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Teletype Network Communication Device

by

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I would like to thank my thesis committee: Craig McArt, James Sias and Robert Kahute as well as researchers in NTID, Anne Van Ginkel, Mike White and Michael A. McMahon for their guidance.

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CHAPTER 1

INTRODUCATION TO COMMUNICATION

In the eighties a lot of new opportunities to break the communication barriers between deaf people and hearing people occurred, bringing the two groups closer together. For example, closed captioning (constantly changing subtitles linked to visual images on television) was actively promoted. It was officially used by the ABC, NBC and PBS Networks. With the advent of closed captioned television, hearing impaired individuals were able to enjoy television more, because by reading subtitles they could understand what was being said and, as a secondary gain, expand their vocabulary. As Nan Decker and Betsy Montandon have noted, " This closed captioning method combines the skills of court stenographers with special computer translation systems to provide almost instantaneous captioning." [1] It also helped increase their knowledge of what was happening in the world. Congress recently passed a law requiring that closed captioning be installed on all television screens that are larger than thirteen inches. All programs were captioned as of 1993. Closed captioning not only helps hearing impaired people, but it also helps older people who are losing their hearing.

A second important development for deaf people was the development of telecommunication devices for the deaf (TDD), which allowed a deaf person to make a telephone call directly to another TDD user.

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1 Nan Decker and Betsy Montandon. Captioned Media in the Classroom, Silver Spring MD.: National Association for the Deaf, 1984.

For a deaf person to call a hearing person, he/she would have to depend upon a relay service. A relay service functions in two ways: to relay a hearing person's message through TDD to a deaf person, or to relay a TDD message through voice to a hearing person. The relay service developed in 1966 was not well used in the seventies, but became well-recognized by deaf people in the early eighties.

The relay service is an expensive program. According to Paul Singleton "As of 1986, California had the oldest running relay service. As of 1990, the cost for operating that relay service was over $31 million. The money to run this service is funded by the State of California and the Federal Government." [2]

Considering the expense of these programs around the country, I realized that a new communication product must be developed. This new product must have some means of helping hearing impaired people and hearing people to communicate directly without the use of a relay service. This new kind of device would be called the Teletype Network Communication (TNC). A direct communication between hearing and deaf people would be possible by combining the TDD, the telephone and the answering machine into one unit. This particular product would utilize the developing technology of computer voice recognition to allow a hearing person's voice to be translated into a digital type display, thus allowing the deaf person to read the incoming message easily. This device would also translate digital type into a computer synthesized voice, thus allowing the hearing person to hear the incoming message.

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2 Paul J. Singleton. Nationwide TDD Relay Standards: Partners in Progress, GRI Monograph Series, 1989.

I wanted to develop a completely new system that would be cost effective. Developing a new product that helps hearing impaired people and hearing people communicate directly without the use of a relay service seemed like a timely project.

In addition to the description of the model for the TNC, human factors as well as comfort considerations in the use of the keyboard and the placement of the LCD screen will be explained. Also, the application of color and graphics will be described. The final section of the thesis will be dedicated to the evaluation of the TNC. It will include a survey of hearing-impaired individuals and related specialists.

CHAPTER 2

COMMUNICATION BETWEEN HEARING AND HEARING IMPAIRED PEOPLE

There are many communication problems that are common during the interaction of hearing impaired people and hearing people. For example, most hearing impaired people experience difficulty with phone conversations to some degree. Depending on the nature of their deafness, one hearing impaired person can use a telephone with no trouble where another hearing impaired person may not be able to use the telephone at all. For those hearing impaired persons who can use the phone, their ability to understand words depends upon the sound frequency of the voice (high or low pitched), the speed at which the person on the other end talks and the amplification. Most deaf and hearing impaired people I have talked to feel more comfortable talking to a female on the phone because their voice tone is softer and has a higher pitch compared to most men.

This difficulty in using the phone to communicate really impacts on the employability of hearing-impaired. In many jobs, the ability to use the phone is extremely important. Another problem area for hearing-impaired people on the job is the ability to communicate with their fellow workers, supervisors, etc. Hearing impaired people really depend on clear lip movement (lip reading skills), gestures and face-to-face communication. Hearing people, in general, do not understand the communication needs of hearing impaired people. Something simple, like having a mustache, can cause serious problems for a person who is trying to lip-read.

I had an experience with one of my teachers at the Landmark School at Beverly Farms, Massachusetts. He had a mustache and I had a terrible time lip reading him. I told him about my trouble and he was willing to trim his mustache shorter so I could understand him better. It was not something that many people would be willing to do, but it really showed he cared. By working together, hearing-impaired and hearing people can find new solutions to many of the conflicts in communication.

