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### Design Sketch to Presentation: The Computers' Role

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ROCHESTER INSTITUTE OF TECHNOLOGY

A Thesis Submitted to the Faculty of

The College of Fine and Applied Arts

in Candidacy for the Degree of

MASTER OF FINE ARTS

Design Sketch to Presentation: The Computers' Role

By

James W. Ross III

September 13, 1983

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Fine & Applied Arts:Date: 3/15/1984

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## I. INTRODUCTION

The purpose of this thesis is to examine, through application, turnkey computer systems as a tool in the industrial design process. Turnkey computer systems are designed to perform certain tasks without the need to program. The rationale of this thesis comes from the need of industry to justify application of computers in industrial design. Industrial designers have not yet integrated computers as a viable tool, for a complete system does not exist at this point in time.

The thesis is divided into three areas of concentration: process, the product designed, and the computers I used. The emphasis is in the industrial design process and where in that process a computer system can be used. The computers used were the Genigraphics (two-dimensional graphic computer), Bausch and Lomb Producer (drafting computer), and the Apple II (with three-dimensional imagery software). The computers were selected because their collective capabilities represented what I believe would be the capabilities of an industrial design computer system. The product designed was a home security system control unit.

The product was researched by meeting with security system experts, looking at current products on the market, and by meeting with electronic engineers to verify future technology. I trained on all three computers and researched a three-dimensional system that had more capabilities than the one I had access to. I investigated process through books and my own product

development packages. I then applied all these aspects (computer, product, process) by designing the product using the computers in the design process (Slide 1). The use of the computers were determined before the process began. However, other uses were discovered along the way. From this project I was able to propose an industrial design computer system (hypothetical), as well as a plan for immediate computer implementation.

The basic purpose of implementing computers is two-fold. First, the use of computer systems should increase productivity. Productivity increase means it should take less time to do certain tasks. Secondly and more importantly, it should simultaneously increase quality of the product. This quality will show in all aspects of the product design. If the systems do not do that they will not pay for themselves.

In the near future, I believe an industrial design computer system will be developed. It will be more complex than any other systems in the market today. With the knowledge gained by this project, studying the Applicon AGS 880 CAD/CAM, and by visiting Kodak and Bausch & Lomb to see the systems currently in use, I feel qualified to assemble on paper an industrial design system. It is my belief technology is capable of assembling such a system. The biggest draw-back at this time is lack of a good, inexpensive, accurate printer or plotter that can turn out color hard copy. The limitations are in the choice of color therefore limiting an ability to make aesthetic evaluations from the hard copy.

# **DESIGN SKETCH TO PRESENTATION: THE COMPUTERS' ROLE**

**The sensitivity and creativity of the designer are the major factors in any good design. The computer is a tool that can enhance the design process.**

**The purpose of this thesis is to design a product using various computers during the design process of that product.**

**James W. Ross**

## II. PROCESS

Process is: "a series of actions or operations conducing to an end;"<sup>(1)</sup> The process can be simple or complex, most scholars holding certain steps in common. The design process according to Hanks, Belliston and Edwards<sup>(2)</sup>, divides the process into six easy steps. (Fig. 1) The steps are: problem identification; preliminary ideas; design refinement; analysis; decision; and implementation. This definition gave me a stepping stone on which to understand my own design process and develop a new variation. I needed a process refined to the point to which I could analyze when computers could be best utilized. This required me to analyze my own design process, research process in general and have an excellent understanding of the computers' capabilities.

In order to refine my process it was necessary for me to divide it into three distinct levels. Each level is unique yet each level is an integral part of the whole process. These levels are: the individual's creative level; the interdisciplinary level; and the disciplinary level.

---

<sup>1</sup>Webster's New Collegiate Dictionary, 1981 ed., s.v. "Process."

<sup>2</sup>Larry Belliston; Dave Edwards; Curt Hanks; Design Yourself (Los Altos: William Kaufman, Inc., 1977), pp. 60-61

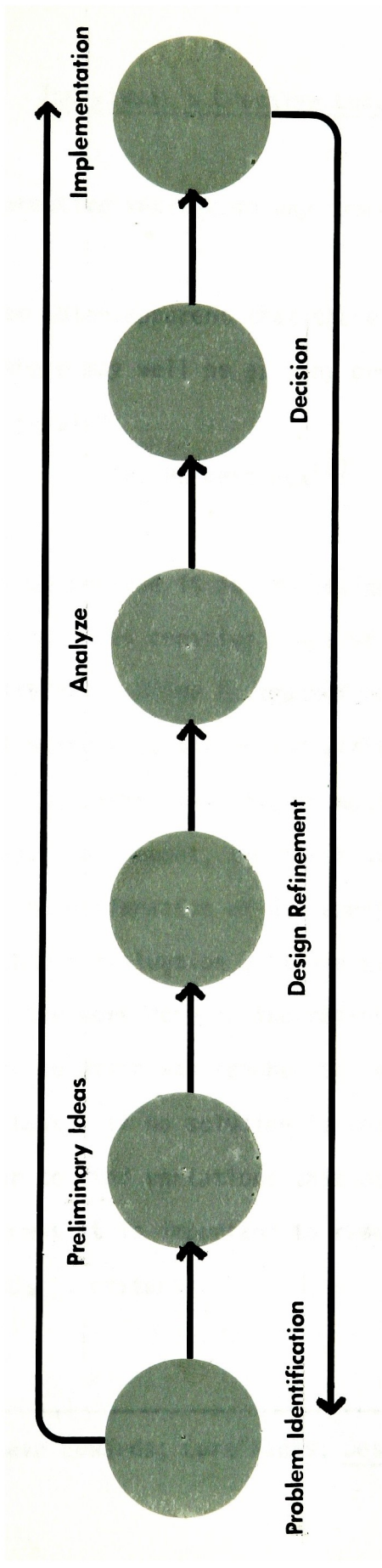


Fig. 1. The Design Process

Individual's Creative Level

The design is the creative vehicle in any process.

"It would seem quite apparent that there is no one creative process and there may well be as many creative processes as there are creative people"

H. Herbert Fox<sup>(3)</sup>

I hold this to be true because it is the designer and his process that makes each design different. This creative level of process for me starts with the formation of criteria. (Slide 2, top left hand corner) These criteria include personal standards, skills and attitudes that evolve from background and education. Revolving in a cyclic motion around the criteria are three sequential steps. Refinement, the first step, deals with the examination of ideas and the explanation of different variations. The second step, analysis, deals with the evaluation of these variations. The last step is to reach a decision on the work done in the refinement and analysis stages. If a satisfactory solution was reached the process would start over again but on a different task. If no solution is reached the refinement stage would begin again in order to find variations that may include a solution to the problem. In this process it is important to remember that all three steps interact with the individual's criteria.

