TOWARDS A COMPUTER ART THEORY

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INTRODUCTION

The revolution in computer technology which is occurring at the present time is and will have a profound affect upon our daily lives. Artists like anyone else will observe this revolution and begin to make use of the coming possibililties. How can the changes in computing technology affect the artist, and why should an artist get involved with the technology at all?

Simply on an economic basis it will soon be possible to own an extremely powerful computer for the cost of a good stereo system. An artist with a computer at home could compose music, produce video effects, generate computer graphics, create animations and play games. The very low cost of this wide variety of capabilities will induce many artists into the field. This economic reality is causing an explosion in the number of people who now have access to computers as compared with only a few years ago.

Does this machine, the epitomy of high technology have any place in the arts? How can an artist approach and use a computer? What aspects of computers are artistically interesting and exploitable? Can the machine be controlled? Will it think for me?

Questions like the ones above come to mind when you tell someone that you are an artist who works with computers. After talking to too many misunderstanding people one must

begin to formulate what the process of using a computer for art purposes involves. The computer being a "general purpose" machine can be misunderstood in as many ways as it can be used. Within an art context one can view the computer in a variety of ways. I will be concerned with several. The computer viewed:

As a tool
As an information processing device
As a system
As a medium
As a medium controller. (A meta-medium)
As an intelligent entity.

One of the problems in dealing with this machine is that it is too versital. How does one narrow down the possibilities? An artist could easily spend years developing and perfecting a single program which deals with a few problems. On the other hand it is also easy to get absorbed by the technology and quickly jump from one use to another to another. The technology is developing so rapidly that as soon as you feel you have one aspect mastered, it becomes obsolete because a newer, more powerful, faster then a speeding bullet machine has arrived. One must be aware of the kind of relationship one is having with the technology and of the dangers of simply becoming a technologist.

Another problem in using this machine for art is that one must start completely from scratch. By this I mean that there does not exist any real history of the aesthetics, art uses, or conceptual base of using computers for art. One must determine what aspects in this device are valid or

interesting to use from an art point of view.

Certainly there are a large number of people in the past who have called themselves computer artists however the vast majority of them are technologists, highly trained in their field who have access to a computer and basicaly just fooled around. A few artists did get their hands on a computer and did produce some interesting results (see illustrations 1,2). These were the pioneers of an obscure, inaccessible medium. Today we are really on the verge of a revolution. Almost everyone will have a computer at home within 10 years and artists will have access to these powerful computers right at home. What will be done with these machines?

In approaching the computer as a tool, system, medium or whatever for art making, one must first obtain some concept of what a computer is and just as important, what it is not. The computer is undoubtably the most misunderstood machine in existence. One reason for this misunderstanding is because of the many levels in which one can interact with computers. For example:

1. Interaction with a highly specific program with an extremely specific purpose. (i.e. getting money from a 24 hour banking machine, or an arcade video game)

2. Interaction with a fairly general program with a specific purpose. (i.e. A general accounting program to aid in keeping a business' books.)

3. Interaction with a program that asks questions on a specific subject with some goal. (i.e. a program which gets input data for a large data base system.)

4. Programming in a very specific high-level language designed for a specific purpose. (i.e. a language which can

'Quad IV', laminated marble, 11 inches high. The computer sculpture program TRAN 2 was used to design the sculpture and draw the cross sections, which were transferred to the marble slabs and traced. The slabs were cut out, laminated together with epoxy, then ground to a smooth contour and polished.

deal with the terms of computer graphics.)

5. Programming in a general purpose high-level language. This is the level of most normal computer programming languages and what most programmers do. (i.e. one can design any of the previous systems at this level.)

6. Assembly language programming. Almost the lowest possible level of interacting with a computer. This is the level where one can program and change a high-level language to add new capabilities to the language. If a process can't be done at this level then it can't be done at all on the particular computer involved.

7. Microprogramming. Extreme low level programming of a computer. One can literally design how one wants a computer to function at the assembly language level. Generally only the people who are concerned with the very low level operation of the computer work at this level.

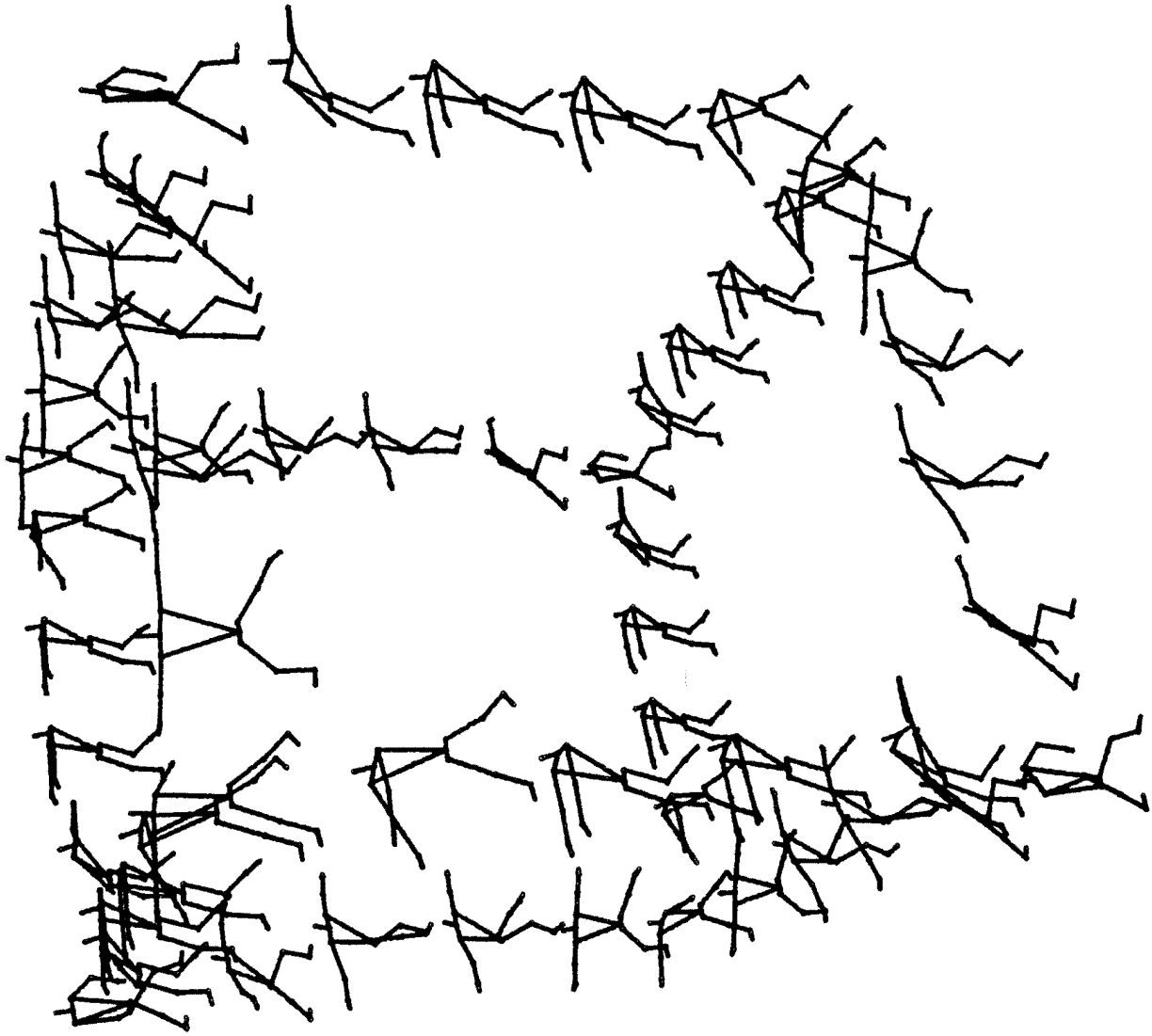
8. Machine level. Everything is 1's and 0's conceptually grouped together to do certain logic operations. Almost nobody works at this level except the people who design new computers, and work with hardware.

