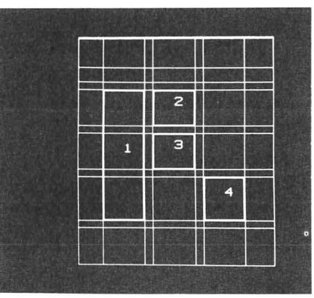


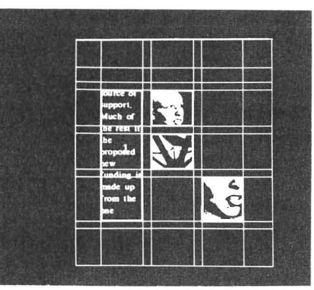












sequence. A page can be easily located by its location in the stack. The numeric value associated with each page determines its position in the workspace regardless of the arrangement of the workspace. This value can be changed by the user, who points to pages and consecutively assigns the page order. A user can easily move between the various configurations of the workspace. Additionally, pages can be rearranged by moving individual pages.

When the planning of pages is finished, page compositions can be refined using *Pager*, a page composition system written by John Thompson at the Visible Language Workshop. The user points to a page and the associated data is packaged and sent to the required data file. When a designer uses *Pager*, a list of existing pages is displayed. Pages sent from the sketch system are identified by their file name and their numeric value in the sequence. When the page is loaded, the grid and existing regions defined in the sketch system will be indicated. Specific text files and images can then be resolved.

The spatial environment and its manipulation forms an integral part of the designer's decision-making process; designing is the process of evaluating visual relationships. Computer systems do not inherently provide a spatial context conducive to such decision-making. The program described creates a spatial context by creating spatial illusions. Stacked and ordered book pages are used to produce the designer's required points of reference.

*Hardware configuration at the Visible Language Workshop consists of a Summa-graphics bit pad and puck, a Grinnel 27 bit frame buffer, color monitor, and a Perkin Elmer 32 bit mini-computer.

Dynamic Information Display

Yoshiki Nishimura
Keiichi Sato

The Video screens and sophisticated computer technology offer new display media for typographic information transfer. However, the design attributes for composition employed by the new media take little advantage of this new technology; instead, they tend to emulate conventional design attributes established for print.

In new media, the state of an information display changes because the three-dimensional structure of its information (the two dimensions of the display plane and the time dimension) is revealed in temporal segments on the display screen; Its communication is *dynamic*. New design attributes for composition must be identified by considering this *dynamic* nature. These and a new design process in which programmed rules assist the designer to create visual patterns in a *dynamic layout* are explored in this paper.

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New Typographic Possibilities

'The new book demands a new writer.' (El Lissitzky, 1923)

Due to the recent development of electronic information handling, more and more people are viewing typographic material displayed on video screens linked to computer systems. Information services such as videotext, computer aided instruction (CAI), electronic mail, and computer-assisted reference service are in practical use[1]. In the near future, electronic media will take over dissemination of much of the typographic information which is presently received through print media.

In the introductory phase of a new typographic medium, established patterns of typographic design for conventional media are directly applied to the new media; familiar design features are reproduced. Once the unique characteristics of a new medium are identified, new patterns of typographic design are introduced in order to take full advantage of the new technology.

The purpose of this study is to examine the new typographic possibilities that electronic information handling and the computer afford. The goal of this research is twofold: first, to identify the characteristics of the new media in comparison with those of print and to develop new design attributes that enhance the quality of typographic transfer on a display screen; and second, to develop a framework for a design process and programmed tools for designers which provide interactive assistance in typographic layout generation.

Performance Measures For Typographic Design

The unique characteristics of the electronic display media can be analyzed from the perspective of communication modes. Communication modes are the ways in which communication takes place; they can be classified by static–dynamic and sequential–presentational relations.

Static and Dynamic Communication Modes. Static and dynamic communication modes are explained by Doblin[2] as follows:

The messages of static media are tangible, and as permanent as the materials used. They need only ambient light to operate. The messages of dynamic media are transient, only there in real time as presented. They require simultaneous conditions: program, equipment and power.

In the static mode of communication, information is persistent on a medium such as a painting, a photograph, and printed text. In the dynamic mode of communication such as in a movie, a televison program, or a videotext, information is not permanent on the medium and is distributed in the dimension of time.

Sequential and Presentational Communication Modes. Doblin also introduces another classification of communication modes, the sequential and the presentational communication mode, based on the character of information reception by a viewer[2].

A presentational medium, such as a poster, is seen at once. It gives a total impression, then the eye tracks over it, picking up details in order of their perceived importance. Sequential media–books for example–are a string of meaning units in time or space. These *are perceived and matched to stored meaning units in our memories and then accumulated into a total message.*

The sequential mode of communication requires or allows a specific order of information reception for efficient comprehension of the contents. The presentational mode of communication, on the other hand, allows an arbitrary order of information reception.

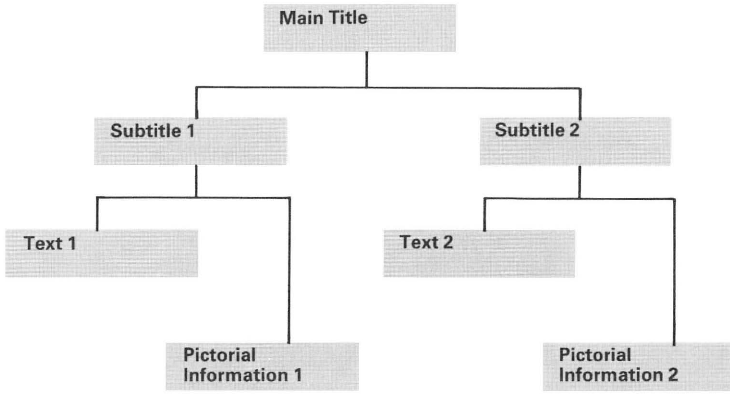
Through the combination of these two classifications, four different types of communication modes are derived:
- Static-Sequential Mode
- Static-Presentational Mode
- Dynamic-Sequential Mode
- Dynamic-Presentational Mode

A conventional book is an example of a medium with a static-sequential mode because understanding of contents assumes a certain order of reading. On the other hand, a poster allows for arbitrary scanning of a static layout of information; a static-presentational mode. The last two modes provide new possibilities for typographic design.

The dynamic-sequential mode is characterized by its linear distribution of information over the time.. This mode is, for example, found in a movie and a T.V. program where total meaning is comprehended by accumulating images presented sequentially. On the other hand, the dynamic-presentational mode is characterized by its non-linear distribution of information. In other words, the dynamic-presentational mode allows viewers to choose a pattern of information presentation by the interactive capability of the medium. The Czechoslovakian branching-movie shown at the 1967 Montreal World's Fair is an example of this type of presentation[3]. At a number of branching points the audience voted on what was to happen next. With the advancement of computer and media technology, the dynamic-presentational mode has been implemented in various forms such as interactive information service systems and electronic books.

The real time interaction with the media is classified into transposition and transformation by Owen[3]. The transpositional operation allows the viewer to observe an information model from different positions in space and time. For example, a video tape recorder can alter the real time sequencing of a T.V. program by executing such transpositional operations as slow motion, backward procession, and freezing. On the other hand, the transformational operation allows the viewer to alter the features of a model to see "what-if". For instance, interactive design processes could change the rules of a typographic generation system to create new typographic formats in a complex presentation system.

Figure 1:
A relational structure of information contents



: **Layout Unit:**

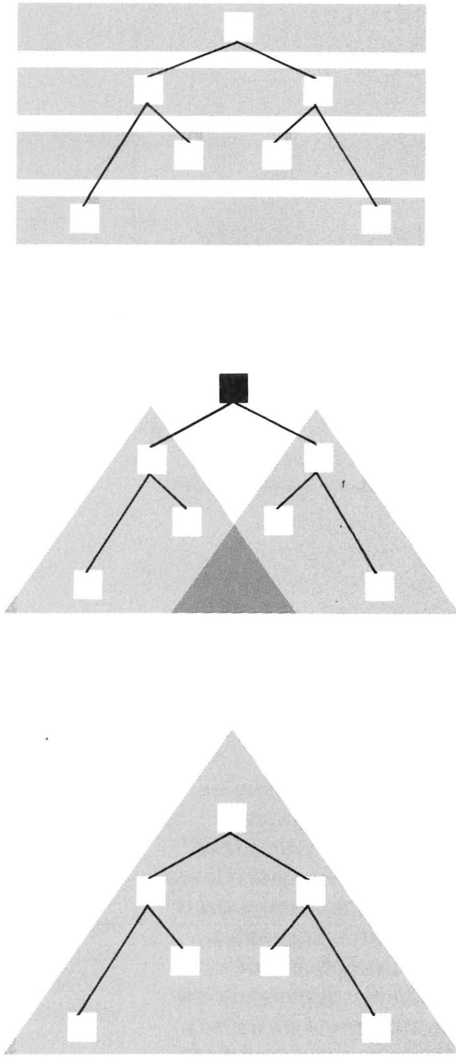
Typographic Presentation of Information

Typographic design is an interpretation process between an original message and its projected meaning for the viewer. Once the information is translated to a visual form such as printed text, all the visual elements and the relations between them develop their own statements. As the content becomes complex, it needs structural organization for efficient communication. A layout is a form of structural representation of underlying information; it defines the nature of the system.[4] Typographic presentation systems need a mechanism to interpret information content. Such a mechanism is shown in ***Figure 1***.

In the hierarchical structure of information contents, there are many ways to compose meaningful groupings of layout units. For instance, layout units in the same level of the hierarchical structure compose groupings (***Figure 2a***), those in a local hierarchy also compose groupings (***Figure 2b***), or the whole structure may also be considered as one cluster in relation to a hierarchy of other information (***Figure 2c***).

The layout units in each grouping are visually united by the consistent quality of their visual patterns. Each group is visually distinguished from the others. Comprehension is enhanced only when these patterns are logically organized. In conventional media, various grid systems are used to produce a logical order.

Figure 2.
Groupings of layout units in a hierarchical structure

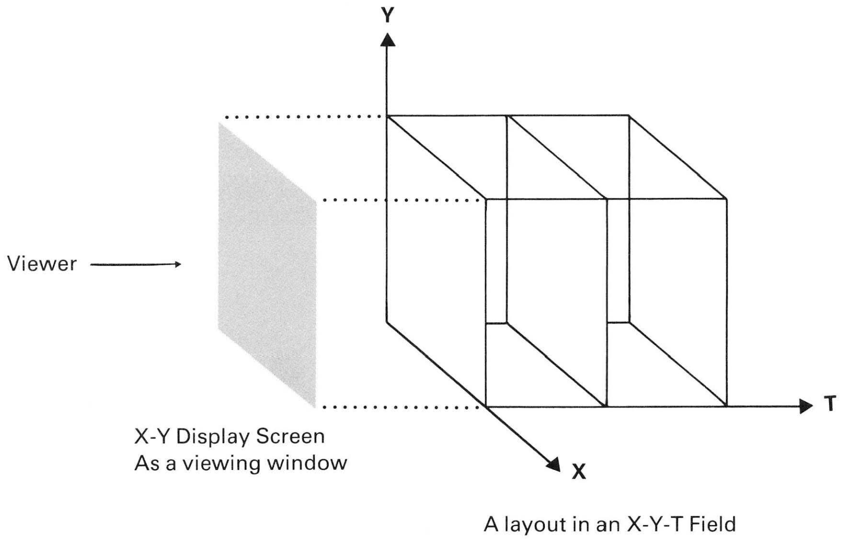


(a) Levels

(b) Local Hierarchies

(c) The Whole

Figure 3.
Presenting a layout in an X-Y-T field



Dynamic Display Mechanisms and Typographic Variables

Typographic information transfer in dynamic communication modes is complex and is an area in which few designers have experience. Since there are no effective guidelines and tools to manipulate and layout typographic elements in time, it is difficult for designers to produce a dynamic layout with accurate prediction of its performance along the time axis. In order to develop effective methods for this class of design problem, it is essential to identify underlying mechanisms and variables of typographic design in dynamic communication modes.