The use of the telephone in home or at work is still a problem that can not be easily solved. The present solution is that a hearing-impaired person who wants to talk to a hearing person can call a relay rervice (RS) with an eight hundred number. This is not a perfect solution because the RS can be very busy during certain times of the day, and can be impossible to access. The RS started to become more common in the late eighties with over 250,000 calls in one month alone in the State of California. In most cases the RS is funded by the states and the Federal Government. In other situations, it can be funded by the people in the community and by organizations who are willing to bear the cost of the service. Some phone companies (like AT&T) pick up part of the tab as a surcharge for the RS. The RS is a non-profit organization. The access to the RS is free, but the person who is calling is billed based on the time the user spends on the telephone. In the State of California alone, it cost over $700,000 per month to run in l987. To continue to cover the cost of the service, the State of California had to pass a bill to collect more money by adding another 5% to their monthly phone line charge.

There are approximately one to eight central locations for the RS in each state, depending upon the size of the state and it's population. When deaf persons talk to the RS, they give their home phone number, name, the telephone number of the person they wish to speak to and his / her name. The RS puts through the call to the receiving party, identifies itself, asks the receiving party if they are farmiliar with the RS, and explains to the receiving party that the RS is interpreting a call from a TDD user and will type back the receiver's response. Some hearing people find it odd and uncomfortable to talk to the RS interpreter (third party) on the phone. It takes time to get used to using the RS because people who use the telephone are more used to talking directly, one person to the other.

As I have stated before, many jobs require the ability to use a telephone. Some hearing-impaired people specifically avoid jobs that require telephone use. Some hard-of-hearing people can use a phone if the phone is modified for a deaf person to use. For example, one deaf person told me that she had to use a telephone once in a while at her job in an insurance company, and the company was willing to provide her with a TDD and other accessories that she needed in the office. As noted Congress passed The Americans with Disabilities Act which requires that the Architectural and Transportation Barriers Compliance Board (Access Board) issued guidelines to ensure that buildings, facilities, and vehicles covered by the law are accessible, in terms of architecture and design, transportation, and communication, to individuals with disabilities.

The law took effect on July 26, 1992, but all requirements must be met by the summer of 1996.

The increased access to all businesses will result in increased demand on the RS and require more operators to handle the load. With the new law in effect, hearing-impaired people should have a new confidence about their ability to handle a variety of jobs. Because businesses are responsible for providing things like TDDs for any hearing impaired worker they may hire, this might cause companies not to want to hire deaf people because the cost of buying and setting up a new TDD is about four hundred dollars. I feel that it would be much more effective for deaf people to provide their own TDD. That way, the company would not have to bear the cost. Deaf people could buy a machine and get tax credit from the Federal Government. Those people who can't afford their own machine could apply for a guaranteed loan from the government, pay low interest payments or no interest at all.

The use of the RS is not one hundred percent effective. As I mentioned before, there are times when a caller cannot get through to the RS.

It requires a lot of time and patience to use this service. Also, there are times when the system is so busy that the caller is limited in the number of calls he/she can make. Some people wait as much as one or two hours in order to get through to the RS.

The RS is not the only way the deaf can communicate with each other or with hearing people. Another alternative is the Vistaphone. This is not an effective communication device for the deaf because of the time-delayed image.

The concept of the Vistaphone is being improved. The sending and receiving image will be through a crystal transparent wire called fiber optics and will improve the delayed image to a "real-time" image. This would be an alternative for deaf people who use sign language, as it would allow them to read each other on the screen.