---

<sup>3</sup>Larry Belliston; Dave Edwards; Curt Hanks; Design Yourself, p. 125



# INDUSTRIAL DESIGN PROCESS

**Concept Criteria**

**Develop and place priority to criteria**

function  
manufacturing process  
cost  
aesthetics

**Design Development**

**Product elements**

form  
graphics  
detailing

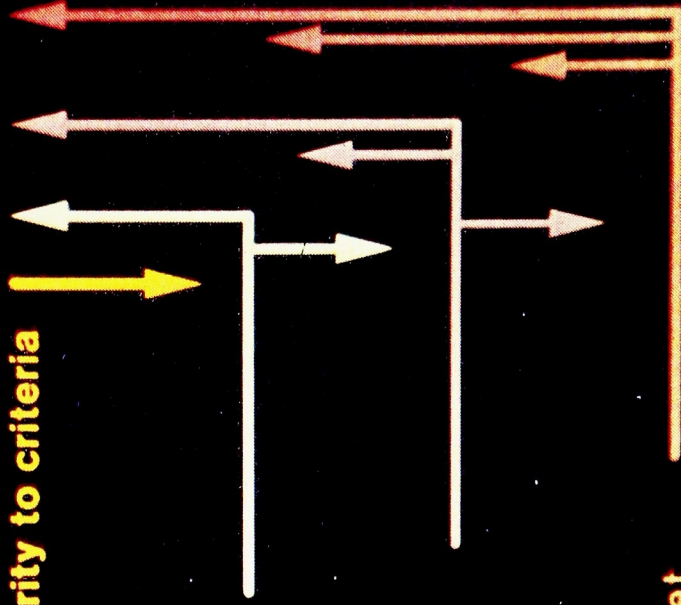
**Evaluation**

**Design presentation**

implement  
make changes  
start over

**Implementation**

**Manufacture and market**



The purpose of analyzing process to this stage was to find where in the individual's design process the computer was best utilized. In this project I found the most efficient use of the computer was in the refinement stage. It can easily duplicate work and help in the creation of a wide assortment of variations on an idea, it is a valuable tool in this step.

### Interdisciplinary Level

The interdisciplinary level is similar to the earlier example of Hanks, Belliston, Edwards. This level of process is shared by many design disciplines and is the base from which the disciplinary process stems. This level has four steps, the first being the concept criteria. This step includes developing and placing priorities to criteria, gathering all information pertinent to the design, and the actual formation of ideas and concepts. Secondly, design development deals with narrowing a concept or idea into some type of workable form. The third step is evaluation and it deals with the presentation of the final concept, with input from other designers and specialists. The last step is implementing the idea or bringing it to a conclusion.

### Disciplinary Level

This level deals with process at each individual discipline's level. For my purposes it is the industrial design discipline, or what I will refer to as the industrial design process. Slide 3 shows my definition of the industrial design process and includes all three levels of process mentioned earlier. In the upper left hand corner is the cyclic creative level and below that in the

# THE COMPUTERS IN THE INDUSTRIAL DESIGN PROCESS

## Concept Criteria

Research ▲ ●

Brainstorm

Thumbnail sketches ▲

● Genigraphics

## Design Development

Sketch ● ▲

Mock ups

Renderings ● ▲

Control drawings ■

■ Producer

## Evaluation

Illustrations ● ▲

Schematic views ●  
mechanical elements  
operation

Control drawings ■

## Implementation

Manufacture

▲ Apple II

first column is the interdisciplinary level. The third column is specific to industrial design and also shows by arrows the direction the process can take. Each step flows into the next, but also can move backwards.

Slide 3 shows another aspect of the industrial design process; the techniques and tools used to accomplish certain tasks in the process (e.g. sketching, rendering control drawings). To further clarify this design process I must describe the interrelationship of the three various levels. The creative level is used everywhere in the design process. The designer is always refining, analyzing and making decisions. The designer's criteria is combined with the concept criteria. All decisions are made through analyzing the project with the designer's personal criteria and the given project (product) criteria.

### III. THE PRODUCT

The first step in doing the project was to decide upon a product to design. After extensive research I decided to design a home security system. The aspects of the product (the control unit) consisted of elements used in most products designed today. The emphasis here was on the functional uses of electronics, efficient use of the product and an aesthetic appropriate to the function. Research was done on this product by meeting with two security system specialists, John Yockel of RIT and Dave Sprague from Technical Services Corporation. They gave me an overview of security systems, their purposes and their future uses. I then went to a few electronic stores to see the equipment on the market. There are two types of equipment: one sold by security professionals, the other by do-it-yourself electronic stores. (e.g. Radio Shack)

The professionals have low regard for the do-it-yourself type. However, they recognize the fact that the expense of their installation of equipment keeps them from the home security market. (Slide 4) Although the equipment is also more expensive, it is more reliable. My one task then was to create a design that could bring a security system into the average house.

My next task was to list all the components of a security system. I divided these components into two separate areas, an active system and a passive system. The active system includes a control unit, receiver

# THE PRODUCT

## Marketing

### Why few homes have security systems:

#### Expense

- planning the individual home system
- equipment
- installation

#### Necessity

What is being protected and what value it has to the homeowner.

#### Effectiveness

Poor installation and cheap equipment increase false alarms, making most systems unreliable.

transmitter, remote controls, motion detectors, window switches, mini-transmitters, heat-smoke detectors, alarms and digital communicators. (Slide 5) The passive system contains preventative or emergency equipment. This equipment includes garage door openers, a management system that turns lights on and off and monitors the house (e.g. temperature, water etc). The task then was to create a system that could be expanded.

I then met again with Dave Sprague and an electronics professor, Dave Pearleman, to discuss what the future holds for security systems. From these meetings I developed a system that includes technology that is either now available or will be in three years. (Slide 6) This included a finger print scanner, a supervised wireless control unit (needs no hard wiring) and state-of-the-art electronics. Also investigated was the use of fluorescent dot matrixes instead of the standard light emitting diode.

The concept was then put together. (Slide 6) I decided to concentrate on just the control unit. By changing the control unit to a supervised/wireless system I could now solve all the problems I had wanted to. Now all the detectors and alarms receive and transmit signals through radio waves. (Slide 7) The control unit can decode all these signals, send out appropriate signals to set off alarms, or report to the police or fire through a digital communicator. If any zone (detector) malfunctions that zone can be turned off without having to shut down the whole system. System expansion can be accomplished simply by purchasing additional detectors and mini-transmitters. I also wanted the control unit to be flexible enough to be both table-mounted and wall-mounted. The product concept would allow someone who lived in an

# THE PRODUCT

## HOME SECURITY SYSTEM

### SYSTEM OVERVIEW

INPUT



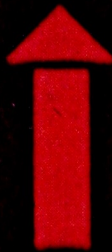
motion detectors  
heat/smoke  
switches



CONTROL



control unit  
turns on/off all parts  
mini-remote



OUTPUT



telephone line  
siren/alarm

# THE PRODUCT

## CONCEPT

### Control Unit

- programmable by owner or security agent
- 250 zone capability
- supervised wireless (no hard wire)
- three level dot matrix readout allowing any combination of text
- finger print scanner programmed to users of system allowing quick access into the system
- house power supply with 48 hour battery back-up
- can be wall mounted or on a table top allowing the owner flexibility as he expands his system
- the control unit can be reprogrammed for more controls, alarms, and sensors
- all planning and selling should be done by security agent, but control unit and most of the system can be self installed

# OPERATION

Characters on  
buttons illuminate in  
alert or program mode

Problem —

Zone (where)