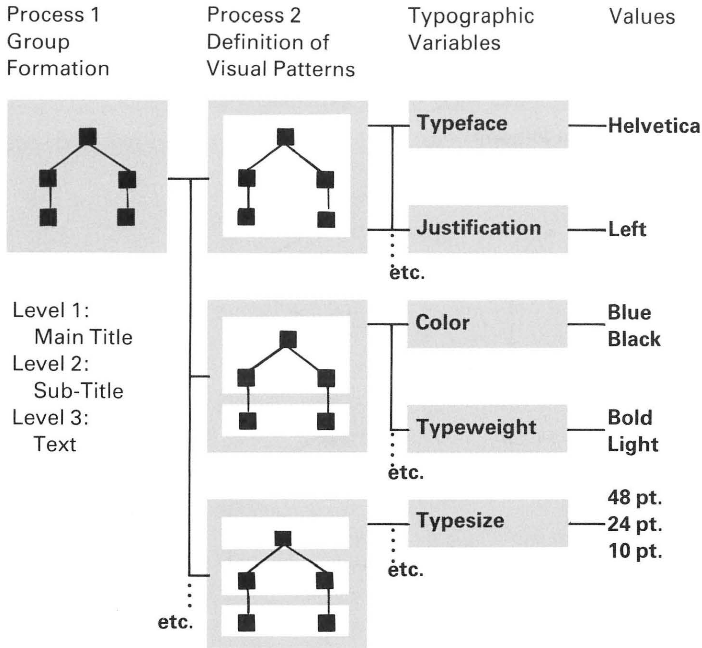
A dynamic layout is generated in (X-Y-T) three-dimensional space, where (X-Y) represents the two-dimensional display plane and (T) represents the time dimension along which a presentation sequence proceeds.[5] A viewer, therefore, observes a three-dimensional layout of typographic elements only through the two-dimensional viewing window as indicated in ***Figure 3***.

Typographic variables are fundamental visual parameters which determine a visual pattern for a layout. There are morphic, dimensional, and allocational variables.

In dynamic mode, typographic variables in the time dimension also need to be handled. Although static and dynamic information media share some of the variables for the representation of typographic configurations, there are some variables inherent in dynamic information media (marked by * in the listing below).

Morphic variables. These determine the morphic characteristics of a layout

Figure 4. The generation of visual patterns



unit. Typical morphic variables are:

- Typeface (font, weight, and angle)
- Typesizes
- Text density (spaces between letters, words, and lines)
- Color
- Text-block format (justification, paragraph indentation)
- Blinking*
- Flashing*

Dimensional Variables. These specify dimensional properties of typographic elements. Some examples of the variables are:

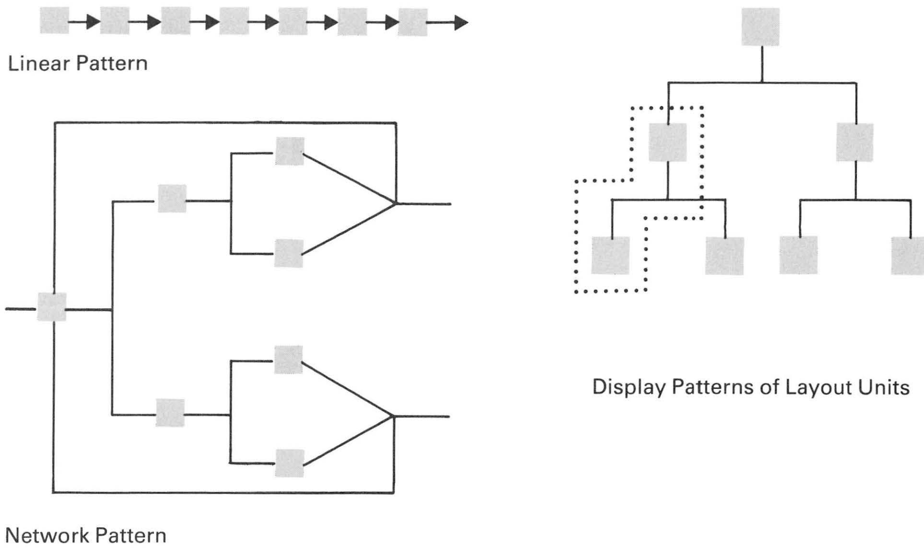
- Horizontal size (text-block width)
- Vertical size (text-block height)
- Duration*
- Line length
- Zoom rate*

Allocational Variables. Variables of this class specify locations of typographic elements in the layout field directly or indirectly. Examples of these variables are:

- Horizontal location
- Vertical location
- Time location*
- Scrolling mode (saccadic or smooth scrolling)*
- Output rate*

The consistency of a visual pattern in a grouping and the differentiation of a visual pattern among groupings are created by assigning specific values to the typographic variables introduced above. This process is explained in ***Figure 4.***

Figure 5. Display patterns of layout units



Layout Generation Process for Dynamic Information Display

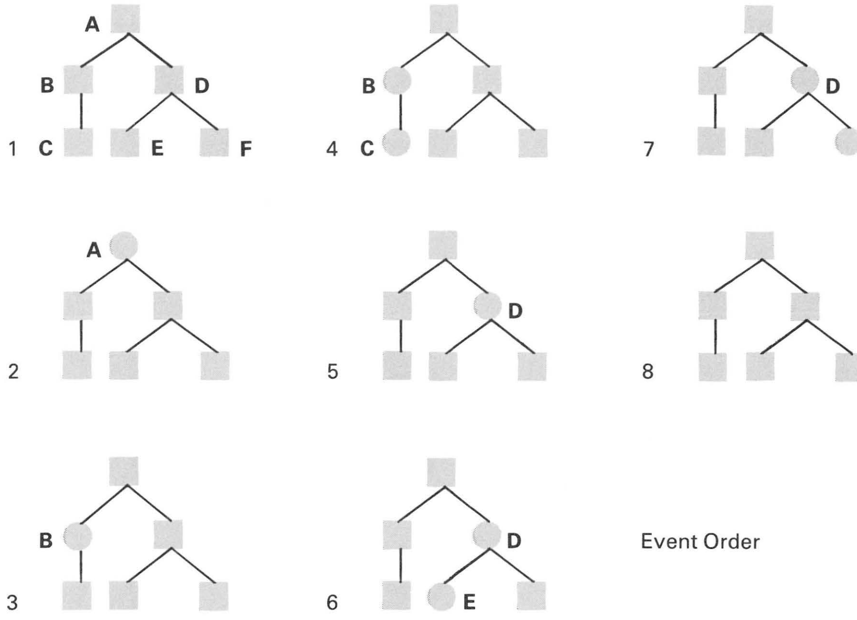
When design situations are complex, like the ones in dynamic layout generation, the designer's manipulation needs to be assisted by logical rules. In the proposed design process, both logical rules and the designer's decision are incorporated in the layout generation.

The logical rules provide a frame work for visual order. For example, rules employed in the design process help the designer to form consistent visual patterns in a layout. Individual aesthetics are employed in the design process because the degree of freedom for generation of visual pattern is extremely large. For instance, such questions as "what typesize should be used for a headline" and "what sort of a grid pattern should be employed for locating layout units" are resolved primarily by the designer's aesthetic sensitivity.

The logical rules only give a designer the formal possibilities of visual pattern. The logical rules can be implemented efficiently in a computerized design system; thus they are call *programmed rules*. With precise and versatile programmed rules, a designer can produce layouts with uniform quality.

Dynamic visual patterns of a layout are sub-classified into dynamic morphic, dimensional, and allocational patterns. Dynamic morphic patterns are determined by assigning specific values to time variables such as blinking and flashing. The dynamic allocational and dimensional relations between layout units are described by the patterns of appearance order and contextual range. Appearance order of layout units is represented by networks in which independent layout units are linked in progressive continuity. These

Figure 6.
Contextual range



patterns are grouped into a linear pattern and a network pattern (see ***Figure 5***). The dynamic presentational (transpositional) mode is required to include a branching network for user interaction. Contextual range concerns the range of a field in which layout units are displayed. The range is defined by values which indicate levels in a hierarchical structure of layout units. For instance, in ***Figure 6***, the layout units in the second and the third levels are simultaneously displayed.

When the patterns of appearance order and contextual range are combined, a pattern of event order is created. In the pattern of event order, both dynamic allocational and dimensional relations between layout units are described. In ***Figure 7***, appearance order for a three-level hierarchical structure is set to a linear pattern (A-B-C-D-E-F).

Assume the contextual range is declared as the second and the third levels. The pattern of event order is shown sequentially: layout units indicated by circles are the ones displayed on screen (on-state), and layout units indicated by squares are the ones not displayed (off-state). Since the contextual range is defined as the second and the third levels, A is displayed by itself, C is displayed while B is on-state, and E or F is displayed while D is on-state.

The accurate time-locations and durations of layout units are determined by giving specific values to two kinds of pauses: a pause of display after a layout unit appears (Pause 1), and a pause of display after a layout unit disappears (Pause 2). By deciding upon a unit of time (one second) and setting the values of Pause 1 and Pause 2 to a multiple of the unit (two or three seconds), a grid pattern of time is constructed.

Figure 7.
Event order and display image

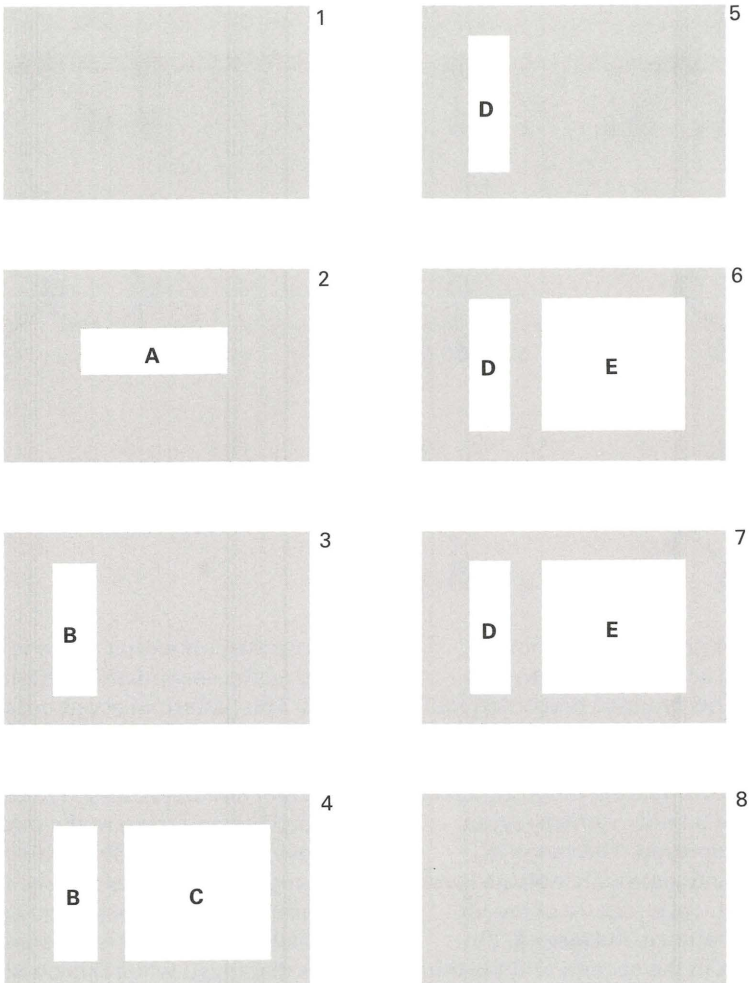
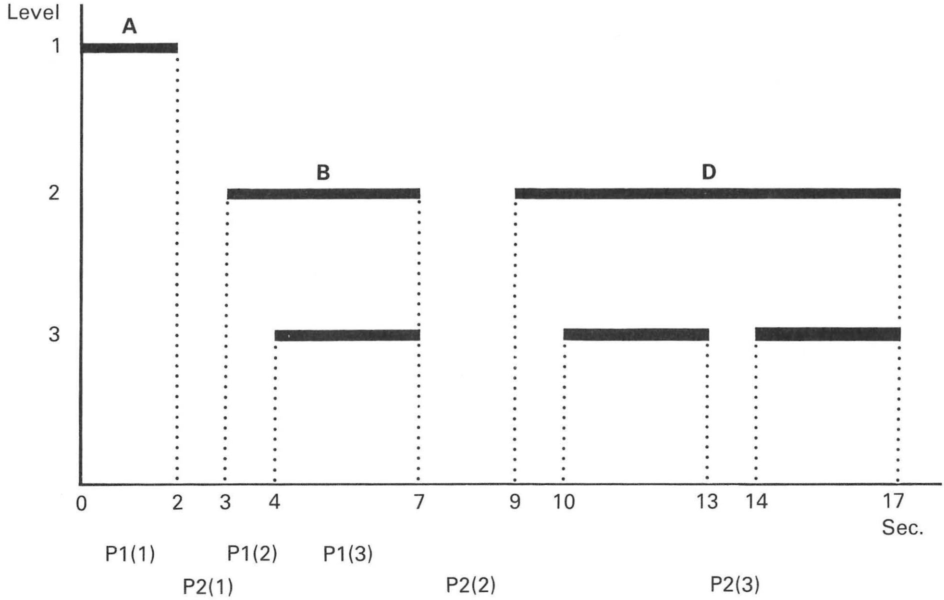