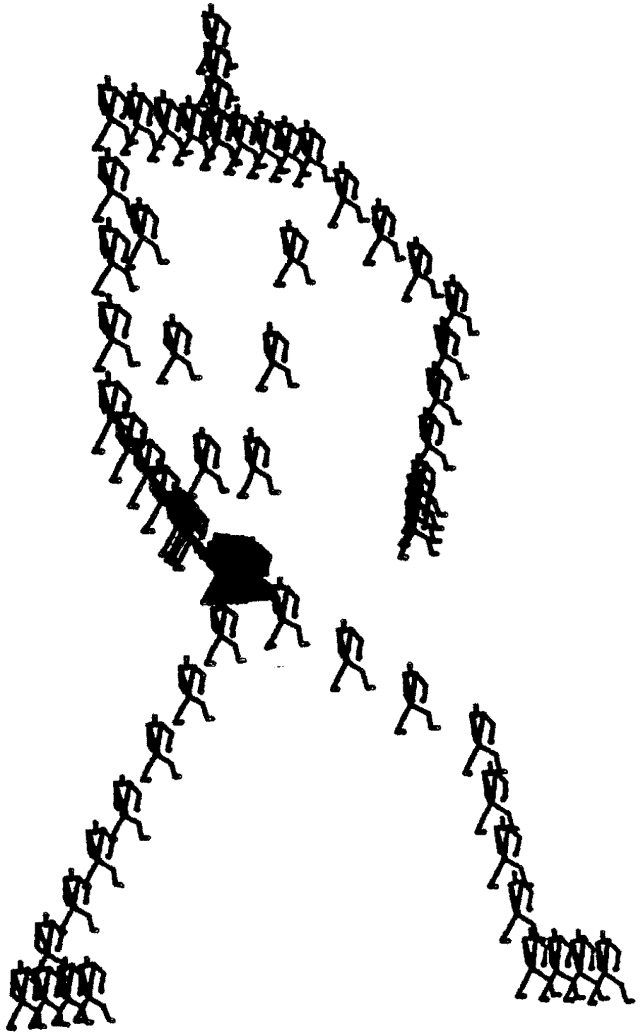
The existance of this large number of man-machine interaction modes is a prime cause for the vast differences in perception about the nature of computers. This coupled with the general purposness of computers has lead to the mis-perceptions of both the expert and layman computer user. It is the common notion that computers can do anything which causes a great deal of confusion. This supposed ability is perceived because of the "generalness" of computers. What exactly is this "generalness" and does it have any bearing to the questions of using a computer for art?

COMPUTER AS TOOL

Wnen viewing the computer as a tool one must simply decide what task one wants to accomplish and determine if those capabilities exist, in a usable form in the computer. Before anything can be done the computer must contain a program telling it what to do. This computer tool follows the instructions told to it in the form of a program or by interacting with a program that is asking you questions. For example one might simply want to fill in a closed figure on a video screen with a color different from the background. GIVEN the program to do this one simply enters the appropriate command and its done. For this particular instance one is simply using the filling tool aspect of the programmed computer. The act of drawing the figure in the first place was the use of another tool in the computer.

Some fairly common computer tools are: An instant coloring tool where you can pick from thousands of colors instantly and color areas of a picture. An object drawing tool which enables you to draw a line with squares or circles or stick figures rather than a simple line (see illustrations 3,4). A perspective calculator which lets you simulate three dimension and "sculpt" drawings. All of these capabilities are little specialized machines (programs) which can be changed if desired. Nothing is really ever fixed in a computer because the programs can always be changed given the knowledge to do so.

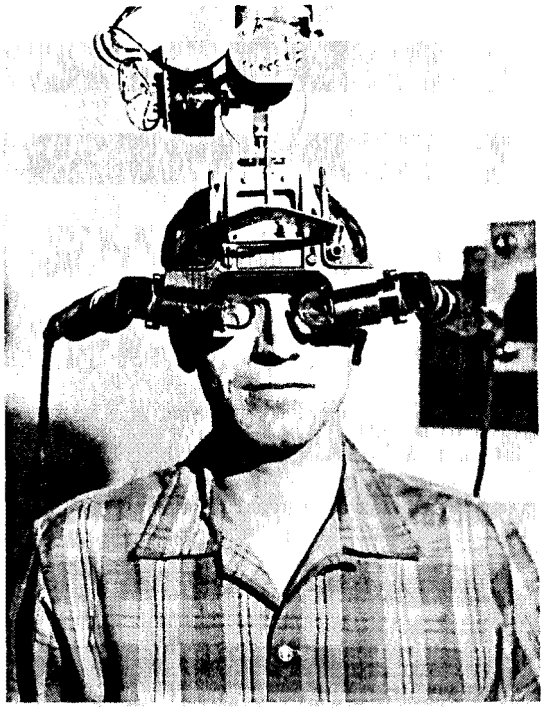




When examined from an art point of view the computer is an empty machine. It doesn't look, feel, smell, or sound like anything at all. Nothing exists. This is quite different from the paint in an unopened tube. You know that X colored paint will be used as paint. You won't use it to create video images, control a camera, create sounds, or shape some stone. The emptiness of an unopened computer can be filled by almost anything. You can create video images, take photographs, produce sounds and shape stones or even paint by simply connecting the computer to the appropriate piece of hardware. The connecting may be complex or expensive (see illustration 5) but the barriers are not conceptual.

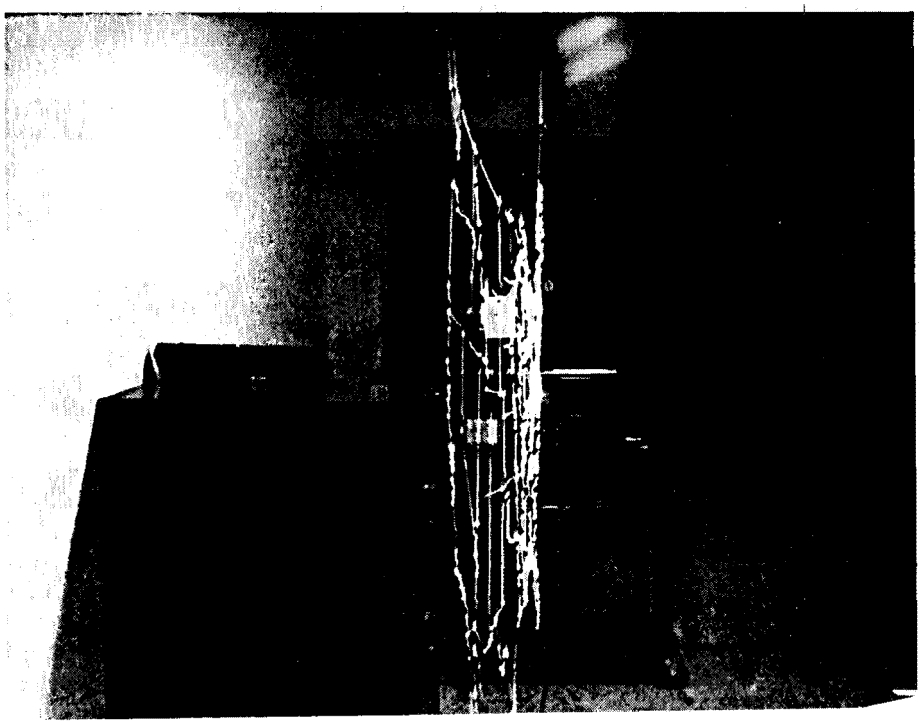
As with any tool, the use of the computer implies an interaction with it. The interaction with computers however can be an extremely complex and varied experience. The interactive design or use of various tools can be viewed as an art act in itself. To quote Charles Csuri a computer artist from the University of Ohio:

> "Another alternative is to view computer art as a real-time object involving user participation and control. The real-time computer art object is an intellectual concept which is made manifest in a visual experience rather than in a finalized material object. This kind of computer art exists only for the time the participant and the computer with a CRT display are interacting as a process. The art object is not the computer or the display, but the activity of both interacting with the participant."(1)



Ivan Sutherland. Front view of user wearing the head-set portion of the head-mounted computer-graphics display system at the University of Utah, 1970. The head-position sensor is shown attached to the head set. The viewer is thus visually surrounded by an imaginary three-dimensional world. Photo by Computer Science Communications, University of Utah, Salt Lake City.