Action —

ALL IS OUT

1	2	3
4	5	6
7	8	9
0	*	

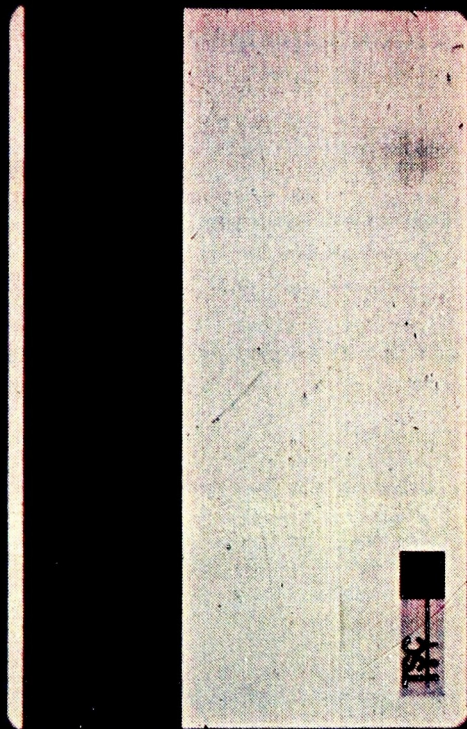
Illuminated light  
when systems  
are normal



Finger print scanner

apartment but wanted a small security system to own one. They could buy a few detectors/transmitters, the control unit and an audible alarm. When they move into a house, all they need do is expand the system; the control unit will handle up to 250 zones. The control unit is basically a mini computer but programmed for a certain purpose. Any combination of text can be programmed into the system (Slide 8) which can also be used as a management system when the appropriate sensors and switches are added.

# SUPERVISED WIRELESS CONTROL UNIT



detector/sensor

control unit

receiver/transmitter

digital communication

calls out to  
security agency  
fire or police

transmitter

#### IV. THE COMPUTERS

Using the Apple II computer I created a sketch of the basic dimensions that the electronics would fit into. By using these dimensions as a data base, I created a series of form studies. (Fig. 2) I was trying to develop one form where the dot matrix could be read from both the wall mount and the table mount position. I felt at this point I needed to go to the mock-ups in order to analyze and decide. This was a clear case when the computer was helpful in the refining step. After creating mock-ups, the decision was made that no single form would be effectively read from both positions. I went back to the refinement stage and created a form which could be elevated by using a button and spring to allow easier reading in the table position. Slide 9 shows this. Note that in this stage of the process I refined, analyzed, and made decisions; the computer only helping in the refining stage.

The next step was to explore proportions and graphic layouts. In the refinement step the Genigraphics was a great tool. Slide 10 shows how the Genigraphics helped in this task. The Genigraphics can move areas such as the buttons anywhere and can easily show variations. These three sketches are only a few of the many I did. The Genigraphics also helped me refine the logo to the point where I could make a decision. (Slide 11) Another option I explored was to make a model that would expose the antenna on the outside of the housing. This would communicate from a design point of view the essence

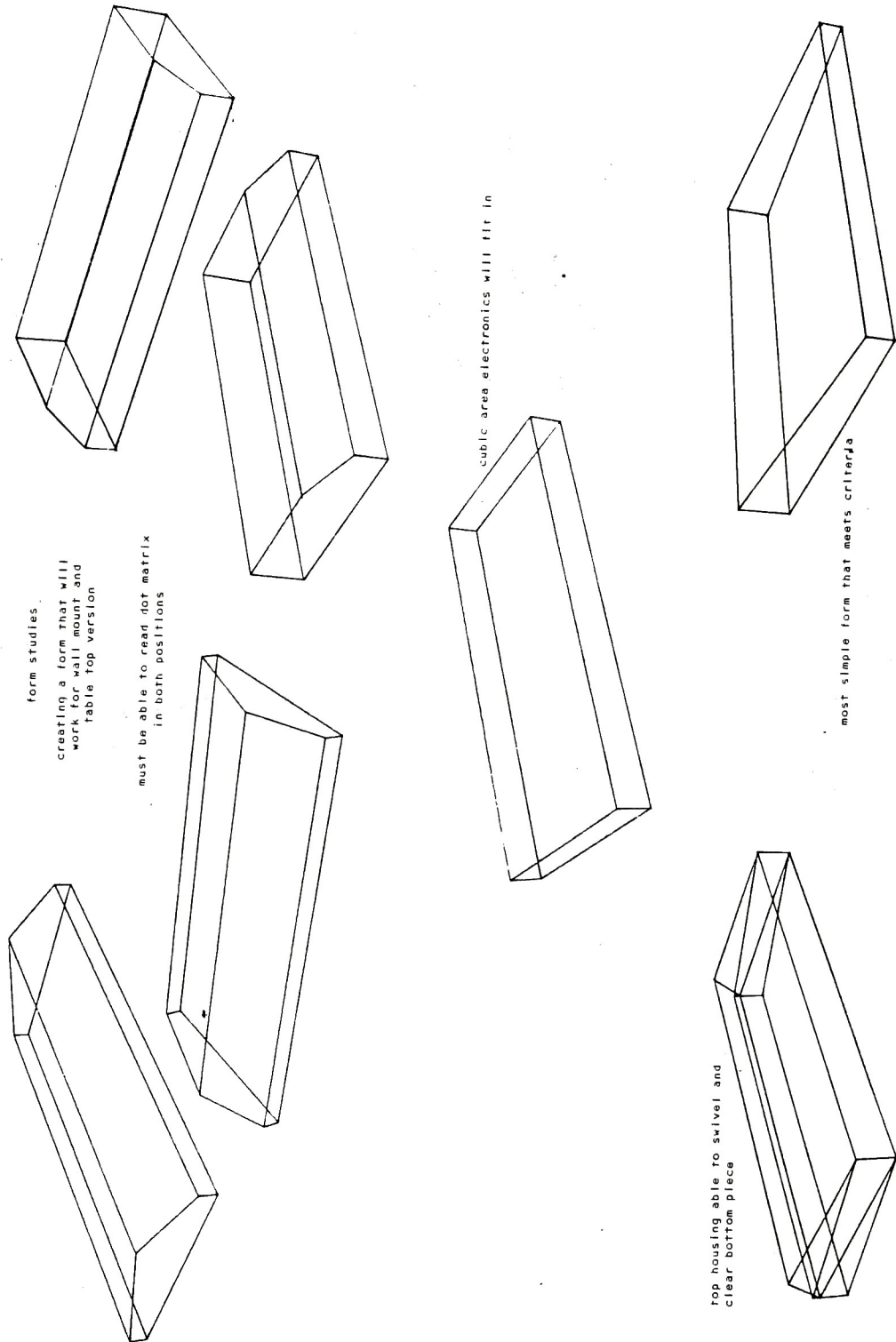


Fig. 2 Apple Sketches; Form Studies

# OPTIONS

Wall Mount

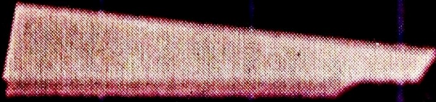
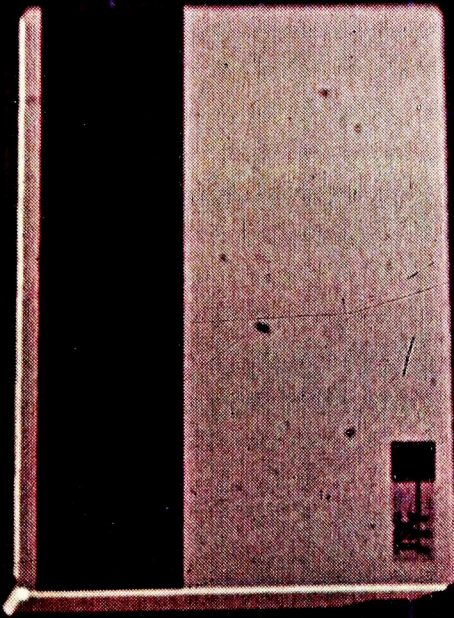