Table 1.
Values of pauses

	Pause 1 (sec.)	Pause 2 (sec.)
Level 1: A	2	1
Level 2: B & C	1	2
Level 3: C, D, E, & F	3	1

Figure 8.
Time map



As an example, the values for pauses, given in ***Table 1*** determine the pattern of event order in ***Figure 7***. The accurate time assignment of the layout units are diagrammed in the time map shown in ***Figure 8***. In the time map, P1 and P2 represent Pause 1 and Pause 2, and numbers in parentheses represent hierarchical levels: for instance, P1(1) stands for Pause 1 of level 1. When more than two layout units disappear at the same time, Pause 2 of a layout unit in the highest level of the hierarchy takes priority. In ***Figure 8***, display pauses two seconds after B and C disappear; Pause 2 for layout unit B takes priority.

These dynamic patterns allow for consistency in planning information display. These patterns also become basic design attributes for layout generation in a dynamic presentational communication mode.

Figure 9.
The design proces in DYNAM

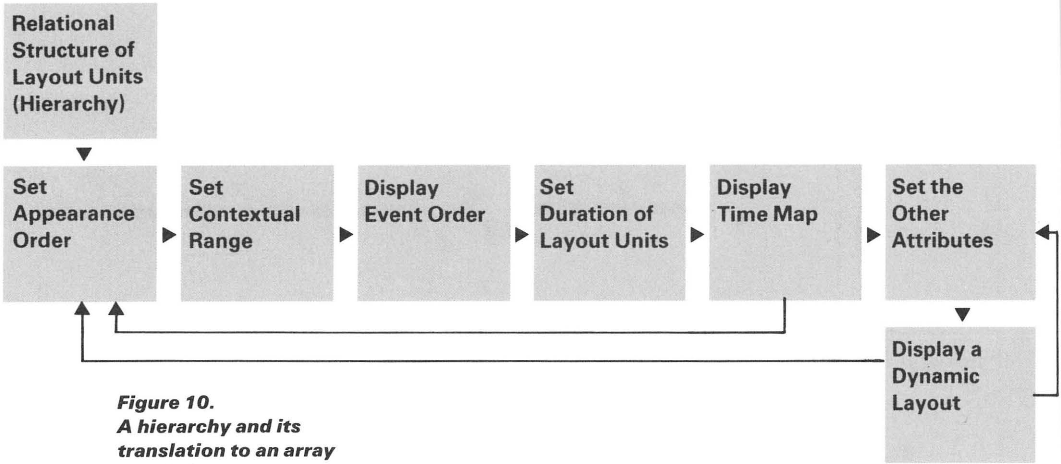
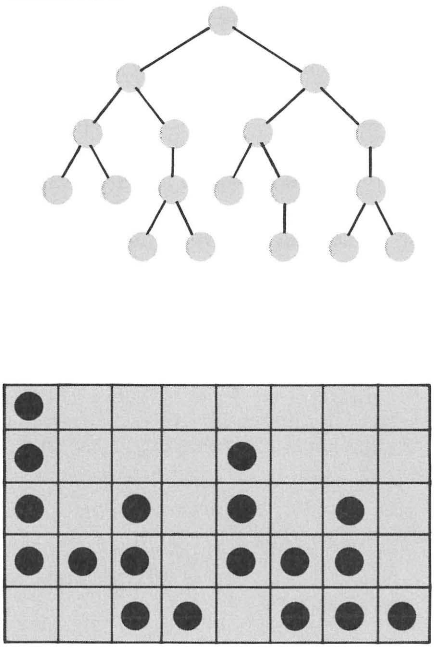


Figure 10.
A hierarchy and its translation to an array matrix form

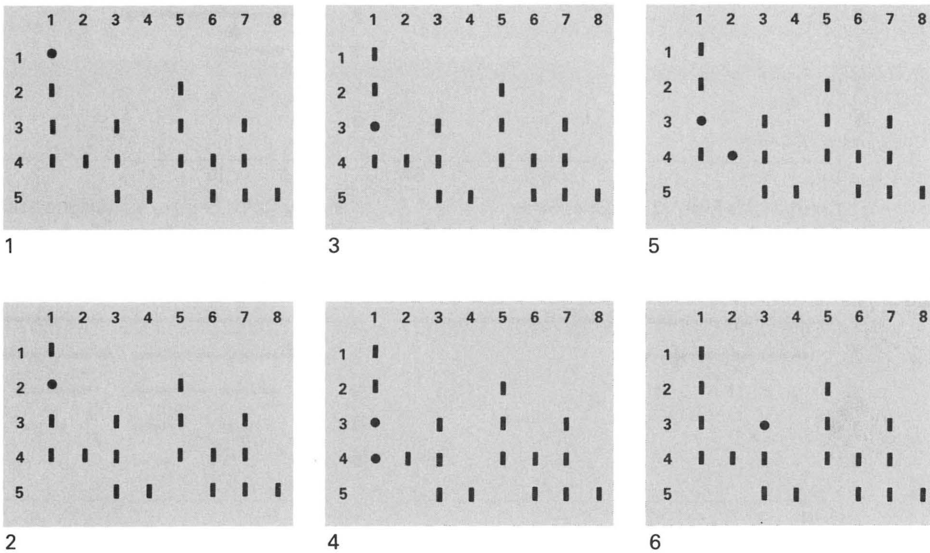


DYNAM Program

DYNAM is a demonstration program to illustrate the proposed process for typographic layout generation. It provides interactive assistance for a designer in creating a dynamic layout on a display screen. A set of simple graphic elements such as lines, rectilinear blocks and circles are used to represent layout units for simplicity in the development of this prototype program.

The design process in DYNAM is depicted in ***Figure 9***. In this process, two kinds of intermediate patterns are graphically displayed on a screen. The first sequentially illustrates the pattern of event order as shown in ***Figure 7***. The second shows the pattern in which the accurate temporal relation of layout units (a time map) is described. These patterns graphically help a designer confirm his decisions in the inter-

Figure 11.
Displayed event order



mediate states of the design process, if he wishes, they can be altered by interactive means represented by feed back channels (dashed) lines in ***Figure 9***. The production of a dynamic layout is performed by the eight steps described below.

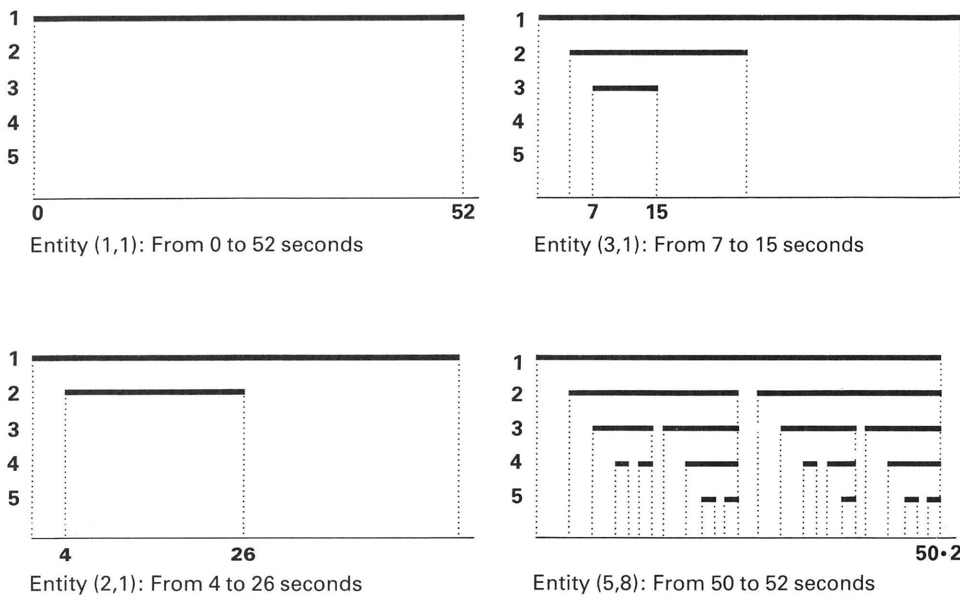
1 The hierarchical structure of the information contents is interpreted into a hierarchical structure of layout units represented by an array matrix as shown in ***Figure 10***. The maximum size of a matrix is 10 rows by 50 columns.

2 The pattern of appearance order is automatically assigned to the hierarchical structure by a programmed rule incorported into DYNAM. (Currently, DYNAM creates only linear patterns.)

3 A pattern of contextual range is determined. The system prompts the user to specify levels of the hierarchy to be displayed together.

4 One of the program rules automatically generates the pattern of event order by combining the linear appearance order and the contextual range specified by the designer. The pattern of event order is dynamically shown on the screen by coloring the hierarchy of layout units: the colored layout units are ones being displayed on a screen (on-state) and the colorless layout units are ones not being displayed (off-state). ***Figure 11*** shows an example pattern of event order (part) in a sequential order. In the diagram, a rectangle represents the off-state of a layout unit, and a circle represents the on-state. ***Figure 11*** shows a linear appearance order with the contextual range of the third, fourth, and fifth levels of the hierarchy.

Figure 12.
Time map



5 The display timing of layout units are determined by assigning values to Pause 1 and Pause 2 of all layout units.

6 The program displays the time map of a dynamic layout. The accurate temporal relation of layout units are graphically displayed on a screen, and the exact appearance and disappearance time (in seconds) for each layout unit are also presented at the bottom of the time map. ***Figure 12*** is an example of a time map for the hierarchy shown in ***Figure 10*** with the specification in ***Table 2***. On the actual screen, a different color is used for each level of a hierarchy to increase the readability of a diagram. This pattern can be altered by the designer's interaction. See the feedback in ***Figure 9***. ***Figure 13*** shows examples of the altered patterns.

7 The other attributes of layout units as listed below are determined by the designer. DYNAM assigns user-specified values to each layout unit.

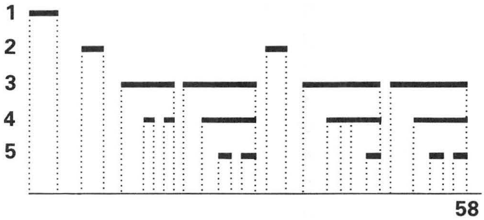
(The variables marked with asterisk (*) are related to time-pattern.)