Ivan Sutherland. Map of the United States as seen by an observer wearing the head-unit display, August, 1970. Photo by Computer Science Communications, University of Utah, Salt Lake City.



A kind of interactive performance piece becomes activated when a level of sophistication on the part of both the user and the machine has been reached. At this level the technical problems of computer usage have been overcome and the creative possibilities become dominant.

A computer is inherently an empty device. It contains a logic framework constructed to follow certain rules, the program. Before a program is fitted into this framework the computer cannot do anything. Because an empty framework exists, programs relevant to anything can be entered. Once a program is entered the computer is then a new machine with a special purpose, or a new tool. As soon as a new program is entered the computer is now transformed into another special purpose machine, another tool. A tool is usually considered to be a special purpose device of some sort. The computer, a single device enables one to program many tools and to use them in an organized fashion.

AN INFORMATION PROCESSOR TRANSFORMATION

What is information processing and does it have any importance to the relationship of computers to the art? Almost anything can be considered information. Where I'm looking, what I see, think, feel is all information of one kind or another. The computer has been heralded to be THE device for dealing with information and this is quite true. Something becomes information once it has been observed. What I think is not information until I put thoughts into a communicatable form so other people can observe my thoughts. This is a type of coding. Computers deal internally with a type of information which can be manipulated to represent all other forms of information. This is digitally coded information.

Dealing with digital information enables one to communicate across previously inaccessible boundaries. The handling of digital information lets one manipulate cross-medium communications. For example speech can control a video image, or a light can control a sound synthesizer. The digital nature of computers allows one to create and interact with an enormous number of quite different mediums. This transformational capability is a unique element in computers and computer art.

Real world, analog, information is encoded into digital information, manipulated by a program and then possibly decoded back to another real world action. This input,

processing, output sequence is a highly simplified outline of the interaction one has with a program.

The transformational aspect of the digital medium is a simple yet powerful element. A single input of data can serve to control and manipulate a large variety of art actions. For example a sentence can be considered the data input. This sentence can then be encoded into a digital format which is then used to play music, generate various types of graphics, control a dancers movements, direct a performance, control camera movements.etc..etc.... One must determine what kind of numbers are meaningful for the particular art events to be controlled. The choosing of a kind of mapping to the activity is of course left up to the artist. The artist decides how the numbers will be used by choosing the art activity and what the particular numbers mean within the context of the activity.

SIMULATION

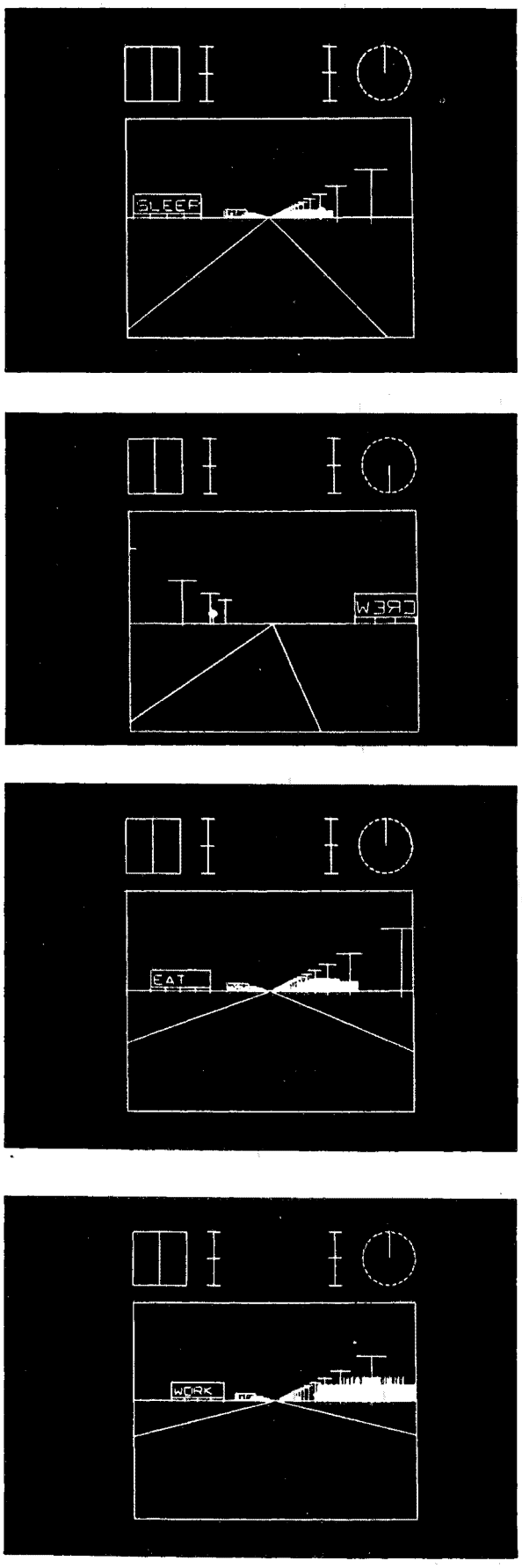
Another aspect of the interaction with digital information is the capability to simulate real world structures. This can be particularly valuable for conceptualizing sculptures of all sorts. One can model an object in three dimensions and observe it from any point of view. This capability exists because the object has been modeled with a digital description. To interact with such a model one does not necessarily have to be aware that such a description even exist. You may only have to turn a dial to

"walk" around the object or landscape modeled. (see illustration 6)

An entire environment can be developed in which one can walk around or fly over which does not in reality exist. In the early seventies Aaron Marcus (see illustration 7) created Cybernetic Landscape through which one might "walk" with the use of a joystick and turn around to see many different objects both static and kinetic in the landscape.

One might simulate huge earthworks which might be tremendously expensive or impossible to actually build. For example one could place huge mounds of dirt in the middle of New York city and actually walk around, on top, or through them. One could turn a corner around Times Square only to find a large dirt ramp. Another possibility would be to create an archive of past large earth and environmental sculptures which no longer exist. Smithsons spiral jetty could be resurrected via simulation, and Christos running fence could be flown over at will.

A crucial element in a simulation which makes it very different then simply a film, is that the person interacting with it is in control. You can go anywhere you chose in the simulated environment and turn your head to look over your shoulder whenever you want. Its the closest thing to reality yet in existence and is a unique property of computers and the way in which they can deal with information.



A sequence from 'Cybernetic Landscape I', 1971-1973.

Simulated computer space is a unique entity. One can interact with it and create objects in a manner which is completely three dimensional in conception even though the image is 2-D. The simulation is a new way of describing both objects and/or events. Different from simple photography or film one can create and modify elements within the model at the touch of a button.