Table Top



# SKETCHING

## Product development

shape configurations and  
proportions  
alternative graphic layouts



# Logo layout sketches

**TSC**  
two thirty one

**TSC**  
two thirty one

**TSC**  
three thirty one

**TSC**  
three thirty one

**TSC**  
thirty one

**TSC**  
301

**TSC**  
301

**TSC**  
301

**TSC**  
301

**TSC**  
301

**TSC**  
two thirty one

**TSC**  
two thirty one

**TSC**  
301

**TSC**  
301

**TSC**

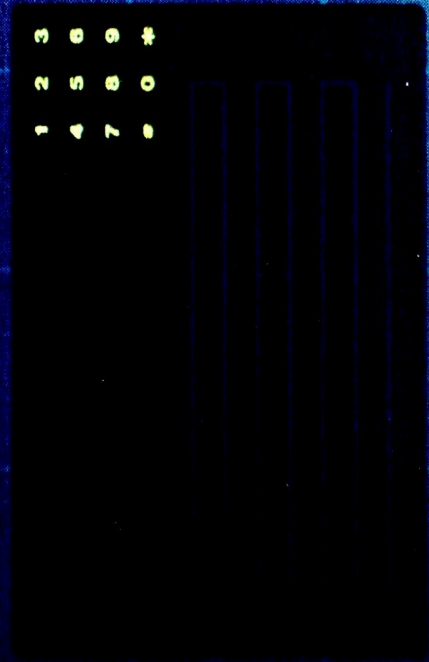
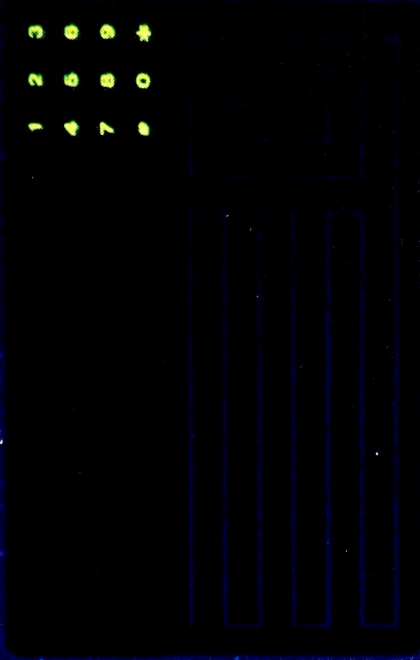
of what makes this unit different from current ones. (Slide 12) Although some of the different layouts of the antenna were intriguing, I eliminated the idea because of the expense.

Once the design was complete I created an illustration by using the Apple II and the Genigraphics. (Fig. 3, Slide 13) I first decided what view of the control unit I wanted, thus allowing me to plot only the visible lines and not the hidden lines. Figure 4 shows a line sketch I created on the Apple computer so that I could layer shapes on top of each other, allowing the high-lights to be the bottom layer. I did this because each one of the shapes that formed different planes need to be a different color. It also allowed me the ability to give the illusion of the proper corner radii. By looking at Slide 14 a better understanding of how the illustration was created can be seen. Since the Genigraphics is a two-dimensional system I had to digitize the lines into the system. This is the only way to insure an accurate perspective. Even after digitizing the perspective into the system, the illustration needed to be altered slightly to adjust to the Genigraphics screen. To alter the perspective, I captured the upper right corner vertices and moved them to the point that looked appropriate. Creating an illustration on the computer is completely different. The rules of rapid visualization still apply; however, the technique is different. One of the most important things to remember is the illustration is created by the overlaying of shapes, the top shape always shows, anything underneath does not. The layers underneath are still there and are only exposed where the top layer does not exist. One of the biggest challenges was in creating a large highlight that would show the dot matrix as a reflective surface. After trying various

# SKETCHING

## Product Development

layouts showing the antenna exposed on the front surface of the housing.



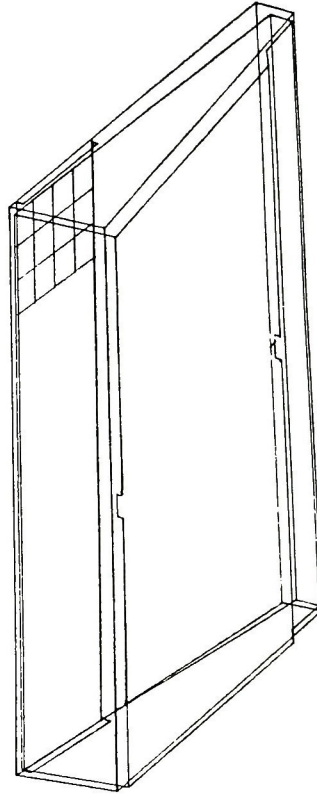
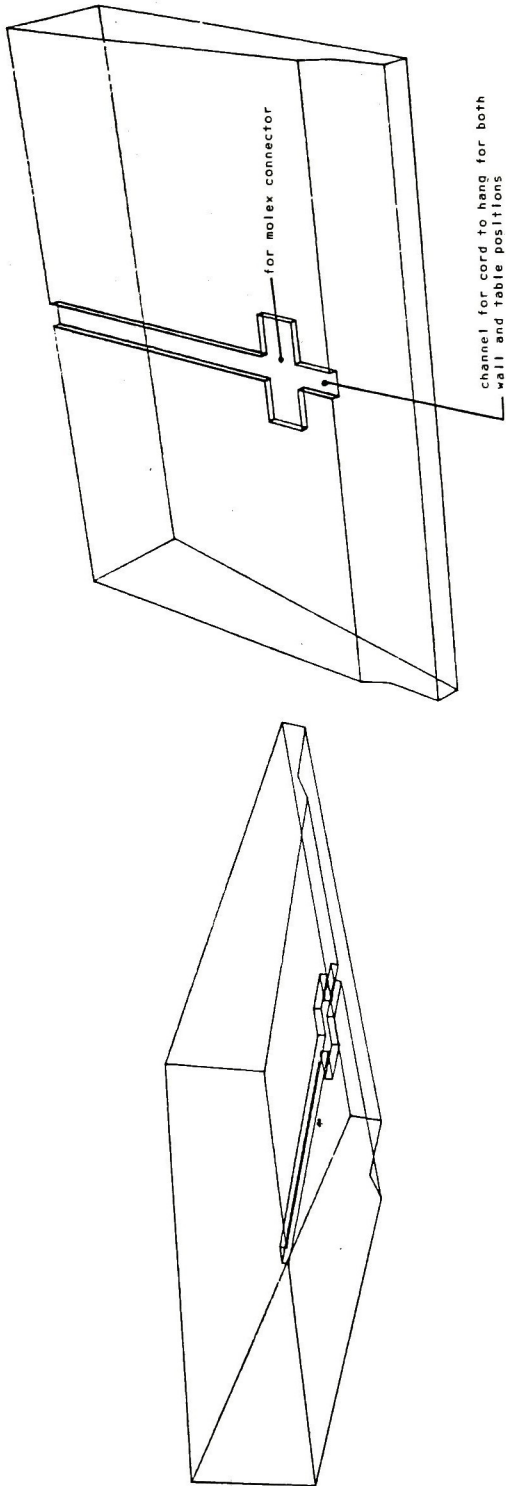