Morphic Variables
- Shape: circle, square, rectangle, triangle, and line
- Color: black, blue, red, magenta, green, cyan, yellow, and white
- Writing Pattern: curves and lines can be set in a specific writing pattern like dots, dashes, and a solid line. When combined with shading, it creates a shading pattern.
- Shading: interiors can be shaded.
- Blinking*

Proportional Variables
- Size

Allocational variables
- X-Y location

Figure 13.
Alternated patterns of a time map



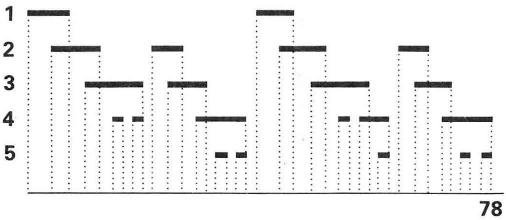


Figure 14.
Displayed image

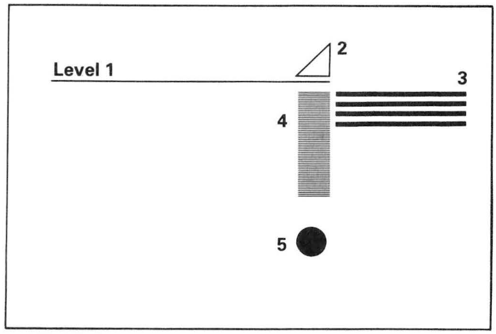


Table 2.
Specifications of Dynamic Patterns

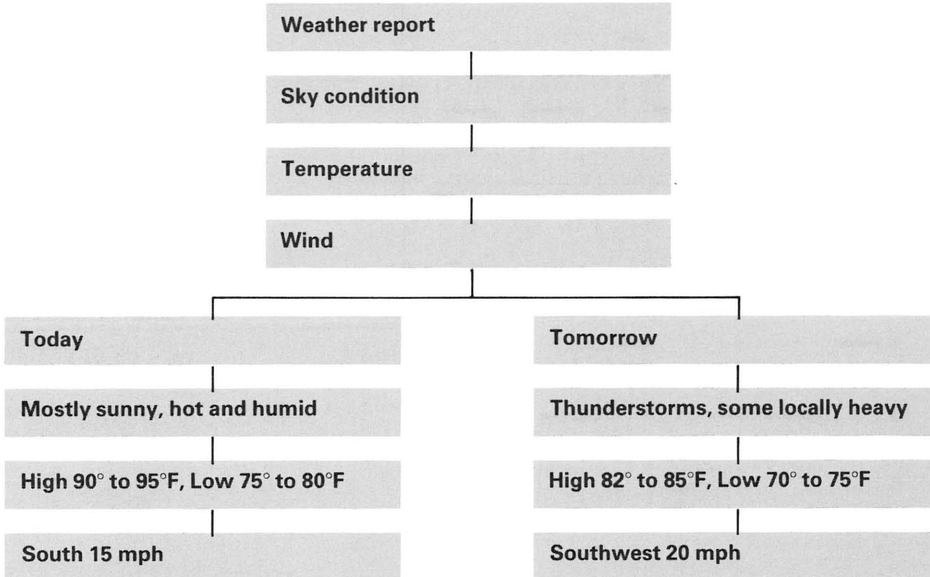
Appearance order	Linear Pattern	
Contextual Range	Level 1, 2, 3, 4 & 5	
	Pause 1 (sec.)	Pause 2 (sec.)
Level 1	4	0
2	3	2
3	3	1
4	2	1
5	2	1

8 The dynamic layout is presented on a screen. ***Figure 14*** shows an example of a displayed image. Each shape represents attributes of the layout units in each level of the hierarchy. These shapes dynamically appear and disappear following the time map pattern shown in ***Figure 12*** and ***13***.

A dynamic layout with actual type could be generated by replacing the symbolically represented layout units with real typographic elements. For practical generation of a dynamic layout, textual information with a specified array matrix needs to be input at **step 1**, and typographic variables such as typeface, typesize, space between lines, and scrolling mode need to be determined in ***step 7***.

Currently, the programmed rules incorporated into DYNAM create only linear appearance order, relatively simple patterns of contextual range, and consistency of visual patterns in hierarchical levels.

Figure 15.
Hierarchical structure
of "Weather Report"



Demonstration of Dynamic Layout

A hypothetical design system generated the next example of a dynamic layout, *Weather Report*. In the system, actual type and additional graphic elements are assumed to be available. The information content to be displayed is shown in ***Figure 15***.

This information can be organized into various hierarchies. With specification of typographic variables as shown in ***Table 3***, the time map in ***Figure 16*** is generated. By assigning the static attributes of the layout units to each level of the hierarchy, a dynamic layout, a series of screen images which are observed at specified moments in time (as shown in ***Figure 17***), is generated.

Figure 16.
Time map of "Weather Report"

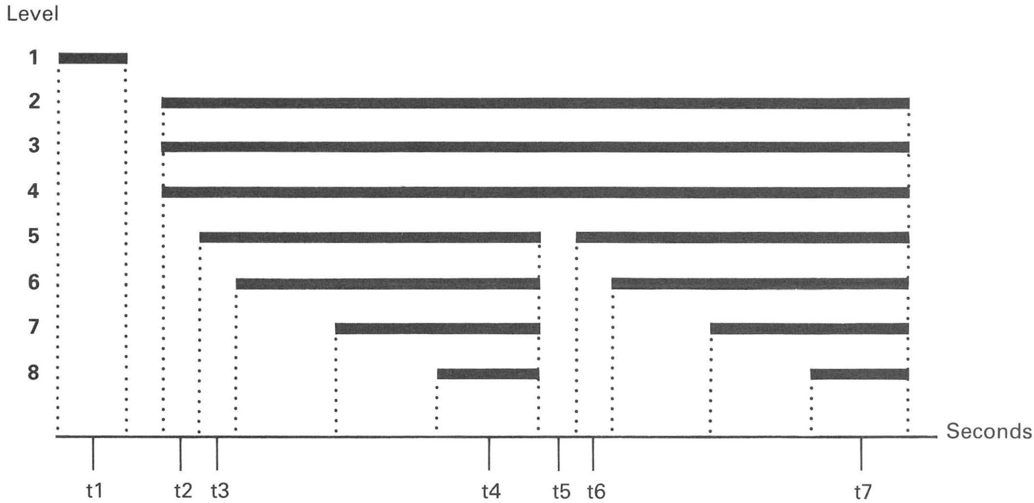


Table 3.
Specifications of dynamic patterns for "Weather Report"

Appearance order	Linear Pattern	
Contextual Range	Level 2, 3, 4, 5, 6, 7 & 8	
	Pause 1 (sec.)	Pause 2 (sec.)
Level 1	2	1
2	0	0
3	0	0
4	1	0
5	1	1
6	3	0
7	3	0
8	3	0

Figure 17.
"Weather Report"

■

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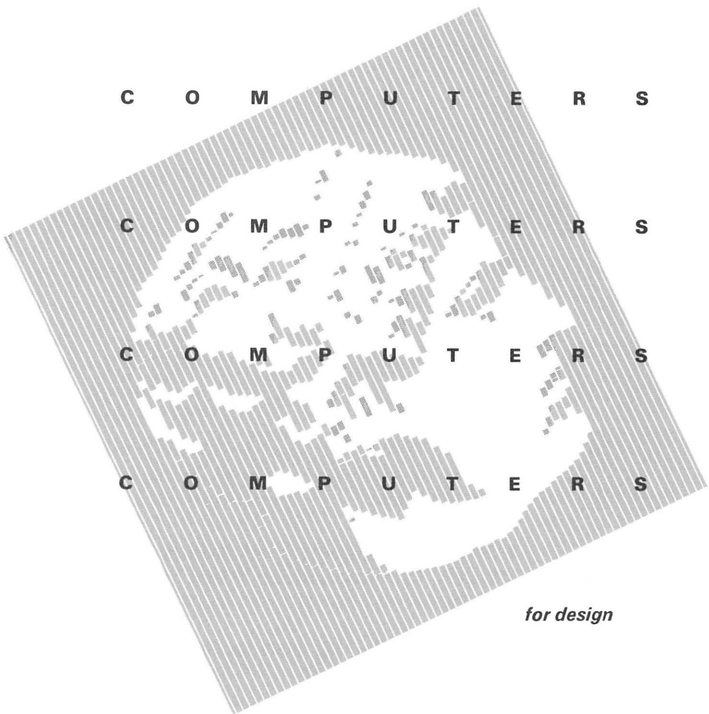
Mihai Nadin and
Leif Allmendinger

design with C O M P U T E R S

design for C O M P U T E R S



for design

Computers in Design Education:

a case study

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Abstract

This article is a condensed version of a larger study entitled *Design with Computers, Design for Computers, Computers for Design-Enhanced Creativity: Proposal for a Computer Implementation Model for a College of Art and Design*. The plan deals with all areas of education that the Rhode Island School of Design is responsible for: freshman foundation, liberal arts, the library, the museum, and first of all the degree programs in art, design, and architecture. For the purposes of this presentation, emphasis is placed on computers in relation to art and design. The plan's main ideas are: 1) What computers can do for design; 2) What designers (and future designers) in the educational environment can do for computers and computer-aided technology. The characteristics of the college and its relations with nearby colleges and businesses were carefully considered in light of the state of the art in computer technology and software.[1]

The challenge

The Rhode Island School of Design (RISD) can and should accept the challenges of post-industrial society because of its advantageous position as an institution highly regarded for past achievements. While faithful to its fundamental values, the School proved adaptable to new exigencies. This is a premise for the entire study. The proposal presents a model for implementing computers and computer-related means of expression, representation, and communication in an environment which, despite its potential, has received scant attention from the computer industry and computer scientists. The College, in its historical, cultural, geographical, and institutional context, is one of the best prepared entities for conceiving and implementing the proposed model, as the following arguments and presentation of directions to be explored will show.

Two issues should be at the core of our concern over the use and study of computers:

1. How will design be changed as a result of the post-industrial revolution, primarily through the extensive use of computers?
2. How will design change the world as it influences technology and human relations, especially in the environment of widespread computer-supported human activities?

Although the Rhode Island School of Design is not and will not become a *high tech* institution, it has to commit itself to considering:

1. issues concerning computer use in its various design, architecture, and art programs (liberal arts should not be excluded), as well as issues of present and future education in these fields;

2 issues of design for computers and their future improvement, especially in user interface, computer graphics, industrial design, and ergonomics;
3 issues concerning the design and production of computers and computer-supported equipment to various design activities, with special emphasis on graphic design, industrial design, architecture, and art applications.

Consequently, during the time this proposal will be pursued, the following will take place:

1 progressive introduction of computers and computer-supported technology in the main programs;
2 encouragement of computer-related student projects and graduate student research as perceived from the perspective of design and art;
3 establishment of an interdisciplinary entity to coordinate the work and interest of faculty, students, librarians, alumni, etc. regarding computer-related and outside research.

For the latter purpose, an Institute for the Semiotics of the Visual, which would coordinate the themes and projects addressed herein, has been considered on the basis of the positive results that semiotic research and instruction has already achieved. The increasing awareness of the role of semiotics in communication (particularly visual communication) and interface has made the Institute a potential center for the elaboration of theory and its application. It would place RISD in the favorable position of being able to confront complex computer issues from a broader perspective in view of the fact that the interface (interaction among people or between people and machines) is conditioned by the *real* human subject (as part of a community or as user of tools, designs, products) as well as by limitations in hardware (tools and other devices people use) and software. This is a *pragmatic* issue that integrates the knowlege of formal structures (the *syntax of design*) and the awareness of content expression in art and design (*semantic issues).* In a college such as RISD, the Institute would concentrate on:

1 communicational aspects of computer-aided instruction in the environment of an art and design college insisting on adequate liberal arts education;
2 semiotic aspects of man-machine relations, i.e. user interface problems;
3 new applications of computers in art and design and the development of conceptual knowlege of such applications;
4 criteria for evaluation of CAD.