SYSTEM

Information is constantly flowing from one part of a computer to another. This dynamic process can be examined, quite naturally in the light of systems theory. There are a large number of elements interacting and reacting to each other depending on how they are related. These elements can include devices physically attached to the computer as well the the person operating and/or programming it. These elements may also exist within other systems and an environment. The level of detail which one may want to examine the system is also an arbitrary decision left up the the artist.

What are some of the elements in a moderately detailed analysis, involved with a simple computer and a simple program? For example lets look at the processes involved to program a computer to draw a line.

First one must have a computer which has the capability or program which enables it to draw. This means that somewhere inside must lie a set of instructions which define what graphic operations are legal and can be executed. One must be able to access the line drawing instructions and input the information of where to start and stop the line. After inputing the information (a process which can occur in several ways) the computer can then execute the line drawing instructions and display the results on its output device, i.e. a video monitor.

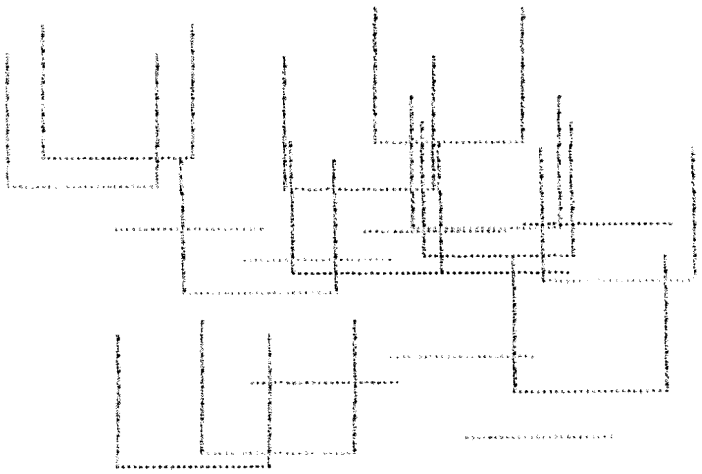
Some of the elements involved in the above process are:

The programmer
The program
Digital encoding of typed information (the program)
Input of program to computer memory
Execution of users program
Execution of graphics program
Input of line data (start and stop points)
Execution of line drawing subroutine
Output of data from line drawing subroutine
Input of returned data to computer memory
Placing of computer into graphics display mode
Video control processor decodes digital information in computer into analog video signal which actually display the line on the video monitor.

Some of these steps are implied and quite invisible in the process of using the computer but are nevertheless there and may turn out to be quite useful in a systems view. These different elements all work together and communicate with only the elements necessary in order to complete the task which is to execute the program. A systems view implies an awareness of ones surrounding elements and environment.

What are some of the system elements involved in a simple program. The following BASIC program on an Apple computer (BASIC is a computer language) generated illustration 8.

```
  1 HGR
  2 FOR I=1 TO 20
  3 X=200*RND(1)
  4 Y=150*RND(1)
  5 GOSUB 100
  6 NEXT I
  7 END
100 HPLOT X,Y
110 HPLOT X,Y TO (X+50),Y
120 HPLOT (X+50),Y TO (X+50),(Y+50)
130 HPLOT (X+50),(Y+50) TO X,(Y+50)
140 HPLOT X,(Y+50) TO X,Y
150 RETURN
```



The above program will draw 20 rectangles on the video screen in random positions. A systems analysis could be as follows.

Lines 1 through 7 constitute the controlling portion of the program. Line 1 tells the computer to go into graphics mode. Line 2 sets up the beginning of a loop and line 6 is the end of the loop. All lines inside of the loop are repeated 100 time, the length of the loop. Lines 3 and 4 use a random number generator to get random numbers within acceptable ranges for the start of the square in x y coordinates. Line 5 tell the computer to goto line 100 for a subroutine, a kind of mini program. The command HPLOT in the subroutine access the line generating capability of the computer and actually draws lines on the screen. The RETURN statement tells the computer to go to the line following the call to the subroutine which happens to be the end of the loop. When the loop is finished lines following it are executed, line 7, which is an END statement telling the computer to stop running the program.

Depending on the level of involvement with the computer the person interacting with it may or may not have to be aware of exactly what is going on in the program. If someone is being given the above program as an example of computer graphics then all that matters are the results, what the individual sees. If the person is a beginning programmer, he might need to know certain aspects of the system. For

example if you don't go into graphics mode then you won't see anything. If the individual is trying to do a detailed analysis of the program and how it performs then all the details would have to be known. A knowledge of system details is only important if one is dealing with the system at a detailed system level.

Programming the computer is dealing with systems on top of systems. The high level computer language is a system. The low level language is another. The disk operating system is another. The components of most of these systems are invisible to the operator and do not need to be discussed in high level analyses.

A computer system contains elements which are related to each other in a digital manner. The communications which takes places between these elements is in the form of digital information and therefore we are dealing with a digital system. This fact becomes important when we realize that a digital system has the capability to simulate other systems. The elements of other systems can be simulated and any other type of system can be simulated. This conglomeration of systems could be considered to be a super system etc.. etc..

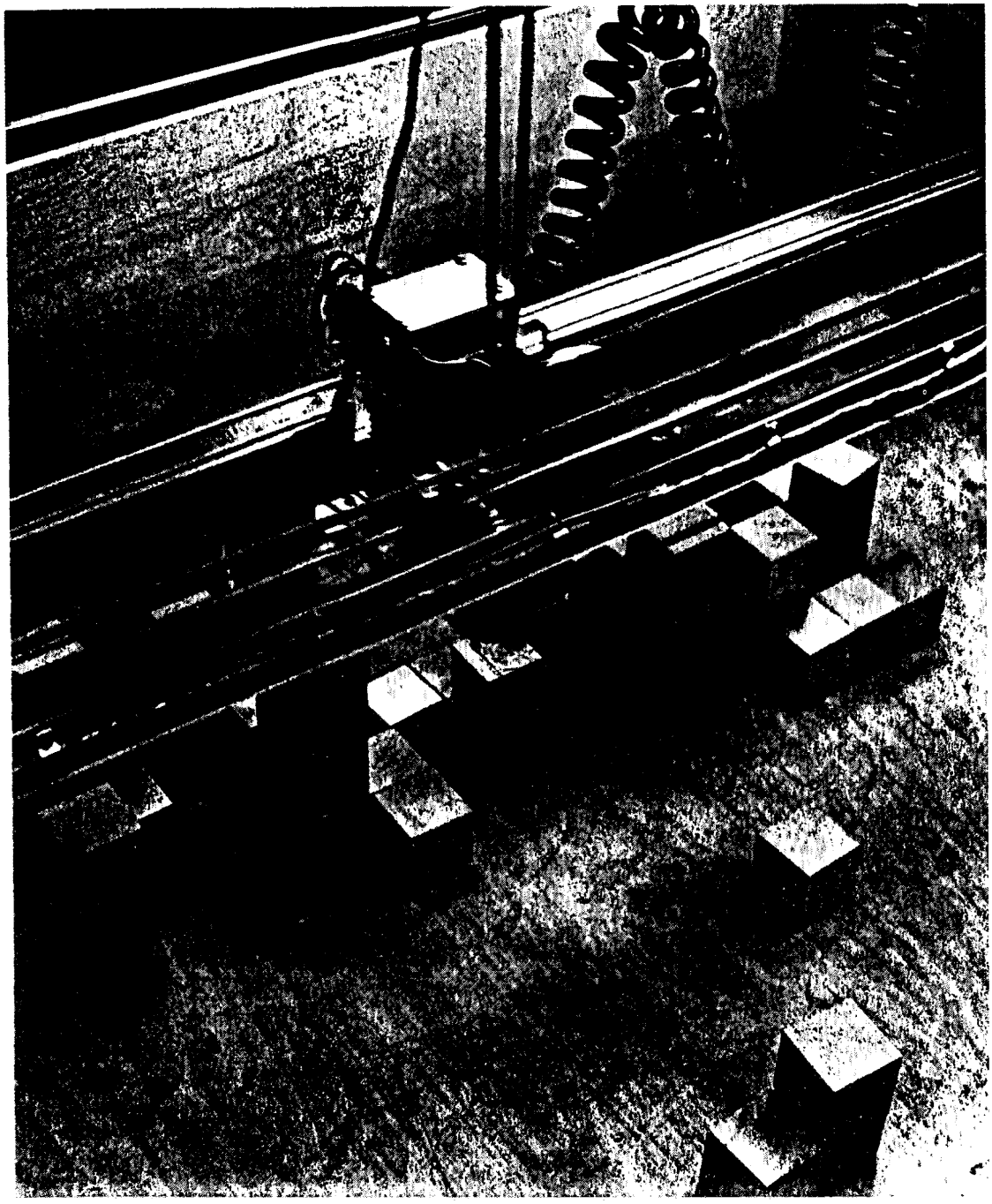
A systems approach is really most useful when one wants to take into account the type of environment one is working in. One program exists within the environment of another which is inside of another. The programmer exists inside of a room which is in a university which has one type of