Fig. 3. Finished Product Perspective

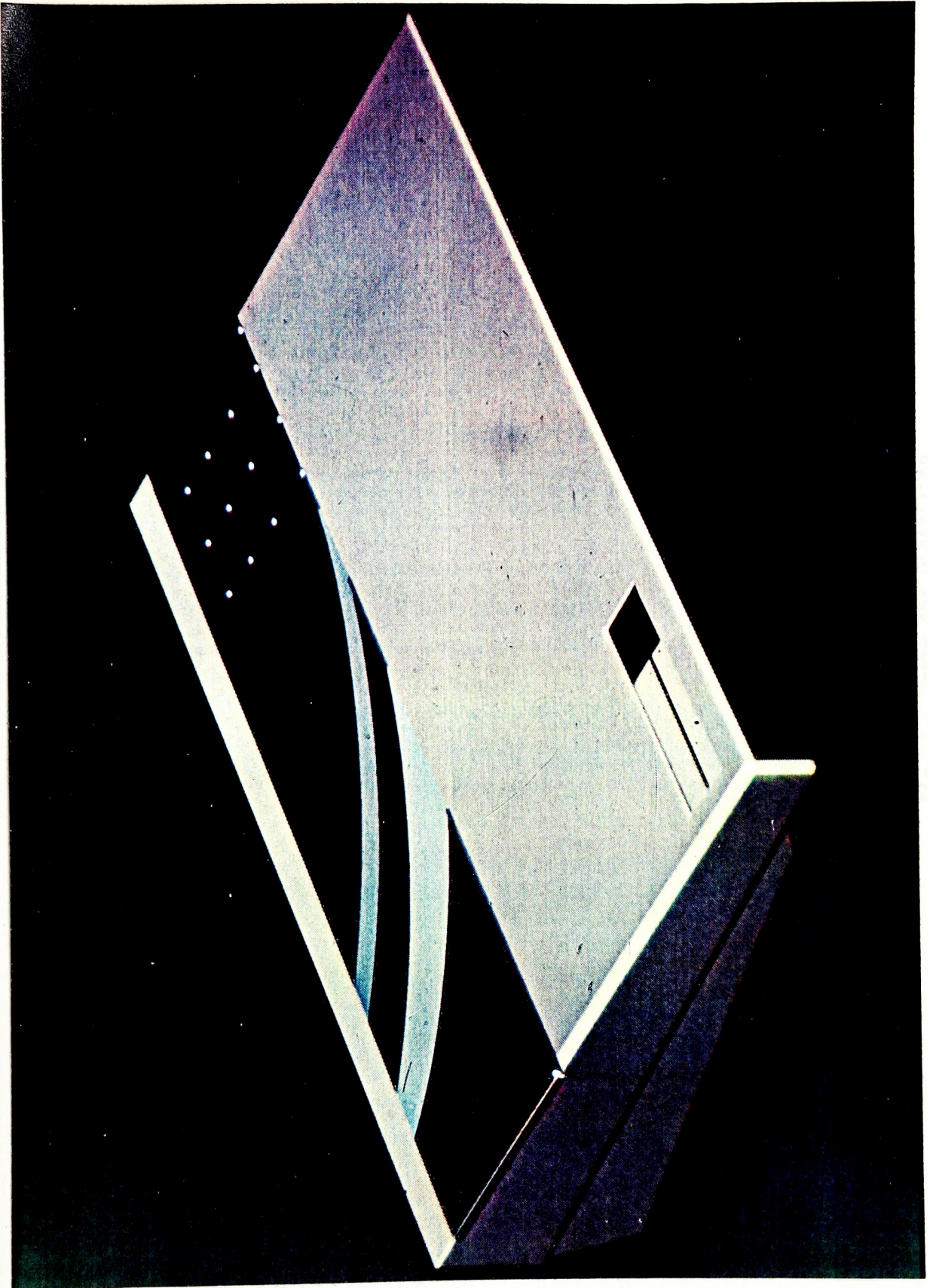


image digitized into Genigraphics

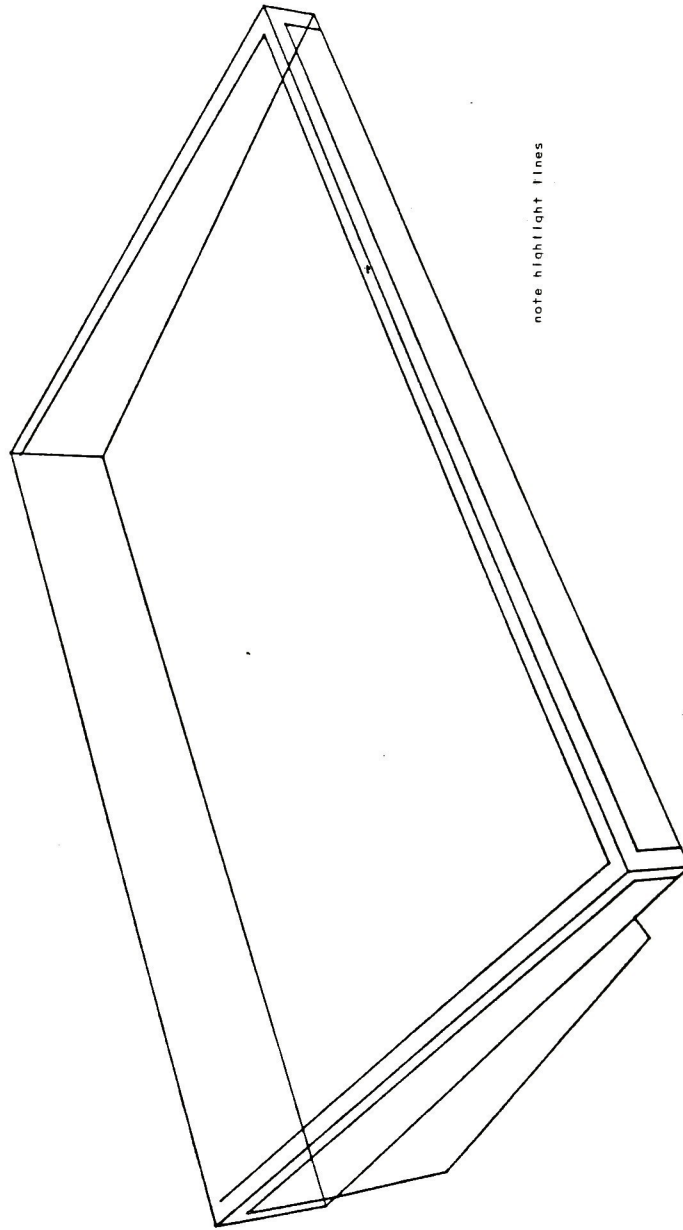
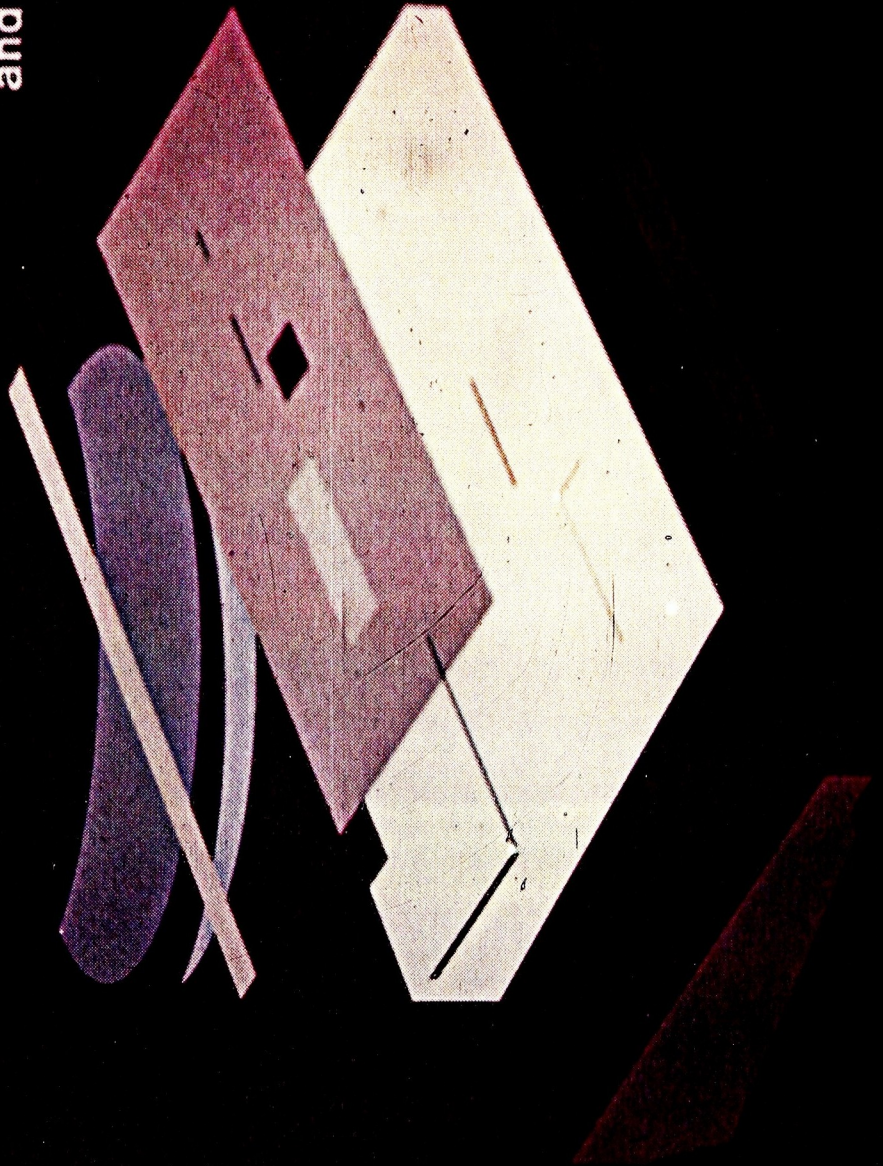


Fig. 4. Image for Digitizing

# MAKING AN ILLUSTRATION ON THE GENIGRAPHICS

digitized perspective  
from Apple II  
and Tektronix printer



vertical bands, I decided to give it sweeping curves. The highlight was created by making an ellipse in which the arc covered the area I wanted. I then duplicated that ellipse and overlapped it over the original. I gave the first ellipse a light grey color, the second a black color, which was the same as the control panel. I adjusted the black ellipse so it exposed a sweeping band of the grey ellipse. I then repeated the same process creating a total of four ellipses, a light grey then a black, then a dark grey and on top was a black ellipse. I then had to overlay a background shape on the housing surface shape in order to cover up the remaining part of the ellipses I did not want exposed. Another way to create this same highlight would be to expand the screen to the ellipses and trace only the part of each ellipse which would be seen. The tracing is time consuming and must be done perfectly or the arc will appear crooked. For my uses it was easier to overlap the shapes. It is important to remember that once a shape is created it can only be deleted as a whole. One cannot delete parts of a shape, one can only overlay another shape on top making it appear as if part of it were deleted.

Once the perspective was created, color variations were easy. (Slide 15) To display more than one color version all I had to do was to reduce each perspective and add them to the screen one at a time. It was also important to compress (this command links all the same colors so the computer sees it as one area of color) the colors allowing room on the screen for additional colors. The Genigraphics can only put 51 different colors on at one time. The Genigraphics also helps in the refining of color choices. It is difficult now to get a hard copy of the exact color but it is in the choosing of the colors that is valuable. The system provides eight million colors giving