This proposal implies that the support of manufacturers, business, and federal institutions established to aid initiative and innovation in education, design, architecture, art, and science will be granted due to the merit of our endeavor and to the impact computer design will have on future *social* and *cultural* developments. Technology can serve as a support for the development of ideals and human values for whose sake technology is conceived and produced. This is why liberal arts education should pay attention to complex social, cultural, and philosophical issues involved in work with computers.

The model proposed will make computers accessible to everyone in the School while respecting the alternatives of using computers in only some creative work, in part of a creative work, or *not at all*. In relation to the RISD community at large, we intend to progressively introduce electronic mail, documentation services, and information storage and retrieval on the campus, connect with similar functions at Brown University,[2] and, through teletext/videotext make an opening to the larger community we live in. We intend to offer continuing education courses via computer-supported communication channels, assuming that interactivity can be satisfactorily maintained.

The Library and Museum are fundamental parts of RISD. In the first case, we have to develop a new concept of the computer-supported library, adapted to the reality of a library in which *text and image form a unit* and in which *visual documentation becomes a design tool*. In the case of the Museum, storage and computer-aided retrieval, probably on videodisc, can lead to a *memory* of exhibits and events to be used for educational, cultural, archival, and other purposes accessible to the public. It is essential for the Library and Museum to have systems for hard-copy, slides, photographs, films, and video tapes of high resolution and of acceptable quality and retrieval capability. This is why we must consider potential support from the computer community and from other industries (dealing with photography, film, video, etc.) which are interested in adapting their products to new market demands.

Our point is clear: future artists and designers who will serve in various capacities in many activities should get the best chance to use computers creatively, in relation to other technological means of expression. This goes beyond computer literacy. Creativity is facilitated by the general context of education and is tested through the independent activity RISD encourages. Creativity is vital to the computer industry as well as to all industries and businesses that use or will use computers. Post-industrial society is characterized by the transition from labor intensive to information-controlled production. Increasingly, mediating activities determine the shape of our present and future, the main *mediator* today being the computer. In order to deal with complex issues deriving from this reality, several faculty members and students have carried on research in semiotics focused mainly on visual mediation through computer graphics, integrated communications networks, user interface, and image processing. The use of computers on campus should be periodically re-evaluated, keeping in mind the main goal of integrating the computer into existing programs.

Design with computers

Our focus is on the application of the computer as a tool and medium for art and design. Pedagogical and financial considerations dictate that this application must progressively develop from its present, almost non-existent scale to the point where it becomes generally available. The cost of hardware, software, and maintenance that fit our needs is indeed high, but RISD should carefully consider the consequences of not offering new technology to students. Because these devices are so complex, time is required to progressively assimilate them into instructional activities and to train faculty members and students. A major consideration is instructor time. Due to the complexity of the issue, the application of the computer as a design medium will not streamline the design teaching process at the very beginning. Once the faculty becomes acquainted with the aspects of CAI, its evaluation and criticism of products and projects that belong to an unprecedented aesthetic activity will be central to the program.

The attitudinal changes we expect concern the *status of work*, of *the producer*, of *criticism and evaluation*, of *marketability*, and of the *representational nature of art and design in culture*. Accordingly, the program will initially be limited in scope, the number of students able and willing to take part being the most important factor. A proposed priority system for student participation should consider:

1. students in departments where familiarity with computer-aided design (CAD) is fast becoming a professional requirement;
2. students for whom computer art or design will be a study concentration;
3. students who will choose to use computers in producing their projects.

These students will work in their respective programs under the auspices of their advisors and the Institute. They will be able, with the computer, to carry out studies of form regarding the limitations of the glass medium, for example, which can be demonstrated on a high resolution color screen. Multi-perspective, computer-aided photography devices, scanning, and digitizing can help photography students and teachers. (Availability may have to be limited to upperclass and graduate students at the outset.) In all divisions, it will be possible to approach the individual–in a college like ours, this is a legitimate expectation–and custom tailor education on criteria that relate to the individual's strengths and weaknesses. No one can foresee how each particular program will (or will not) use computers. The strategy is to proceed step by step inside and outside the educational environment, to learn by doing, exactly the way we educate our students.

The School's mission is to provide the best educated artists and designers at the time and for our time. We can help hardware and software researchers, manufacturers, engineers, etc. to improve their products. Hardware and software are produced by people who deal mainly with technological aspects, disregarding or being unaware of design, communication, aesthetics, and other aspects of user interface. The users, be they designers, educators, librarians or others, are left to face a complex device, unprecedented in the history of mankind, that manufacturers hand down more often than not under market pressure and before sufficient research on user interface and other important aspects (ergonomic, social, cultural, etc.) is carried out. But in order to contribute design ideas and sensibilities, we need experience with the tools; we have to use them; then we can evaluate them from the perspective of our profession. This implementation model thus becomes an evaluation procedure that should interest a large segment of our society. Support from those segments of the business community looking for computer-trained artists and designers will influence our preferences. We will respond to the demands of industry and business in respect to education, expecting in turn their support and contributions to RISD's endeavor. The Institute will oversee the integration of demands and responses in order that the expectations of the School and of industry are responsibly met in curricula and research.

During the two years of its activity, the Computer Literacy Committee made several recommendations. Educational access and experience with computers should be acquired as soon as possible. In order to avoid duplication of effort and to minimize cost, a computer program at RISD should be school-wide, not limited to one department and independent of others. The program should stress art and design education applications rather than programming or computer science studies. The program should begin with microcomputer and computer-aided communication systems. Cost, plus the fact that applicable software is readily available, plays an important role in this decision. Microcomputers could later serve as *intelligent* terminals in a future network to be gradually set up and supported by a mainframe computer. Furthermore, the experience the School would gain in the first two years of this implementation model would help in later use of more powerful computers and in taking the initiative in RISD's field of expertise. Initial applications of the program would be directed towards design, the area where interest and aptitude are most demonstrable and where computer skills are fast becoming a professional requirement. From this beginning, the program would spread by *chain reaction*. The art programs, for example, would prepare for computer use by being exposed to recent works and new techniques, by experimenting with smaller units, and evaluating currently available PAINT programs. This would set the foundation for total integration within eight to ten years. Within the four-phase framework proposed by the Computer Literacy Committee,[3] the Design and Architecture Divisions will simultaneously pursue a number of applications suggested in this plan. The goals set forth herein cannot be realized if some applications are neglected. Lower level applications must provide a foundation for higher level applications; and the latter must facilitate improvement of the former.

Initial application consists of using microcomputers for structural analysis and technical enhancement of the student work in architecture and industrial design, and computer-supported typesetting and other means of electronic publication in graphic design. For the first application, students will be introduced to simple programming as an alternative to conventional mathematics. This offers several advantages. By writing simple programs, students are freed from mechanical aspects of conventional mathematics. They will have immediate visual confirmation of their calculations (conventional mathematics offers no confirmation). By realizing the relationship between program and visual output, students should gain insights into *visual thinking*. Another important advantage is that, once written, these programs can be applied to a group of problems. At present, structural analysis is time consuming, and students tend to guess when working on a project. Similarly, the microcomputer's word processing capabilities make it possible for students to realistically and comprehensively document their projects. The documentation is now so time consuming that it frequently becomes functionally impossible. Computer use should encourage better argumentation from the students and a broader basis for criticism by students and faculty. Computer-supported graphic design applications should help in the transition from Gutenberg-based technology to electronic devices.

The next step in computer implementation will be to teach basic elements of competency in CAD for the job market. While one of the distinguishing aspects of RISD is that design skills take precedence over technical skills, proficiency in the latter is nevertheless a basic requirement of all design departments. CAD skills are becoming akin to drafting, camera and model making skills that students commonly use to produce their projects. Today, computer skills are in demand because of their scarcity. In the future, they will be a basic requirement for employment in most design professions. It is therefore important that most design students be exposed to the computer while still in college. Furthermore, this stage will serve as an introduction to higher level applications.

Higher level application deals with the computer as a complex design tool. Here the emphasis is on design and artistic quality rather than on technical aspects. Familiarity with the computer's capabilities are a prerequisite since it is only through application as a design tool that a student gains understanding of how the tool is simultaneously a design medium. True CAD will come about only when designers are able to think in the language specific to computers, within its possibilities and restrictions. Students and faculty can experiment on a visual level with the goal of *integrating human factors and aesthetic values* into computer design.

Design for computers

Computer technology promises to change the nature of design and participate in the establishment of new forms of graphic expression. Past design problems dealt with specific information and could be solved by a craft-oriented approach, which cannot lead to the complex visual systems necessary for conveying the non-finite, non-sequential information the computer is capable of conveying. It is only through experimenting with the appropriate medium that a new, more objective form of design can be developed[4] and the medium itself be improved. Experimentation will also lead to better understanding of the role of the designer in an environment in which the visual will play an increasing role.

A continuation of higher level application involves research. RISD has carried out research in the past and is qualified to do so for visual and design aspects of computer technology. We are qualified to pursue the following directions:

1 Development of visual standards for electronic communications. At present, we are negotiating such research in videotex.

2 Development of the computer as an ergonomic research tool. For this, we would seek to work with a university or company with programming capabilities. This research could lead to applying the computer as an aid in dimensioning industrial and architectural designs to more closely agree with human standards, to applying the computer in understanding the body's tool-using capabilities in respect to industrial design and design for the handicapped. (We insist on the last application in view of its significance to society).

3 Design of hardware packaging for future/potential technologies in computer-related fields and design of ergonomic input devices.

4 Research on input/output devices and user interface from a visible language perspective. Emphasis is on making the computer more responsive.

5 Research on training and education of art and design users of computer systems from a design perspective.

6 Digitizing techniques, antialising procedures.

7 Hard-copy procedures.

8 Non-CRT dynamic image display.

9 Image processing, interactivity, establishment of parameters.

(The list is not exhaustive and does not represent an order of priorities. It is subject to what is possible and necessary and to the students' and faculty's fields of interest).

Design is a discipline that reconciles human issues with technology, that mediates between the user and the technology used. As an art and design school, we can contribute to the development of the computer as it relates to people. Since nearly all computers are intended for human interface, design is very much a computer concern. We seek to set standards for the computer as a design medium. Videotex, teletext, and electronic publishing lack the graphic quality of traditional media. Iconic interface has proved effective, but there are few guidelines for producing effective icons and for articulating a visual language as an effective user interface system. We can offer constructive criticism of computer graphics and CAD/CADAM systems from a design viewpoint and, through the Institute for the Semiotics of the Visual, offer an interdisciplinary perspective so lacking in the development of new computer systems. Students and faculty will apply the medium to areas overlooked by technicians while demanding that new products be introduced. The possibilities we offer to the computer industry are as unlimited as the imaginations of our students, faculty, and (even) administration.

Many paths to social innovation have been opened by the responsible use of new technology. Substantive changes are the result of more efficient data-processing techniques usually associated with the fourth generation of computers. New problems arise and new tools are invented to cope with them. However, strengthening a particular technological model does not contribute to its validity. If activities that made no sense before computers are now transferred to computers, they still do not make sense and oblige us to ask: when are computers justified and what makes them necessary in a particular field of human activity? We know that computers can easily become mass generators of tasteless products, of objects repugnant to aesthetic value. The computer is not to blame for the ease with which it reproduces bad taste. The human subject who programs such products and affects public perception of value through an aesthetic *dumping* facility is at fault. To prevent misuse is a utopic ideal. Computers cannot be built to be *guardian angels* of aesthetic and social values. What can be affected is the education of the user, the one who influences the quality of the products the public expects from machines.