bureaucratic system. This educational system exists within other systems. One can go on and on. Depending on the level of systems involvment that the artist want to be involved with, one can deal with the various aspect of the various systems.

Another aspect of a system is the implied capability of communications from one element of the system to other element. This passage of information can take place in both directions and many times feedback mechanisms arise. The artist twists a knob which draws a particular color and then the artist decides to twist the knob again because of the previous feedback of the color. Feedback systems are a kind of regulatory mechanism which exist in all biological systems as well as some mechanical ones. The most common negative feedback device is the thermostat which regulates the temperature of a space.

With computer systems it becomes possible to construct feedback art systems which respond to the environment as well as the artist. For example Nicholas Negroponte's "SEEK": (see illustration 9)

> "SEEK is a sensing/effecting device - a device for finding things out and doing things - controlled by a small general-purpose computer. SEEK deals with two-inch cubes which it can stack, align and sort by means of an electromagnet roaming overhead. These cubes form the built environment, cased in glass, for a small colony of gerbils. The gerbils are incessantly bumping into the cubes and disrupting constructions." (2)



The computers involvement in feedback systems can become important to increase the complexity of such a system and to simulate components of a physical system which is impossible to build. Rather than actually buying and building new hardware the computer enables one to change the components of a system with software, programming thus improving greatly the possibilities of creating increasingly complex systems. The computer can be a controller of the system directly or can simulate an environment to which other system components respond. It is the relationship between system components which make a system unique. Individual elements are not isolated in a systems environment. Jack Burnham in talking about systems esthetics says:

> "Systems components derive their value solely through their assigned context. Therefore it would be impossible to regard a fragment of an art system as a work of art in itself." (3)

The attitude of artworks as inherently related to their environment is one way of dealing with the complexity of certain types of artworks. The role of digital information communications in all of this can be quite important because of the universally applicable nature of digital information. Many previously different and incommunicatable systems can now communicate with each other once a digitally based translation of the system has been devised.

MEDIUM

The computer can be approached as an art medium. What are the characteristics of any medium and how does the computer compare to other art mediums? A medium is generally thought of as being something physical, like paint or sculpture. It might be simply an activity, as in performances. Regardless of your definition of a medium I would say simply that the computer can be considered one and it is worthwhile to examine it from that point of view.

The flexibility of the computer is an extremely important part and can overwhelm the artist trying to understand what kinds of things are possible. Paint can only be used so many ways. A computer can be used in an unlimited number of ways because not only can you do uniquely computer actions but a computer can also control other mediums.

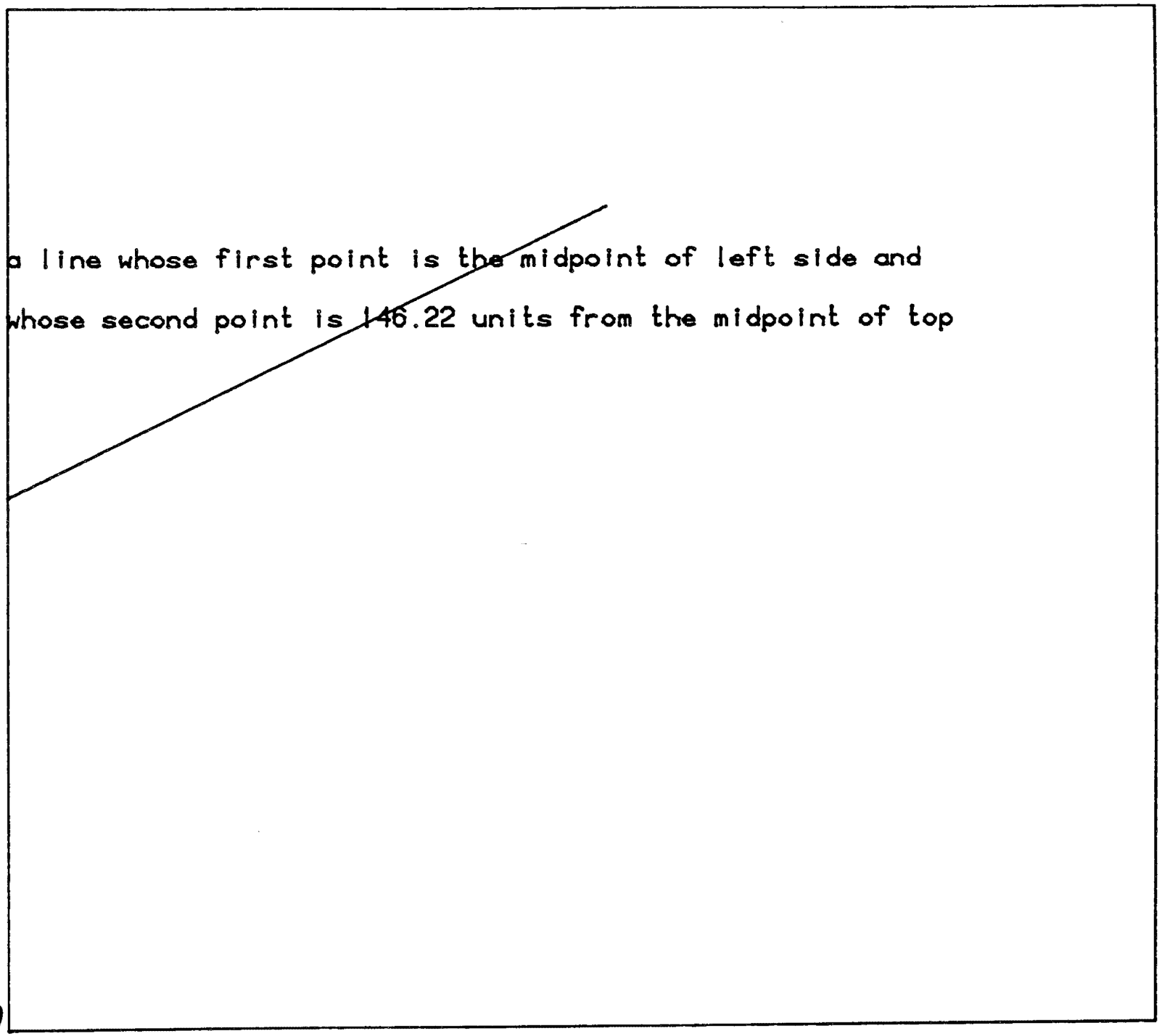
If the computer is a medium the act of using the medium is programming. It is really only when you get involved with programming, even if at a very basic level that the power and flexibility of this machine becomes available and quite easily usable. In order to really understand what a computer is one must understand the concept of the program.