# Color Variations

J Ross/83



the designer many variations. In traditional approaches the designer chooses color by going through color swatches. This is time consuming and inefficient compared to seeing the color on the product illustration instantly. This is one of the most valuable tasks the computer performs. It is important to note that although a perfect color match between computer and product is difficult right now, the value is in how it increases efficiency in the design process.

A valuable tool in evaluation is the schematic view illustrations. (Slides 16-17) This demonstrates the relationship of the mechanical parts of the product to the housing. It may also show how parts are to be connected. I made a cross-section schematic and a schematic of the product in an open position. These views quickly demonstrate the mechanical configuration so an evaluation can be determined. If problems arise the mechanical can be checked. I created the schematics on the Genigraphics, however, it could also have been done on the Producer.

My finished mechanical was done on the Bausch & Lomb Producer. (Fig. 5-6). This equipment is set up solely for the purpose of drafting. Before using the equipment, I first had to work out all the details of the product. A very important aspect of using this equipment is knowing exactly what needs to be drawn, including the dimensions. Time is very valuable on the equipment. There is little time to sit and figure out dimensions while at the computer. It was necessary for me to make a rough mechanical and a plan. The plan included writing down what layers I wanted the mechanical to be divided into. The Producer works on sixteen different layers, and each layer can be edited, and displayed separately or together. This means the object lines

# CONTROL UNIT SCHEMATIC

Battery (9 volt, 48 hour back-up)