If we compare the technical performance of computers to their design, we see the discrepancy between the two. Stereotype design condemns computers to a limited potential. Introducing computers in art and design education is the necessary step towards a new form of applied design meant to improve the way they relate to what they do and to their users. Improvement of the computer and its software cannot come about without the involvement of artists and designers.

Computers for design

An important topic is the role design plays and will play in the future of society. We have to understand that, due to complex changes in the way people in the post-industrial age think and act, the designer will have an increasingly active role, will be a source of new ideas and concepts related to the way we live, work, and approach our environment. In order to fulfill these expectations, the designer has to be able to produce and experiment with as many ideas as possible, to use the new tools that technology places at his disposal in order to present valid proof of the ideas he upholds. The computer is considered a problem-solving tool. For the first time since tools were introduced in human praxis, one tool, one piece of hardware can adapt to and support numerous and very different activities. And because the computer can do this, it can lead us to redefine the main values in the civilization of which it is a component.

It is frequently said that computers enhance human capabilities and creativity. Actually, the computer allows for *diversity* because its main functions rely on the logic of permutations. In discussing diversity, we again refer to the relation between problems, problem solving, and problem generating. While designing, the designer effects changes the world. Designing is a complex activity that entails a responsibility extending from present to future, from one generation to another. The computer cannot guarantee the better. But it can be the tool that helps us evaluate alternatives. Before making a final decision, the designer has to deal with several models. In some design activities (architecture, industrial design, illustration, graphic design), alternatives are essential. Solutions are time consuming in a field where time is an expensive commodity. The computer is the best medium for alternative studies and more and better contextual analyses. It frees the designer from stereotype activities, from everything that is not directly creative, encouraging the designer to consider as many options as possible.

Equally important at RISD is swift and easy access to visual source material from books, periodicals, and extensive clipping files. In a school of art and design, the library is an integral part of education. It provides access to writings essential for opening new horizons to future artists and designers. New technology offers the potential for better access to these resources, for expanding library capabilities (especially through videotex and teletext). However, none of the systems currently available provides the variety of documentary sources that RISD Library offers to students, faculty, and other users. This variety is countered by the problem of storage. A videodisc system can store vast amounts of information; its image storage is of high quality; retrieval is swift; and the permanence of videodisc storage is well suited to library use. The system also offers the distinct advantages of easier access to reference material, simultaneous referencing of material, elimination of cross-referencing. The system is space efficient and practically immune to theft and damage. (Both of these factors pose a growing threat to our collections). Reshelving and inventory could almost be eliminated. There are difficulties in *computerizing* the RISD Library. A computer network with a video interface is necessary. In order to provide *free* access, there must be an adequate number of terminals. For display of artwork, high resolution color terminals are required. Data storage and retrieval programs would have to be reasonably sophisticated and adaptable to the needs of an art school. The largest problems by far are a time commitment of several years and the work required to create a database. Because of this, an electronic reference tool would at first only supplement the existing Library. (Our proposal does not foresee a *terminal library* but a more complex environment in which traditional values connected to the book are preserved while others, not possible in the *Gutenberg Galaxy*, are made possible). We are aware of the problem of *electronic perusal* as opposed to reading and will find out under which circumstances such reading behavior occurs. Because the database of an electronic reference system can be accessed by a great number of users at once, RISD will be able to share its database with other universities and libraries and, through home computers, with the general public.

For instruction, RISD wants programs that will sharpen analytical and critical skills and which are consistent with the way people think, i.e., heuristic programs with a high degree of interactivity (LOGO, for example). Existing successful programs will be used to teach students concepts and factual material in degree programs and liberal arts, but we must make our input at each phase of development of software for instruction in art and design. CAI offers several advantages: if the program is interactive and the student sees direct visual confirmation of his reasoning, he has more opportunity for involvement and is likely to learn more. Learning is self-paced. The instructor is freed from the stereotypical aspects of instruction and evaluation so he can apply his competence to the creative aspects of teaching and to the student's creativity.

Engineering problems (in architecture and industrial design), perspective, basic theories of color (in freshman foundation and the fine arts) are among many areas where CAI serves an important purpose. A main issue in our approach is interaction among students. Since art and design are becoming a matter of interrelationships and interinfluences, it follows that we encourage these dynamic qualities and train students accordingly. This interaction will at first be limited to physically co-present persons. In the future, distance should not be an important factor. Interactive editing, among other things, will provide teachers and students, regardless of where they are, with the necessary instrument for sharing information at each level of work.

The multimodal system represented by the generic medium computer will fundamentally change not only the designer's and artist's work, but also the perception and pragmatics of art and design. These changes will effect the entire system of values participating in what we know as culture. It would be shortsighted not to deal with the pragmatics of art and design in the framework of a civilization in which the computer will play an important role. Without upholding theoretical models that describe future societies based solely on technology, we know that technology will be a source of new forms of aesthetic expression, of quite unusual perceptive modes, and unprecedented social evaluation procedures. Considering the entire evolution of the man-machine relationship, we can say that designers have always suggested ways of adapting tools to users. What is today called computer graphics is the visual representation of very complex problems and data. Computer graphics, when removed from the context of design, becomes a technical problem; the very character of visual language is lost. Involving designers in designing new computing units, new microchips, new large integrated circuits means to allow from the beginning for better visual quality. To allow for better visual quality means to allow for a higher degree of *intelligence*. The great competition in the current computer market is for higher intelligence. Until now, computers have proved to be marvelous instruments in approaching syntactic problems, that is, problems related to the way different signs (mathematical, technical, graphic) are put together. The next generation of computers will have to approach semantic problems, in other words, the relation between how something is represented and what is represented. It is at this moment that the designer intervenes and ensures that those inner relations characteristic of the visual image are taken into consideration and adapted to the use of the machine participating in complex human activity.

Cost

This proposal entails an investment, not only for its own sake, but also to consolidate our role in the art and design world. Figures are relevent for the commitment we must make and for obtaining support from manufacturers for the cost of equipment because we require machines not commonly demanded by the market (and consequently more expensive). Support is also desired for software from commercial entities and academically-oriented foundations. The National Endowments will be considered as an important potential supporter of our endeavor on the basis of the implications already presented. RISD will invest at least one-half million dollars in equipment over the next three years. A figure in the same range will go towards setting up a computer center and preparing classrooms and studios for working with computers, and a network system (to support security functions, electronic mail, cable TV, etc.). RISD is in the process of rehabilitating four buildings purchased to meet the growing needs for studio and study space. Thus it can (and should) integrate the needs presented below in its rehabilitation plans.

The following is a simplified list.The estimates take into consideration help from outside sources.Technical support for the entire project will be met according to the needs that grow with our system.

$800,000	Computer center (to house mainframe or super–minicomputer and graphics terminals)
To be estimated	Networking
$250,000	Workstations on campus (according to objectives given above; initial consideration given to SUN, Apollo, Lisa workstations)
$125,000	Computer lab (in the freshman foundation program; for computer literacy courses using microcomputers)
$65,000	Equipment leasing (for special projects stemming from research contracts with business and industry)
$240,000	Maintenance (for the computer center, lab workstations)
$100,000	Software development (specially conceived for RISD for this program)
$360,000	Personnel (coordinator for the entire program, faculty for computer literacy, for computer graphics, for CAD and CADAM applications, for research and development, programmers, network technician, etc.)

RISD at a Glance:	Founded in 1877
	Divisions: 4 (Architecture, Design, Fine Arts, Illustration and Photography)
	Departments and Programs: 18 (11 MFA programs)
	Current Faculty: 96 full time; 65 adjunct
	Current Enrollment: 1800

This article is based upon a completed proposal written for the Rhode Island School of Design in conjunction with Brown University, Providence, Rhode Island. The author's outline in its entirety, taken from the Table of Contents, is reproduced below as a paradigm for future proposals.

Preface	RISD in context Issues, premises, activities
Design with computers	Introduction: Computers in art and design education? The RISD proposal: Part of a continuing commitment The cooperative agreement with Brown University Scope A strategy for implementation Application: the design and architecture departments Application: the fine arts departments What should the RISD implementation model offer
Design for computers	Introduction: responsible use of new technology Directions of research The future of design with computers RISD–a fertile environment Some potential drawbacks Potential student demand
Computers for design	Introduction: problem solving/problem generating Teletex/videotex An electronic reference tool for art and design Computer-aided instruction Development of a new medium The visual and man-machine communication
Attachments	Computer related courses at RISD A partial list of research projects done at RISD Estimated cost of the program Students, personnel and buildings Acknowledgements

[1]Once submitted, such a document does not necessarily become the blueprint for future action. Even when accepted, its fate is frequently effected by people knowing nothing about the issues involved or in the context of the *politics* (computers represent power!) that too frequently plays a role in academic life. In 1981, near the end of my first year at RISD, I was the only faculty member to pose (and insist upon) the question of computer literacy, and this in the framework of a new curriculum in liberal arts. In the autumn of that year, the Sloan Foundation issued its well known report, which added weight to my ideas. Working in computer graphics since 1965 and as a consultant to industry and higher education since the late 1970's, I initiated a program for implementing computers at RISD. Having witnessed the efforts to obtain funds for computers made by the chairman of the Design Division and faculty in Architecture, I realized that without a unifying concept, such efforts would do more harm than good. After several presentations before the Computer Literacy Committee and the College Council, I agreed to draw up this comprehensive proposal. Students–really excited about the perspective of involving computers in their design education–alumni, business, the computer industry, and even some faculty members supported this study. Leif Allmendinger deserves special mention for his untiring work as my research assistant in gathering information and in preparing the layout for publication.

[2]Since 1901, RISD and Brown University have had a cooperative agreement that benefits both schools and their respective faculties and students. Each semester, about 200 Brown students take courses at RISD, and 100 RISD students attend Brown courses. In 1983, Brown made public a *Proposal to the Systems Development Foundation*, advocating the "wired university". This long-term plan is underway and receives impressive support and grants from the computer industry.

[3]Because of the scope of this article, many details pertaining to RISD's specific condition are omitted. Those interested in the details should contact the author.

[4]See "Creativity and Technology" by Sharon Poggenpohl, in *The Design Journal*, Summer, 1983.

Communication and Code

Code

synerg

Graphic Design : Towards Digital Applications

The Synergism Between Visual Communication and Code

Mary Jones

The disciplines of Graphic Design and Computer Science interact synergistically; the computer is used by the designer as a creative tool while the scientist benefits from the designer's contribution concerning the best use of the visual potential of the medium. The graphic designer is urged to become computer-literate not only to take advantage of current technology in the design workplace or to seek new professional opportunities in the computer field, but to participate in the development of software that will best serve the designer's needs without restricting the dynamic nature of the design process.

In 1979, when I was a design director at a university press, I noticed that more of our suppliers were switching to computer typesetting. I was intrigued with this new method of typesetting for several reasons, it not only allowed me more latitude in book design, but the quality I was used to specifying, wasn't compromised by the new technology. The more I learned about digital composition, the more I wondered if this technology could be expanded to include other elements of the book such as graphics and even layout of text and graphics.

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Initially, I wanted to learn more about digital composition so I could apply it in my work as a book designer. My growing interest led me to the Visible Language Workshop at M.I.T. There I became more convinced of the potential benefits of digital technology for my own field and I began to realize that the computer industry is greatly in need of the skills of graphics designers.

problemsolving

Until recently, the quality of computer graphic images have simply not kept pace with the technical achievements in computer graphics. The needs of graphic designers, their creative thought processes, and their approach to problem-solving can and should be implemented into the design of better digital tools. An equitable balance between graphic and technical expertise is needed. Graphic designers can contribute to this development by being computer-literate users and also by assuming more responsibility in creating digital design interfaces.