A program is a series or instructions or orders which tell the computer to do certain operations. A computer never does anything it is not programmed to do. Only when a program gets complex enough or the programmer doesn't

understand some aspect of it do we hear things like "I didn't program that to happen." or "What in the hell is it doing." The program is written in a programming language which is "understandable" to both the person writing it and the computer. It must be stressed that the computer doesn't "understand" anything in the way humans do. It is mearly following a complex series of logic operations which may be given the appearance of understanding or intelligence, but more about artificial intelligence later.

A programming language is a tool or group of tools or system with which a programmer communicates a process to the computer. The way in which a particular problem is solved is called an algorithm. An algorithm for drawing lines may be fairly standard by the exact way in which it is written will depend on the programming language being used to implement the algorithm.

Algorithms are not unknown in the art world. Much of Sol Lewitt's work has consisted of defining a process and then executing it to its logical conclusion. For example his incomplete cubes and simple line drawings with written explanations of them. Given a relatively simple algorithmic art it can become possible to simulate an artist who functions this way. The examples show work I did a few years ago to simulate certain aspects of Lewitts work. (see illustration 10)


a line whose first point is the midpoint of left side and
whose second point is 146.22 units from the midpoint of top

This simulation of other artists raises the possibility of having programs which define stylistic elements of artists. I am quite sure that you can't have programs which simulate the styles of most artists. However for those artists where an algorithmic method is dominant, a program could be written which would produce works similar to that of the artist.

A perfect example of this is Harold Cohen. Cohen has been working for many years on a program which produces very human looking drawings. He raises many issues about the nature of the viewer of computer work and of artificial intellegence. One point which seems very strange however is that the program produces drawings very similar to the type of drawings which he used to do by hand. When asked to explain this he says:

> "That's a difficult question to answer. It is evidently true that the drawings the machine does today are recognized as my work by anyone who knew my work 10 or 15 years ago. I'm not sure that I can explain it adequately."(4)

It is obvious that consciously or not one of the most significant things that Cohen has done is to simulate his own former style. The program that he has himself worked out is an algorithm of his former style.

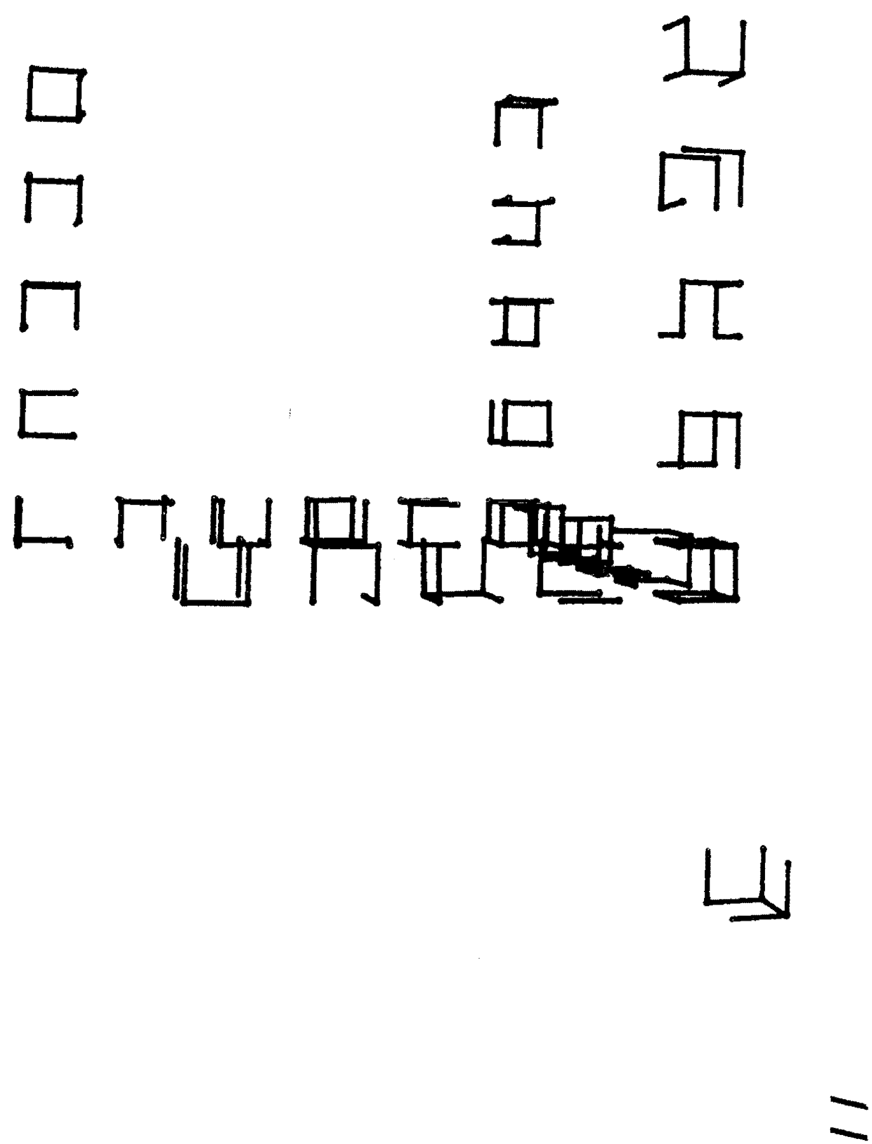
There are however some crucial differences between opening up a Lewitt book, observing his art, and the observation of a computer executing an algorithm. For one

the book is a completed, finished and unchanging entity. The idea behind it is not. Lewitt, if he had time and patience enough could have produced thousands of unfinished cubes.

A computer program can go through these variations and display them on a TV monitor or physically draw them on paper. Moreover the different types of variations could be so numerous as to run on forever, if for example, we start dealing with several cubes or cubes made of other cubes. (see illustration 11) There is no limit to a process which is being synthesized dynamically. The program might randomly decide how many cubes and how many sides to display at any point in time. The algorithm is the structure that one has programmed to enable the decision making capabilities of a computer to function in art terms.

The complexity involved in using the various aspects of computers for art are also affected by the manner in which we view the computer or medium. As Terence Hawkes in "Structuralism and Semiotics" says:

> "When the extension of the body, which we call a medium, causes one organic factor to become dominant over the others (the telephone has this effect on the voice : silent film had the same effect on bodily gesture) then it will inevitably affect the nature of the discourse. That is, the medium will begin to affect the message. When this takes extreme form, we find ourselves confronted, not with a medium which simply transmits a pre-packaged message, but with an autonomous semiotic system, with a 'life' - that is, with messages - of its own."(5)



Upon showing a work of some sort involving the use of a computer one always becomes involved with explaining various technical and pseudo-technical aspects of the work. The medium as an entity in itself strongly influences the perceptions of the viewer because is send out "messages - of its own". Everyone has heard of computers and has some preconceived notion of what they are and what they are supposed to be. When confronted with an unusual use of the machine the response must always be taken in the context of how familiar the viewers are with the machine, the medium. This can be said about any medium. The level of education that an individual has about a particular medium will always affect the perception of works in that medium.

The computer however is a quite different type of medium because intuitively people approach it as being another being of sorts. It is an entity which kind of acts on its own, supposedly. This perception exists because of the way in which a computer can be made to appear intelligent and because of the rule following capabilities of the computer. In semiotic terms one could say that there exists a strong entity which is signified via the simple sign of the computer.