Mother board

Power board

Finger print scanner

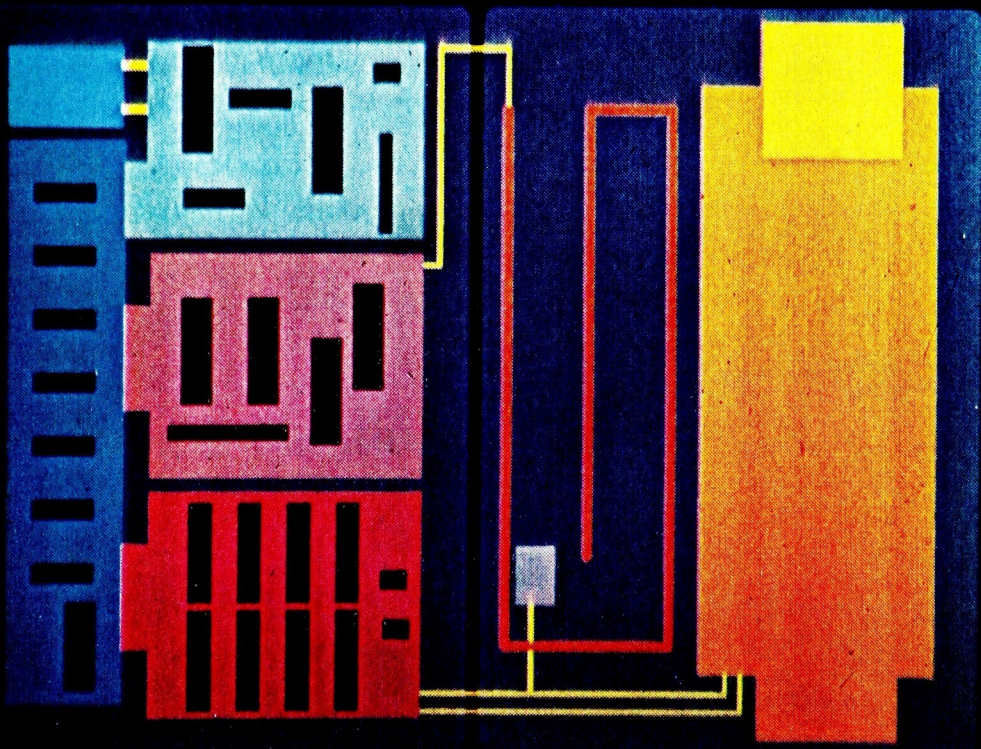
Receiver/Transmitter

Decoder  
(8 bit processor)

Antenna

Vacuum fluorescent dot matrix

Control panel



# CONTROL UNIT SCHEMATIC CROSS SECTION



**Battery**  
(9 volt, 48 hour back-up)

**Control panel**

**Power board**

**Antenna**

**Vacuum fluorescent dot matrix**

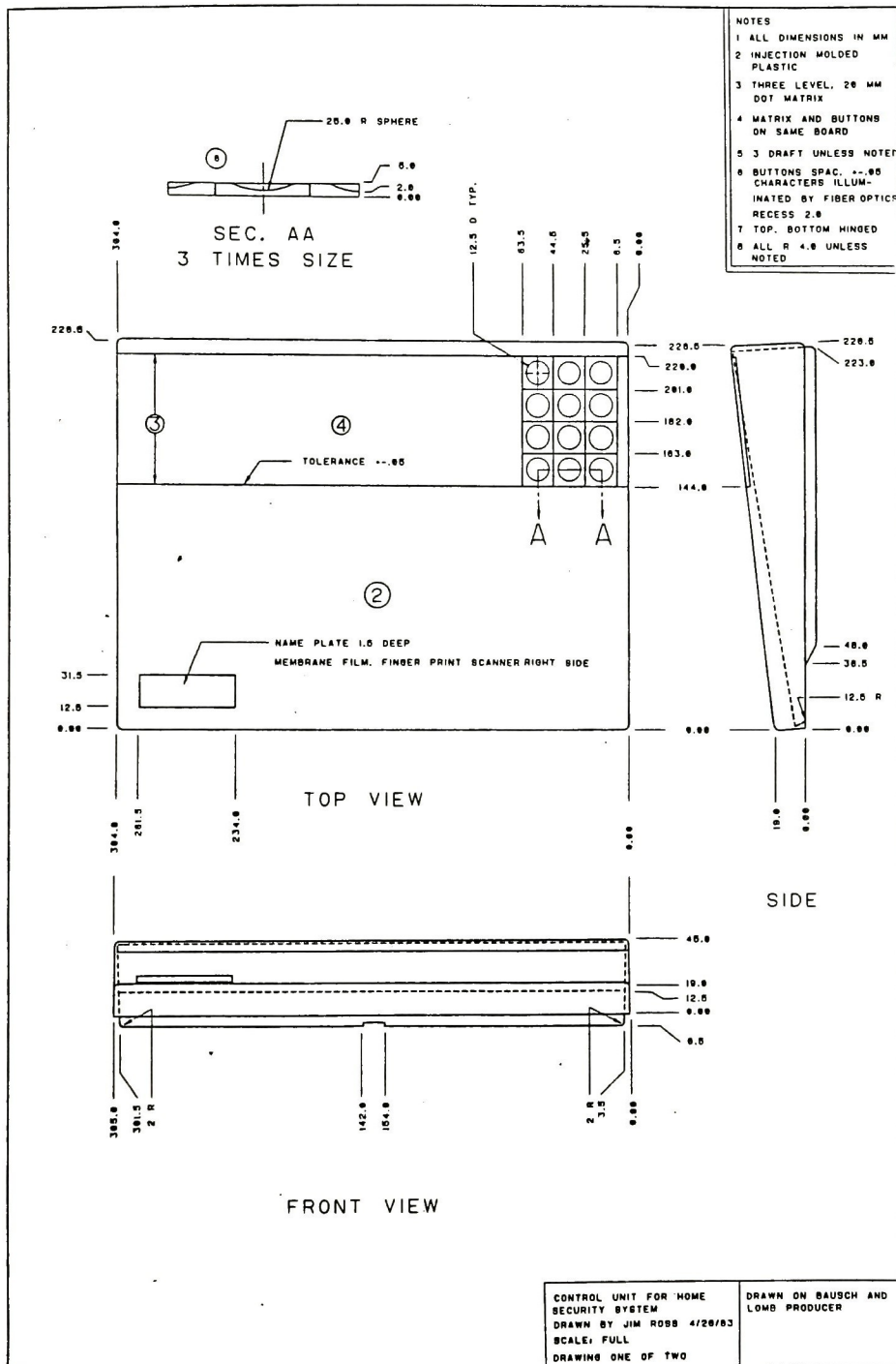


Fig. 5. Mechanical One from Producer

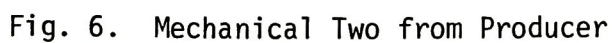


Fig. 6. Mechanical Two from Producer

can be on one layer, the dimension lines on another. The purpose of this is two-fold. Editing can be done on the layer with the dimensions without fear of editing another valuable part of the drawing. Secondly, each layer can be drawn with a different pen size and color thus allowing the dimension lines to be not only a different weight, but also a different color.

The finished mechanical is printed out on a drum plotter. The dimensions are limited to thirty four inches wide and the mechanical can be as long as the roll of paper. This fact is important to remember in laying out the mechanical. The biggest problem I found in using the Producer was in making the transition from the screen to the printed mechanical. Careful planning is essential in laying out the mechanical properly. It must be drawn so the image is well within thirty four inches on one side. I wanted to fit my whole mechanical on one drawing at full scale. I could not do so and properly lay out the images. This is why I have two mechanicals.

One of the biggest problems using this equipment is the size of the screen. To see or work on a small detail it is necessary to expand the window or enlarge that area as if you were looking through a microscope. On the Producer I used, the more complex the drawing the longer it took to regenerate the image. A command on the menu allows the dimensions to be displayed as lines. This will save some time if reading the dimension is not necessary. The lines represent the positions of each dimension. The dimensions are still in the memory and can be regenerated anytime.

The best way to check for any errors in the mechanical is to run a plot off. Any errors can then be changed through editing. It is always important to save your work on the back up memory in case the electricity goes off.

## V. CONCLUSION

### The Project

The research, development and understanding of the design process was of fundamental importance in the project. It allowed me to organize the uses of the computer systems before the actual process began. It was also important for me to understand where in my own creative process (refinement stage) the computers would be a benefit.