Effective visual communication is becoming more important to computer graphics because of the growing capabilities of the computer, especially the micro-computer, and because computers have been expanding out of the laboratories and into our daily lives. Additional memory and more powerful processors are transforming the micro into a computer capable of simultaneously processing large and diverse amounts of complex data. PC's are evolving from 8 bit to 16 bit interactive, multi-task workstations connected by communication networks, linking numerous users and providing diverse applications. Some of these systems will serve our present needs for faster financial, management, and communication abilities, especially in corporate and educational environments. Other systems will contribute to the design and implementation of new concepts, such as electronic books, electronic curricula, and expert systems.

Though many companies are not yet making the best use of graphics in their products, the recent trend is toward systems that are well suited to use graphic possibilities. For example, technology has encouraged a move away from alpha-numeric monitors (in which objects on the screen are limited and their flexibility of movement greatly restricted) to bit-mapped screens in which individual pixels can easily be manipulated to represent greater varieties of objects anywhere on the screen. The *Apple MacIntosh* is an example of a bit-mapped/graphics oriented personal computer. A mouse is used to point to the screen for selecting, creating, and manipulating objects. Screen Icons as symbols of objects are used in place of menus and keyboard commands; the user moves around in graphic space instead of having to remember the names of things he is looking for. In addition, the use of windows allows the user to call up multiple and diverse kinds of information simultaneously on the screen for comparison or reference. This process not only duplicates the natural motor abilities and perceptual skills of humans, it also expands the need for clear, logical graphics.

Graphic Designers as Collaborators

If, as I believe and as industry trends indicate, graphics oriented systems are the wave of the future, graphic designers and computer scientists will work closely together. The relationship is valuable to both disciplines. While the graphic designer and the computer scientist may appear to speak different languages, there are essential similarities in work-style. These similarities provide a natural bridge for collaboration.

Both graphic designers and computer scientists are planners, involved in a team approach to problemsolving. The computer scientist, whether a programmer, system designer, system analyst, graphics guru, or hardware specialist is part of a modular team whose common goal is to create and assemble all the necessary components in computer and software design.

The graphic designer hardly creates in isolation, but is accustomed to working closely with people of various skills and knowledge, in identifying, defining, and analyzing problems from conception to completion of the project. Historically, graphic design has had a symbiotic relationship with prevailing technologies. The graphic designer acquires sufficient technical expertise to understand tool capabilities and to influence the development of technology toward more flexible uses and higher quality output. The scientific and humanistic attributes of the design profession provide the bridge for the designer to become a technically literate and equal collaborator in future tool and process making.

Both computer science and graphic design are process oriented, applying analytical and synthetic principles to generating and organizing information. But the methods employed and the end results are different. The computer scientist processes information for machine comprehension. Application of abstract constructs such as trees, lists, and transactions, maximizes machine efficiency and performance. Software designers are concerned with developing a means by which results can be attained automatically and consistently.

The graphic designer, as an interpreter and contributor to human communication, develops a clear and concise visual transmission between sender and receiver. By exploring, analyzing, and systematically coordinating structural, aesthetic, and semantic relationships, the graphic designer is concerned with achieving effective human communication.

The two fields come together in the discipline, computer graphics. Computer graphics use the technical capabilities of the computer (such as optimum speed and processing ease in organizing and disseminating large, complex amounts of data) with the potential for effective expression of visual communication. A synergy between the two disciplines, computer science and graphic design, is essential to the future development of computer graphics as an effective visual communication medium. What role will graphic designers have in the future of computer graphics? How will their influence and expertise become a guiding factor in making better digital graphics, better electronic design procedures, and in making better digital design tools for other designers?

The impact of graphic design on computer systems can be extensive. Points of entry for the designer include the images that the computer system produces, on-line and off-line vehicles of information through which a system is learned and operated, and the internal make-up of the system through its software structures.

The most apparent and immediate need for graphic design expertise is in the area of documentation. Vast quantities of instructional data must be organized and presented clearly, concisely, and logically, on-line and off-line. As graphics capabilities migrate from mainframes to micro workstations, the needs of less literate users must be met. Improved documentation will be needed and self-training features will become more frequent. One of the challenges to software designers is to make software systems accessible to more people. This means paying closer attention to what attributes relate to successful use, such as improved user interfaces for both novice and experienced users. A beginning would be to build into the system extensive on-line help and tutorial facilities that are visually organized and visually referenced.

There are several interesting characteristics involved with this design task. If designers are creating both the on-line and off-line versions of the documentation they face the task of organizing the data into two different final media forms. The data will be printed on paper and distributed in a binding, or remain in electronic form residing in a HELP file or a

TUTORIAL program. The former assumes traditional print production attributes and linear form, while the latter dialogue is accessed randomly or by interactive dialogue. Different design limitations are imposed for the on-line documentation; typographic selection is limited and the information is observed in screen chunks of different determinant lengths rather than pages of specified lengths and *guides* such as page numbers and running feet. As the next generation of software moves away from the traditional keyboard input to easier-to-use alternatives such as touch-sensitive screens, mice, voice actuation, and direct input from other data sources, graphic designers will have new design challenges.

As experts in the organization of visual communication, designers have been instrumental as consultants to computer scientists in a variety of graphic areas, selection and application of type-face design, selection of appropriate color systems for commercial software packages, and coordination of graphics systems for statistical purposes. Graphic designers also contribute to computer graphic research by relating their own experience to those who design expert systems. By describing how they create and visualize their ideas, they assist the computer scientist in making machines that draw on and respond to this judgmental process.

To the designer, the computer represents the newest and fastest tool for conceiving, developing, and reproducing printed output such as books, magazines, posters, and brochures.

The skills of the designer can be divided into two general categories: judgmental and mechanical. The judgmental, or decision making stage, is characterized by experimentation and change. Decisons made and remade concern not only how something should look, but whether it is communicating effectively. This requires extensive thought and visual exploration. The second category, mechanical functions, involve putting the elements together to produce the communication.

Both skills are integrated on computerized systems and can be implemented with speed and ease if the user's needs are properly met. Designers can experiment with visual elements such as size, shape, color, and typography; explore visual relationships, and see the immediate results of their decisions, and then implement those decisons. A designer has more control of the complete design task because the computer is a comprehensive design tool. On some computer graphics systems, the designer assumes responsibility for color separating and typesetting, two tasks traditionally sent out of the studio for completion; the computer becomes a kind of multi-purpose assistant.

Computers can be more than tools for helping with various aspects of the design task; they have the potential for altering our work process. The objective is to go beyond mimicking past media and to continue to develop processes that utilize and exploit the unique capabilities of the computer.

Graphic Designers as Software Developers

Graphic designers have an important role to play (if they choose it) at the most critical conceptual stage of the process, by transferring their expertise directly into the development of graphic software that enables other designers to work in more comfortable and natural ways. As Karl Gerstner said "graphic designers will design processes, not just products." By developing programmatic approaches to software design, the designer creates the process in which design takes place. When the software has no embedded visual biases or values and the basic visual elements are manipulable, then the design environment is changing and dynamic. The computer is restricted to useful mechanical functions while the designer retains full freedom to experiment, select, and rearrange visual elements, information, and make the visual decisions.

dynamic

Creating an interactive design system begins with a task analysis. This involves establishing and understanding the goals of its users, what information they will need for performing their tasks, what data they will generate, and what methods they will use. From training and first-hand experience, a designer intimately understands the type of system most suited to the designer's abilities and methods of working. Making the needs of graphic designers, the way they think, and their approach to problemsolving an integral part of software design is the key to creating useful tools.

The expanding capabilities of computers are contributing to the formation of new non-print related concepts, processes, and methodologies for disseminating information and instruction. Some of these totally electronic processes involve analyzing the way we learn, teach, intuit, understand, and perceive things. By simultaneously organizing and displaying multiple pieces of information from diverse sources for the user, who is engaged in a multisensory way–with sight, voice, touch and hearing, computers become truly conversational.

More colleges and universities are requiring incoming freshmen to purchase their own PCs. Most students use these machines to complete individual homework assignments, but in some universities these micros are being connected by electronic networks. Students attend a live lecture with a professor teaching a particular subject, simultaneously, each student uses a micro to reference the lecture as it is being given. For example, a computer science student can listen to a teacher explain how a sorting algorithm works, simultaneously see the source code on a micro and a real-time animation performing the specific task. Classwork is accomplished interactively; the student electronically sends assignments to the teacher who checks and returns them electronically. The task for developing an electronic curriculum such as this falls to the educator, the software programmer, and the graphic designer, who orchestrates the visual material.

In my position as Manager of Digital Support, I'm putting together a system for total in-house electronic delivery of design and production functions. As many magazine and book publishers move toward integrating their in-house processes for designing and producing print products, a designer's specialized skills are vital to analyzing these publishing functions and designing the configuration of electronic tools necessary to serve them. The tools facilitate the following functions: design/design workstations; copy-editing/wordprocessing; production/scheduling; and telecommunicating authors' manuscripts. In addition, selection of an electronic network to connect the system components is part of the total task. This network with the proper telecommunication software can interface with college bookstore networks to electronically deliver textbooks and electronic course notes for distribution. This is a deeper look at the steps that will lead to an electronic curricula.

Concurrent with the development of electronic curricula is research and development in electronic books and video disk instruction processes. These forms of electronic instruction involve organizing information in non-linear ways and integrating visual elements from diverse sources such as text, digitized halftones and illustrations, and animation to create an interactive approach to instruction. I've watched bored chemistry students come alive when they pour different colored solutions into beakers, make mistakes (and *explosions*), and then try to figure out what went wrong. Students gleefully *experiment* ignoring the tutorial in favor of discovery. The student explores the topic being taught and in the process of learning, creates a personal form of instruction. Graphic design makes this a fascinating learning experience as well as a personally satisfying form of instruction.

Artificial Intelligence

Future systems will understand how an expert in a particular profession would approach a problem and use that expertise to solve a similar problem. Some future systems will even have artificial graphic design intelligence. These systems will know how to do some layout, especially chart and statistical layout. They will follow basic rules for good design imbedded in software or in silicon chips. Others versions of expert systems will serve as intelligent aids for graphic designers to use in conceiving and completing design-related tasks. In both cases, graphic designers will be instrumental in creating and implementing these future systems.

Conclusion

There are dramatic changes occuring in the visual communication environment. The increasing use of computers is altering the context of graphic design. We need to be more vigorous in examining the changing patterns of communication, in recognizing our specific design needs and processes, and in influencing the future of visual digital systems.

Traditionally, graphic design has been a field that demands pragmatic performance. The future requires us to go beyond this superficial emphasis. Graphic design must analyze the more complex issues that will enable us to define our profession and visual communication with more precision.

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Graphisme: Informatique–Franchir le pas
Sharon Helmer Poggenpohl
Notre environnement change à vue de nez. L'ordinateur qui est un des instruments de ce changement nous invite à renouveler toutes nos idées concernant la qualité, la production et al signification de tout graphisme. Ce numéro est consacré à l'enseignement du graphisme et ses rapports avec l'ordinatuer. Le sujet est abordé sous plusieurs angles. Philosophique: quel effet l'imagerie éléctronique a-t-elle sur l'éducation artistique? Créatif, conceptual: comment est-elle affectée? Technique, pratique: que permet-elle de faire? et à quel prix: éconimique? moral?

Graphisme: Informatique—Leur porée? Leur place?
Charles Owen, Sharon Helmer Poggenpohl (editor), Roger Remington, et Michael Twyman
Les representants de trois universités: The Illinois Institute of Technology, Chicago, Illinois; The University of Reading, Reading, England; et The Rochester Institue of Technology, Rochester, New York, échangent leurs expériences dupuis l'introduction de l'informatique dans leurs programmes de cours. Ces échanges courent sur 7 mois. Ils ont été recueillis par Sharon Helmer Poggenpohl et abordent les aspects pratiques aussi bien que philosophiques; ils embrassent la perspective de l'enseignement du graphisme informatique en particulier.