META-MEDIUM

The role of a computer in the handling of all types of information can also be viewed as a way of handling all types of mediums. Information which has relevance towards one particular medium becomes manipulable by the computer when the medium has been encoded. If I define video animation in terms which the computer and its associated devices can handle then video animation can now be handled in a meaningful manner by a computer. After encoding, the medium of video animation is workable in a meaningful manner by the computer.

The key here is in the way that a computer can be used to control anything. You can connect almost anything to a computer because of the digital nature of the information being used. Anything can be interpreted in a digital manner and then be dealt with in some manner by a computer. In art terms this means that once an art medium has some digital translation or interface it can be hooked up to a computer.

Once several mediums have been encoded the information processing power of the computer can then be directed to control the various types of mediums which have been previously defined and encoded. The process of defining a particular medium and determining a suitable encoding is one function of the artist, as this phase of medium breakdown can be quite arbitrary. The control of several mediums by a single process controller is an ideal function for a

computer. The medium of music can be controlled just as easily as the medium of animations. Many different output devices such as computer controlled video, plotter, milling machine, color xerox, fabric weaver, music synthesizer, and speech synthesizer could all be considered separate mediums under a single controlling process. This creation of a controlling process would be accomplished by the interaction of an artist with the meta-medium, the computer.

ARTIFICIAL INTELLIGENCE

Since WWII and into the 60's there was a great flurry of activity in Artifical Intelligence (AI) research. Great claims were made for these new and wonderful thinking machines which would translate languages, replace decisionmakers and solve the worlds problems. The term intelligence as applied to computers is extremely misunderstood and misused. No matter what you may have been led to believe by optimistic scientists, hollywood or whomever, the fact is that as of today no computer can match the intelligence of a cockroach.

The confusion of intelligent computers is partly due to the domain of knowledge given to a computer and the level of interaction that one observes with this program. There seems to be an inherent desire for people to inject human qualities on to computers. There may be a kind of subconscious wish to believe that machine really do think. Harold Cohen has explored this aspect of computers with his installations. Jack Burnham seems to agree with Cohen when he says " It is doubtful if non-anthropomorphic sculpture can exist." (6)

Computers can be made to appear very intelligent but as the saying goes appearances are deceiving. So far computers can be made to act intelligently within a very limited domain of knowledge. A program may accuratelly deal with chemical structures, or a particular set of diseases, or specific world model of any sort, however people don't deal with just

one type of model or simple set of data for anything. No one has any idea really of how human beings are capable of jumping from one kind of perceptual model to another. I might view a manhole cover as an obstacle, art work, part of sewage system, escape route or any number of things depending on my frame of mind. Yet all I saw was the manhole cover.

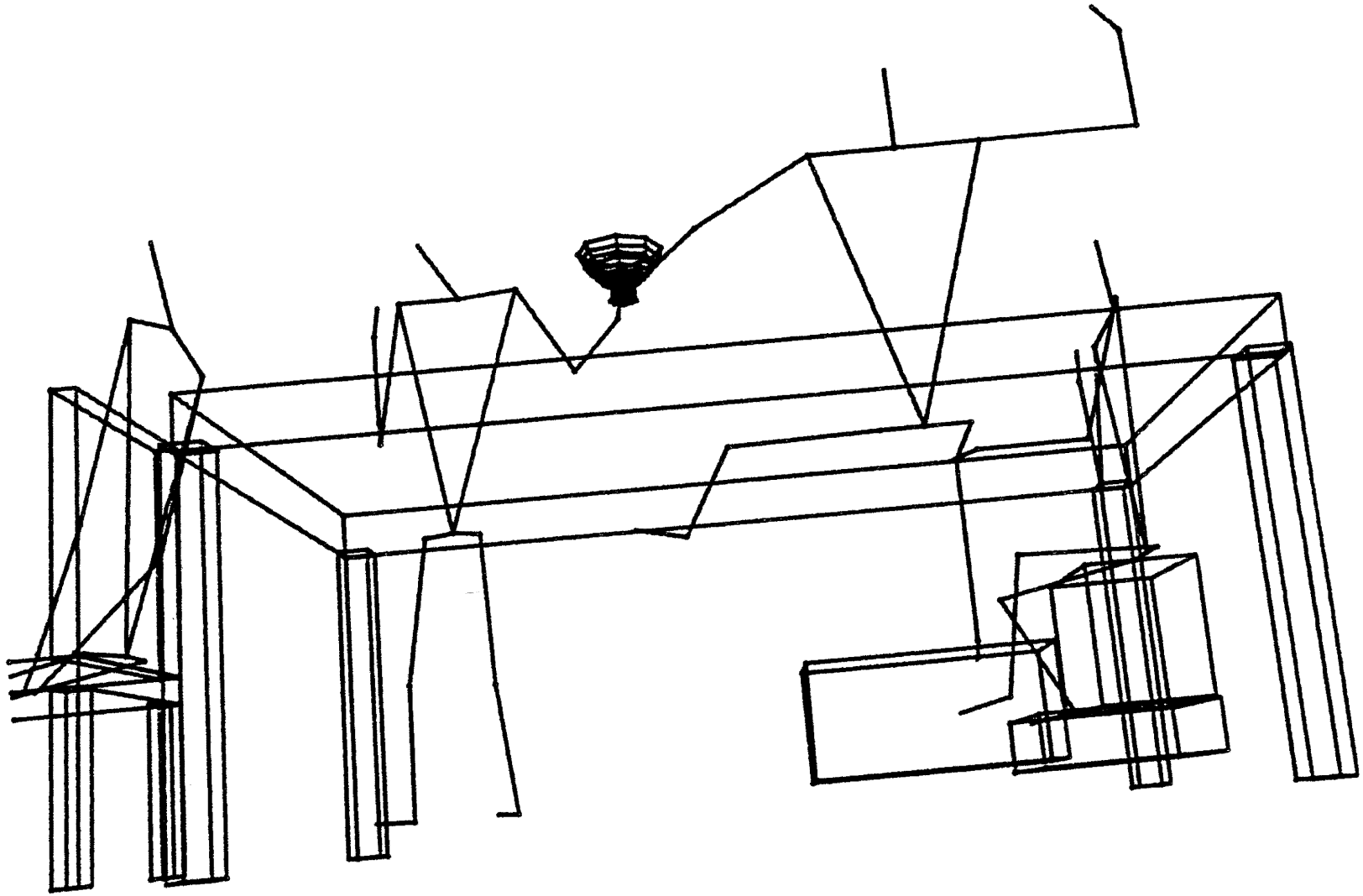
Computers may someday be very intelligent however that intelligence will be of an alien nature (7). We exist with in a particular type of biological body which plays a huge role in how we perceive things. Any type of real intelligence which may arise in computers must be very different from the human type of intelligence. Art, one of the most human of activities is simply not going to be produced by computers chugging along all on their own.

WORKS VS THEORY

The next question to answer is how does my own work fit into the many theoretical aspects of computers described previously. One of my first attempts at doing a non-trivial art work was to write a program which generated a model for a random sculpture. This was done by drawing a random line and simply rotating it to create a cylindrical object. The idea is that given the algorithm to produce such works an infinite number of sculptures can be generated. As I shortly thereafter learned, Robert Mallory was doing a similar type of work and actually constructing the pieces.

The simulation of another artist, Sol Lewitt, was my next big venture and these works proved to me that the style of an artist is a highly complex process which can only be partially simulated by a computer. Another algorithmic type work was part of a computer dance system I developed. The computer can generate random stick figure positions and given the proper equipment an infinite dance can be generated.