The researching, choosing and developing of a product was the best way to test the uses of these systems in the design process. The aspects of the product (the control unit) consisted of elements used in most products designed today. The emphasis was on the functional uses of electronics, efficient use of the product and an aesthetic appropriate to the function.

The computer system collectively, accomplished the tasks I expected. The amount of time it took to accomplish tasks on the computer was noted. The computer tasks included: learning the efficient use of the particular system; extensive experimenting to achieve professional quality; mistakes; and computer operating failure. The computer time was checked by the amount of time between logging in and logging out. The table reflects the actual computer time and does not include preparation.

Fig. 2	Apple Sketches; Form Studies (each includes plotting time)	15 Minutes
Fig. 4	Apple Sketch Image for Digitizing Includes plotting time	20 Minutes
Fig. 3	Finished Product Perspective (Wire frame)	3 Hours
Fig. 5-6	Two Mechanicals and Plot on Producer	24 Hours
Slide 13	Perspective Illustration	12 Hours
Slides 16-17	Two Schematic Views (not including corrections)	4 Hours
Slide 15	Color Variations	30 Minutes
Slide 9	Options	1.30 Hours
Slide 7	Operation	4 Hours
Slides 10-12	Product Sketching (Combined)	20 Hours

The actual computer time should not be compared with the amount of time it would take to perform these tasks using current methods. I could very easily cut the time at least by 50% now that I have experimented. Also, speed on the computers comes with proficiency. I will discuss other time savings in the "future" section of this chapter. If all three systems could be combined into one, the time savings would also double. In many cases once the work was completed it could be duplicated and used in other tasks. For example, once the product was digitized into the Genigraphics and the illustration completed, the image could be enlarged, reduced or duplicated. The actual time to do one illustration may be long but it can be used in many other tasks. The same is true for the three dimensional program and the computer drafting.

The Future

The purpose of the thesis was to analyze the role of turnkey computer systems in the industrial design process. A conclusion can not be complete without putting in perspective the future role of the computer as I see it with the experience of this project.

The basic purpose of implementing computers is two-fold. First, the use of computer systems should increase productivity. Productivity increase means it should take less time to do certain tasks. Secondly and most important, it should simultaneously increase quality of the product. Improvements in productivity and or quality will have to be evident before most companies will invest in large scale implementation of these systems for industrial designers, due impart to the large expense involved.

As illustrated by this project, there are tasks that may not appear to save time. However when you look at the whole process, time is saved at the end. The computer systems can edit, duplicate, store and communicate material efficiently and more accurately than a human can. For instance, it took me longer to do the control drawings on the computer than it would to have drawn them myself. But it was extremely easy on the Producer to edit, and then plot as many high quality prints as I needed. If applied to the manufacturing world, the prints could have been sent across the country through the phone system.

The idea of communication is a key to the productive implementation of these systems. If a product is designed at some point on a computer all the

data can be transferred to another designer, engineer or department who may be involved in the project, all through the computer. These people can be miles apart and will have the information at their fingertips. With the advent of computer aided manufacturing, this use of the computer will be increasingly advantageous.

Looking at just the industrial design process I can see the computer implemented gradually and at the same time, productively. I have an implementation plan that allows for a choice in the amount of computer involvement in the design process. This is considering the fact that there is not a comprehensive industrial design system on the market, yet.

### Computer Implementation Plan

Phase One: The evaluation of long and short range goals. Decide where in the design/manufacturing process computers will increase quality and efficiency. Certain products may benefit from a certain computer system. Cost factors should be heavily discussed and any plan should justify these costs. A system that will expand with the long range goals should be the ultimate choice.

Phase Two: The implementation of a drafting system. A good drafting system will allow the users to digitize existing mechanicals into the system. They can be stored, edited or plotted at anytime. The system should have the flexibility to communicate with other systems already in use.

Phase Three: The implementation of a three-dimensional system. A wire frame system with rotation, perspective views, orthographic views and hiddenline removal are essential. The system should be compatible with the drafting system and should share the plotting hardware. The best system should allow for easy operation. The menu should be alterable in order to customize the system to the user's changing needs. The digitizing of information into the system (act of drawing on the computer) should be as easy as using conventional paper and pencil. The total system at this point should allow the designer to use it at any point in the design process. This includes using a perspective plot as an underlay for illustrations or renderings, this would insure accuracy.

Phase Four: The implementation of solids modeling. (If compatible to goals.) If necessary, solids modeling can be added to the system. This allows the designer to fill in color to represent solid shapes, since wire frames only show object lines. The color choices (in three-dimensional systems) may be limited because of the tremendous calculations involved.

A two-dimensional color system (such as Genigraphics) could be useful if the design process involves a large amount of graphic work (i.e. dash board, control panel, etc.)

All systems should be turnkey computers. The designers need not and should not be programmers. They are employed to design, not program. Many systems (such as the Producer) use several languages making any programming by the user time consuming. I do feel it is essential for someone on the design

staff to have knowledge of the languages used by the system in the event of a simple malfunction or for the purpose of training and supporting other designers using the equipment.

### Industrial Design Computer System

In the near future, I believe an Industrial design computer system will be developed. It will be more complex than any other system in the market today. By the knowledge gained by this project, studying the Applicon AGS 880 CAD/CAM, and by visiting Kodak and Bausch & Lomb to see the systems currently in use, I feel qualified to assemble on paper an industrial design system. It is my belief that technology is capable of assembling such a system. The biggest draw back at this time is lack of a printer or plotter that can turn out color hard copy. The limitations are in the choice and quality of color, therefore limiting our ability to make aesthetic evaluations from the hard copy.

The system should consist of two screens, similar to the Intergraph. One screen would be used for the drafting and three-dimensional work. This part of the system would allow the designer to design either in three dimensions or orthographically. It should be capable of rotation, dissection of a three-dimensional image, orthographic layout, perspective, hidden line removal, typefaces, isometric views, duplicating, expanding and reducing. These are all capabilities of current systems such as the Applicon and Intergraph.

The second screen would be a high resolution screen with software similar to the Genigraphics. It should be capable of two-dimensional color graphics but should contain a comprehensive animation package that would work in three dimensions. Hard copy from this half of the system should be photographic by nature (e.g. slides).

By the interaction of these systems, a type of solids modeling with a choice of any color should be possible. The Genigraphics is not capable of three dimensions because of the tremendous calculations involved in creating perspective. It can create any kind of shape, which can appear to be three-dimensional (e.g. my product illustration). If after working in the three-dimensional program a wire frame image is created, it could be transferred in some form to the high resolution screen. The designer only needs to fill in the shapes and an illustration can be made. The concept then is to do all the complex designing on the three-dimensional system (rotation etc.), then transform those complex calculations to a form that will allow color to be applied. This form which is transferred could be similar to the pink reference shapes that the Genigraphics uses.

Once the color is added, the shape can be linked and duplicated, as on the Genigraphics. The color will also link up to a standard system related directly to the material intended to be used. Also through this system all the pertinent information about the material (color, surface, mechanical properties, cost, processing specifications) will be available at the touch of a button.

The system should use a digitizing pad, puck, or pen to simulate drawing. The interaction between the designer and computer should be similar to the interaction with standard tools. This is done in both the Applicon and Intergraph systems.