Graphik gestalten: Computer-Graphik überbrückt die Lücke
Sharon Helmer Poggnpohl
In der rasch sich wandelnden visuellen Welt stellt der Computer besondere Anforderungen an Qualität, Ausfuhrung und Bedeutung. Diese Sondernummer über Ausbildung im Graphik-Gestalten behandelt die Beziehungen zwischen Ausbildung im Entwerfen und Computer-Graphik. Vielerlei Gesichtspunkte werden vorgestellt: philosophische; welche Bedeutung hat Computer-Graphik fur die Entwurfs-ausbildung, im Kreativen wie im Begrifflichen, wie verändert sich der Entwurfsverlauf, technisch und praktisch, was können Computer-Graphiken tun, und zu welchen wirtschaftlichen und psychologischen Kosten.

Graphik gestalten: Computer-Graphiken–was bedeuten sie, und wo passen sie?
Charles Owens, Sharon Helmer Poggenpohl (Herausgeber), Roger Remington, und Michael Twyman
Drei Ausbilder von verschiedenen Universitäten, vom Illinois Institute of Technology, Chicago, Illinois, vom der University of Reading, England, und vom Rochester Institute of Technology, Rochester, New York, Diskutieren ihre Erfahrungen mit der Einbeziehung von Computer–Graphikin ihre–Entwrufsprogramme. Das folgende *Gespräch* zwischen dem Herausgeber und den Teilnehmern erstreckte sich über sieben Monate. Die Diskussion bewegt sich zwischen praktischen und philosophischen Themen und zwischen dem speziellen Gesichtspunkt der Ausbildung im graphischen Entwerfen und einer allgemeinen Entwurfsperspektive.

Composer des graphiques à l'aide de graphiques: les icônes et leur édition visuelle
Dorothy Shamonsky
L'auteur présente un system qui permet de rédiger et d'éditer des informations à l'aide de graphiqes ou icônes. Ces icônes sont des bitmaps de petit format avec des instructions concernant leur position dans l'espace, leurs positions entre elles et l'ordre de leur succession. Deux programmes interactifs ont été écrits: un pour la création des icônes proprement dits; l'autre pour leur utilisation. Ces icônes se créent de deux façons: (1) en dessinant les bitmaps à partir d'éléments en mémoire; (2) en remplissant des contours. Les scripts, eux aussi, se créent de deux façons: (1) en organisant les icônes, (2) en appelant une succession d'éléments et en enrégistrant l'ordre de appels. Ces scripts peuvent être édités, mis en mémoire, rappelés et ré-arrangés. Toute opération se fait à l'aide d'un PUCK, d'une tablette, de menus et d'unités visuelles. L'auteur donne un historique des icônes et des illustrations selon différents systems.

Comment établir une page dans son contexte graphique
Morissa Miller Rubin
Il est question d'un systême de mise en page qui tient compte des pratiques courantes des maquettistes en matière de positionnement, de déroulement et d'intervention. Le systême fournit des programmes qui permettent de concevoir, de projeter et de comparer plusieurs pages à la fois.

Beschriftung von Graphik mit Graphik: Ikonen als visuelles Bearbeitungswerkzeug
Dorothy Shamonsky
In diesem Aufsatz wird ein System von graphischen Verfahren zur Beschriftung und Bearbeitung von Graphik mittels graphischer Repräsentationen oder *Ikonen*beschreiben. Diese Ikonen sind kleine *bitmap*–Bilder, die Information über die räumliche Anordnung, Listenplazierung und Verweise in Unterprogramme enthalten. Zwei graphische Programmpakete wurden geschrieben, die miteinander in Wechselbeziehung stehen, von denen eins die Ikone erzeugt, und das andere mit den Ikonen beschriftet. Ikone können auf zwei Weisen erzeugt werden: (1) durch Aufstellung von Bit-Karten (bitmaps) aus Rahmen-Zwischenspeicherbildern, und (2) durch Zeichnen durch das Ausfüllen eines Gitters. Es sind Ikonen aufgestellt worden, die Sprungmarken zu Reihen von Bildumwandlungs-prozessen enthielten. Skripte können auf zwei Arten erzeugt werden: (1)durch Zwischenspeicherung von Ikonen, oder (2) durch das Durchspeilen einer Liste von Graphiken und Aufzeichnung der Folge der Ergebnisse. Skripte können bearbeitet, gespeichert, wiedergegeben und erneut bearbeitet werden. Alle Wechselbeziehungen wurden mit Maus, Tabelle, Wahlliste und visuellen Hinweisen durchgespielt. Es wird ein historicher Überblick über Computer-Ikonen gegeben, wobei verschiedene Schlüsselsysteme als Beispiele verwendet werden.

Räumlicher Zusammenhang als Hilfe zum Seitenumbruch: Ein System zun Planen und Skizzieren
Morissa Miller Rubin
Es wird ein Seiten-Layout-System geschaffen, das den gegenwärtigen Gestaltungsprozeß des Gestalters sowie räumliche Hinweise zur visuellen Entwicklung und Entsheidung berücksichtigt. Dieses System sieht Programme vor, mit denen aufeinanderfolgende Seiten gleichzeitig aufgebaut, betrachtet und bewertet werden können.

La dynamique de l'information projetée
Yoshiki Nishimura et Keiichi Sato
Les écrans vidéo et l'informatique las plus sophistiquée apportent de nouveaux moyens d'affichage pour la transmission d'informations typographiques. Toutefois les dispositifs de composition en usage dans les nouveaux medias ne tiennent aucun compte des possibilités les plus récentes et se limitent aux ressources de la typographie las plus traditionelle. Dans les nouvelles techniques la nature même de la présentation est modifiée par la troisième dimension (celle du temps qui se rajoute aux deux dimensions du plans) que révèlent les ségments d'une séquence projetée. Elle se fait sur le mode dynamique. Pour renforcer l'impact d'une typographie à l'écran, il faut désormais définir de nouvelles instructions permettant de rendre cette dynamique. C'est ce que l'article développe en même temps qu'un système dont les règles programmées permettent au maquettiste de céer des graphismes et des layouts dynamiques.

Les ordinateurs dans l'enseignement du design: un cas particulier
Leif Allmendinger et Mihai Nadin
L'article est le résumé d'une étude plus détaillée. Il décrit chacun des départment de la Rhode Island School of Design: les cours préparatoires, les arts libéraux, la bibliothèque, le musée et surtout les cours d'art, de design et d'architecture. L'accent est mis plus particulièrement sur la place accordée à l'informatique: (1) l'aide apportée par les ordinateurs; (2) le rôle des designers présents et à venir dans l'informatique et sa technologie. L'article fait bien ressortir les caractéristiques propres au Collège de Rhode Island et las position qu'il occupe par rapport à ses voisins dans l'enseignement et dans l'industrie. Par rapport aussi à l'actualité informatique et aux logiciels en service.

Dynamiche Infomationsdarbietung
Yoshiki Nishimura und Keiichi Sato
Video-Bildschirme und ausgeklügelte Computer-Technologie bieten neue Darbietungsmittel für die typographische Informationsübertragung. Aber die Gestaltungseigenschaften für de Satz, den die neuen Medien verwenden, machen wenig Gebrauch von den Vorteilen dieser neuen Technologie; stattdessen neigen sie dazu, herkömmliche Gestaltungsmerkmale, die für die gedruckten Medien gebräuchlich sind, zu erreichen oder zu verbessern.

In den neunen Medien ändert sich der Zustand einer Information, weil ihre dreidimensionale Struktur (die beiden Dimensionen des Bildschirmes und ie Zeit-Dimension) durch die zeitlichen Abshcnitte auf dem Bildschirm deutlich wird. Ihre Kommunikationsart ist daher *dynamisch*. Um die Durchführung typographisher Aufgaben auf dem Bildschirm zu verbessern, müssen neue Gestaltungseigenschaften für den Satz gefunden werden, unter Berücksichtigung dieser *dynamischen* Natur. Diese und ein neuer Gestaltungsprozeß, in dem programmierte Regeln dem Gestalter helfen, visuelle Muster in einem *dynamischen Layout* zu schaffen, werden in diesem Aufsatz untersucht.

Computer in der Graphik-Ausbildung: Ein Fallbeispiel
Leif Allmendinger und Mihai Nadin
Dieser Aufsatz ist die Kurzfassung einer längeren Untersuchung für einen Plan, der alle Bereiche umfassen soll, für die die Rhode Island School of Design zuständig ist: Grundausbildung für Studienanfänger, freie Kunst, Bibliothek, Museum und Diplomausbildung in Kunst, Gestaltung und Architektur. Der Schwerpunkt liegt bei den Computern in ihrer Beziehung zu Kunst und Gestaltung: (1) was Computer für die Gestaltung tun können, (2) was Gestalter (und künftige Gestalter) für Computer und computerunterstützte Technologie tun können. Die Besonderheiten dieser Schule und ihre Beziehungen zu benachbarten Schulen und Unternehmen werden sorgfältig im Lichte des Entwicklungsstandes der Computer– und Programmierungs–Technologie betrachtet.

Le graphisme et son utilisation informatique
Mary Jones
Le graphisme et l'informatique sont deux disciplines appelées à travailler en synergie. Le graphiste peut se servir de l'ordinateur pour créer de graphismes nouveaux. L'informaticien peut bénéficier du talent du graphiste pour utiliser au maximum les ressources visuelles de l'ordinateur. Le graphiste est invité a s'informer, à s'informatiser. Pas seulement pour profiter des ressources existante, pour acquérir des qualifications professionnelles dans ce domaine, mais pour aider à élaborer de nouveaux logiciels qui répondront mieux à ses exigences sans imposer de limite aucune à la dynamique de sa créativité.

Graphik entwerfen: Zu digitalen Anwendungen
Der Synergismus zwischen visueller Kommunikation und Kodierung
Mary Jones
Die Fachgebiete des graphischen Entwerfens und der Informatik stehen in synergistischer Wechselbeziehung: Der Graphiker benutzt den Computer als kreatives Werkzeug, und der Wissenschaftler profitiert von dem Beitrag des Graphikers zum bestmöglichen Gebrauch der viseullen Möglichkeiten des Mediums. Der Graphikier muß den Umgang mit dem Computer lernen, nicht nur, um die gegenwärtige Technologie an seinem Arbeitsplatz ausnützen zu können oder um neue berufliche Möglichkeiten im Bereich der Computer zu suchen, sondern auch, um an der Entwicklung von Programmen mitzuwirken, die den Bedürfnissen des Graphikers am besten dienen, ohne die dyunamische Natur des Entwurfsvorgangs einzuschränken.

Correction
Philip Bryant, "Reading Library Catalogues and Indexes," Volume XVIII, Number 2. Inadvertently, the illustrations for this article were printed in the wrong order. A corrected reprinting of the article is available on request.

Leif Allmendinger is currently pursuing an MFA in Graphic Design at the Rhode Island School of Design and studying Computer Graphics at Brown University. He has been teaching assistant for a number of courses at RISD (Visible Language, Charts and Diagrams, courses in computer graphics and programming for design purposes, and others). Recent professional positions include computer graphics designer at General Electric and work at Nadin & Ockerse, Ltd. in researching and preparing a semiotic evaluation of computer user-interface. He is a member of the Association for Computing Machinery (Special Interest Groups in computer graphics and human interaction: SIGGRAPH, SIGCHI).

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James Ver Hague is a Graphic Design educator, freelance designer, computer graphic consultant, and also the Rochester Institute of Technology's first *Institute Professor*, an interdisciplinary role which establishes linkages between RIT's various Colleges and Departments, particularly in the area of Computer Graphics. Mr. Ver Hague has experience in the field of computer graphics, ranging from the nations's space program to microprocessor-based applications in graphic design. He has lectured and exhibited nationally and is currently doing research on microcomputer software for graphic design, computer graphics for package design, and the development of computer literacy for design students and professionals. He holds master's degrees in Graphic Design and Mathematics and a bachelor's degree in Sculpture.

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