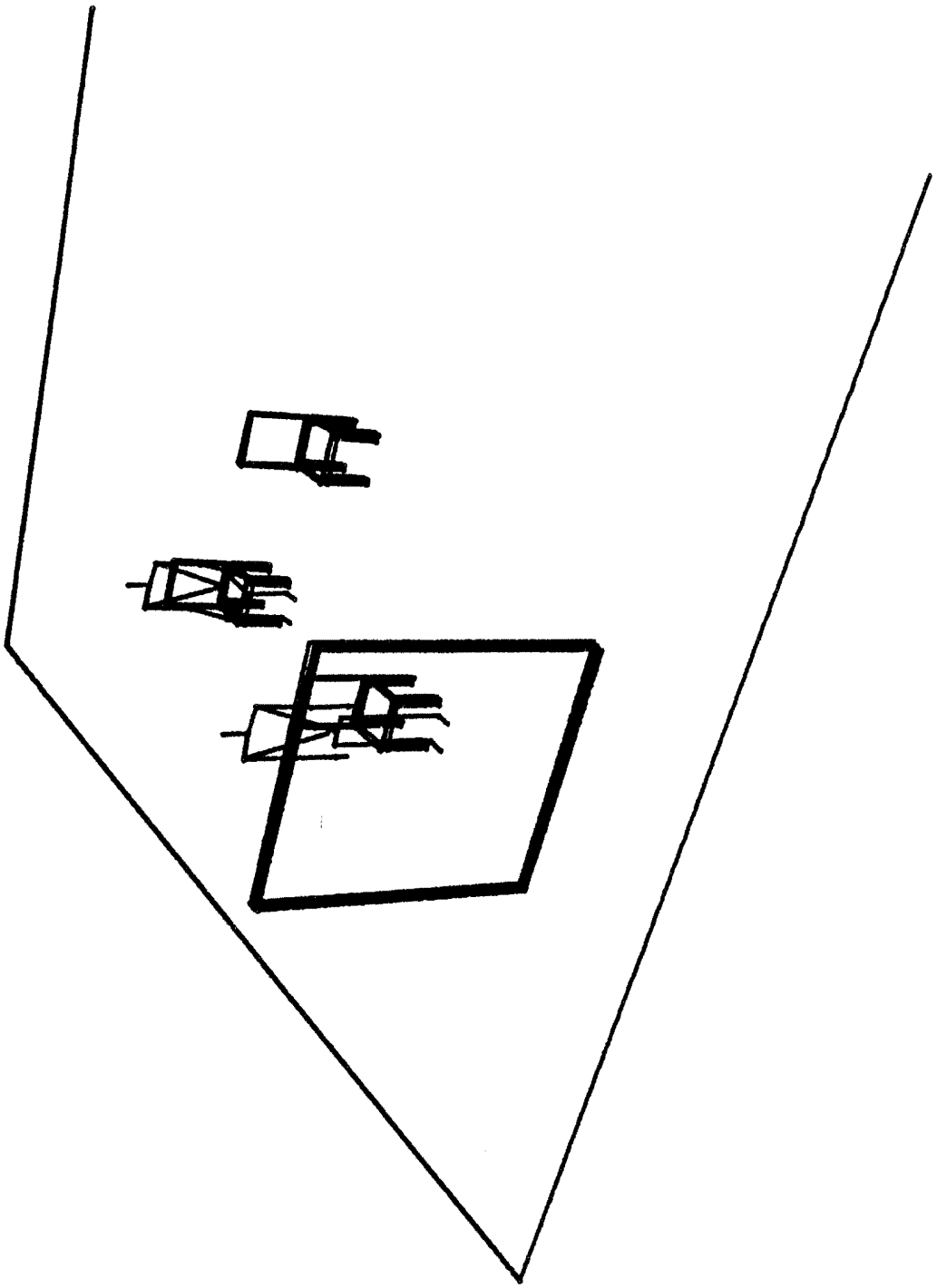
The nature of simulated space and objects was demonstrated by my alternate views of classical paintings. (see illustration !2) These works could only be done within the framework of a computer space simulation. The interactive choice of a viewpoint and the unique entity of computer space is hopefully demonstrated here. The ability of the computer to deal with space in a dynamic way was also a prime aspect in the animation "Da Movies" which I made



about one year ago. (see illustration 13)

One possibility which I have not had the time to try is to take advantage of the portability of microcomputers like the APPLE. (see illustration 14) This equipment could be carted around to all kinds of places and installations using some of the computers capabilities could turn out to be quite interesting.

Having just recently gained access to color graphics equipment the possibilities have become quite numerous. First, however one must gain an appreciable understanding of the equipment and systems involved, a time consuming task. Currently I am working on a film which will demonstrate the digital nature of information dealt with by the computer. Words will be encoded and used to control all aspects of the images and sounds in the film. Throughout all my work I have consciously decided not to focus on any one particular aspect of computers and art, because of the newness of the field. I feel that it is more important at this point in time to try and define what interesting possibilities exist, than eventually to focus on a single aspect. At some time in the future, hopefully, my broader understanding of the field will lead to works which function on many levels.



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CONCLUSION

The complexity of a machine like the computer cannot possibly be viewed in a single manner. One must approach the use of a computer for art with the awareness that one is only dealing with the machine at one level at a time, in one mode at a time. Viewing computers as information processors, systems, mediums, or meta-mediums are all correct depending on the particular piece, place and time involved. Each view or theoretical basis one chooses can contribute to the overall ideas involved and the rejection of any one can only detract from the understanding of the whole conceptual basis of computer usage in the arts. Some particularly useful questions for viewing computer based art are:

Why was a computer used for this particular task?

Is this process a practical possibility without the use of a computer?

What aspect(s) unique to computers am I dealing with in this particular piece?

Real "Computer Art" is that art which is possible only by the use of a computer. Such things as infinite animations which never repeat themselves. The use of randomness in many many ways to produce a great variety of effects which never repeat. The simulation of objects in the real world on video monitors which react to the wishes of the person "playing" with the piece. Interactive walks through landscapes which don't really exist. All of these works would be works which exploit the possibilities of the computer.

Sources of Illustrations

1. "Artist and Computer", Levitt, Ruth; Harmony Books, New York., 1976; Robert Mallory "Quad IV" laminated marble, 11 inches high.

2. Davis Douglas "Art and the Future", Praeger, New York., 1973; Charles Csuri, "Sine Curve Man" 1967.

3. Authors work.

4. Authors work.

5. Davis Douglas "Art and the Future", Praeger, New York., 1973 Ivan Sutherland's head-mounted computer-graphics display system, pg 104.

6. Sigraph '79 slide collection, Marconi Radar Systems.

7. "Artist and Computer", Levitt, Ruth; Harmony Books, New York., 1976 Aaron Marcus "Cybernetic Landscape 1" 1971-73

8. Authors work.

9. Benthall, Jonathan "Science and Technology in Art Today", Praeger, New York., 1972; Nicholas Negroponte "SEEK" 1970.

10. Authors work.

11. Authors work.

12. Authors work.

13. Authors work.

14. Authors work.

Footnotes

1. Csuri, Charles in "Artist and Computer", Levitt, Ruth ;Harmony Books, New York., 1976 pg 86

2. Benthall, Jonathan "Science and Technology in Art Today", Praeger, New York., 1972 pg 77

3. Burnham, Jack "Great Western Salt Works" , Braziller, New York., 1974 pg 21

4. Roth, Moira "Harold Cohen on Art & the Machine", an interview in "Art in America", September-October 1978 pg 107

5. Hawkes, Terence "Structuralism and Semiotics" , University of California Press, Berkeley CA., 1977 pg 135

6. Burnham, Jack "Beyond Modern Sculpture", Braziller, New York., 1968 pg 332

7. Weizenbaum, Joseph "Computer Power and Human Reason", W. H. Freeman and Co., San Francisco., 1976 from Chapter 8.

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