TABLE 1

NEW YORK RELAY SERVICE FUNDING FLOW CHART

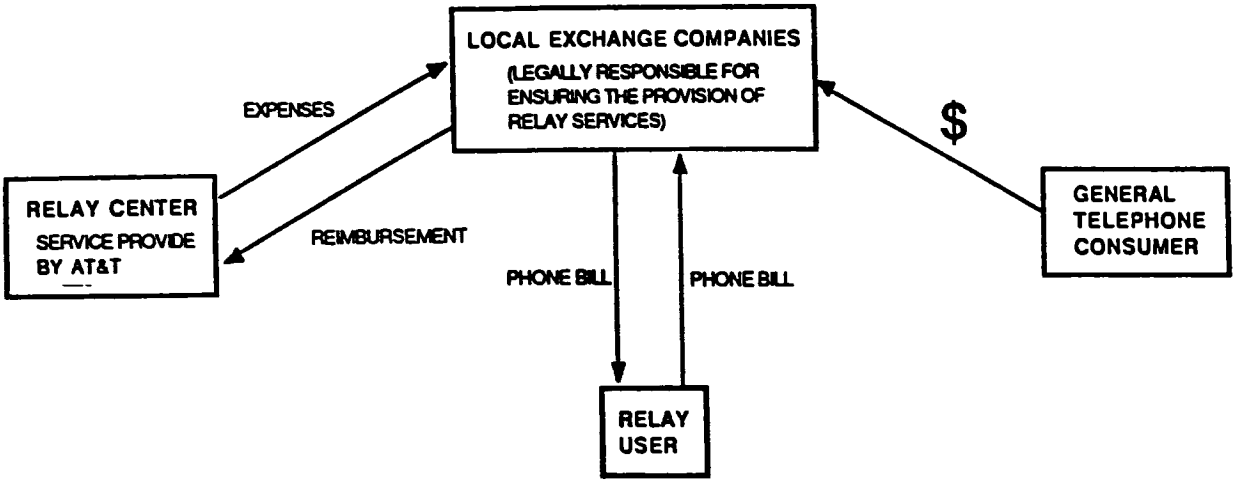
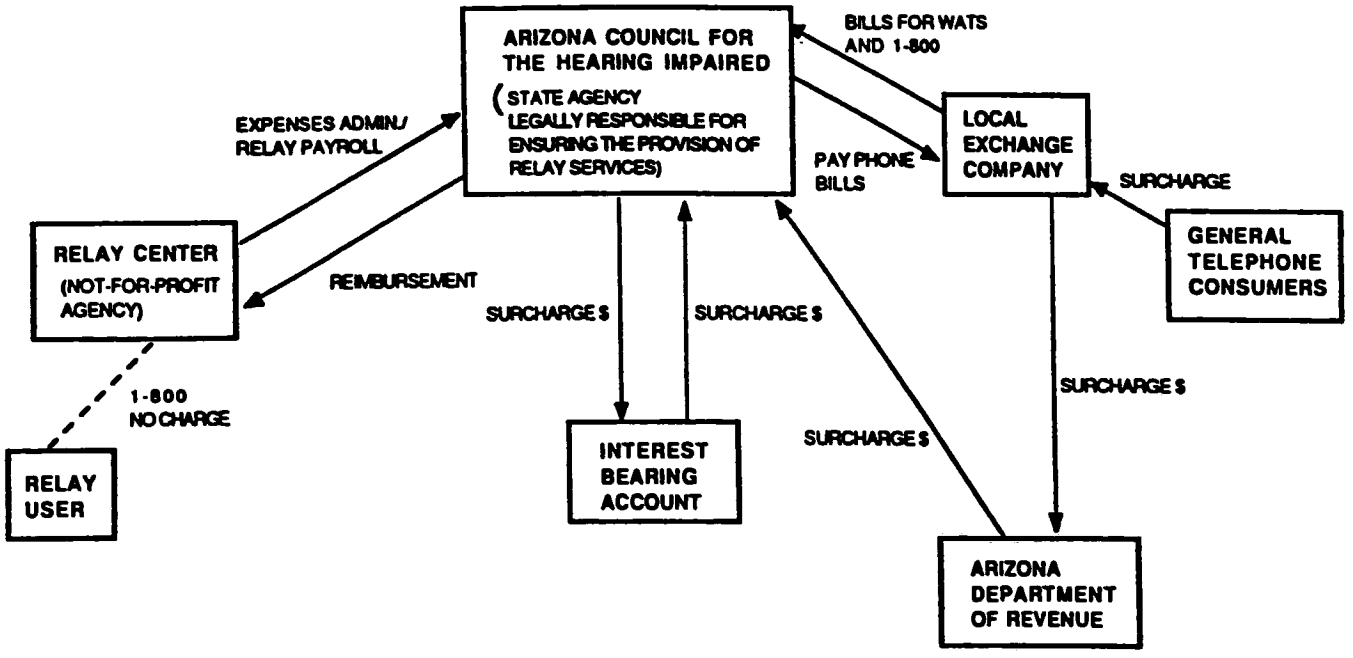


TABLE 2

ARIZONA RELAY SERVICE FUNDING FLOW CHART



CHAPTER 3

TELETYPE NETWORK COMMUNICATION DEVICE

I propose a new communication device for hearing impaired persons. This device would be called the Teletype Network Communication (TNC). There are a number of reasons why the TNC would improve the lives of hearing impaired people. The most important reason is that hearing and deaf people could communicate directly with each other. This would give hearing impaired people a sense of independence and would eliminate the need to talk through a third party system. Since the TNC will function like a telephone, without any restriction such as limiting phone calls or waiting periods, hearing impaired people will feel more confidence about their ability to access public information. Because the new unit will be portable, deaf people will be able to carry it with them wherever they go.

After going through a number of ideas in the development of the new TDD to serve the deaf community better, I came up with the idea of a new product called Teletype Network Communication (TNC). I have wanted to find new ways to help cut cost in the State and the Federal Government for running the the relay service in the United States, and also help increase communication options for the deaf to have better access to reach out to people without delay in waiting for the relay service. One benefit of having the TNC is that deaf and hearing impaired can become much more independent and have better self-esteem Deaf people will be able to expand their career options.

The TNC would be much different from the TDD, except it would have some similar functions.

The TNC will change the way we communicate in the deaf and hearing world. The reason for this change will be that the TNC will offer a portable communication option for the deaf people. The TNC translates digital type to voice, and voice to teletype on the LCD screen. This will make two people comfortable and confident without the need of a third party (relay service operator) translating the message. This will cut time and provide for more direct communication by two people.

People wanting to contact each other by phone will have no problem and will be able to do it on their own. By using this TNC, they won't have to be concerned about the time waiting for the relay service or the breach of confidentiality while they are using the relay service.

GOALS

- The Teletype Network Communication will be just as easy to use as the old TDD. All the necessary parts will be included in the system according to the sequence of the operation, the frequency of use, the importance, and other considerations.

- The product should be sleek and lightweight so it can be carried around easily. This is one of the most important features, because this product should work any place at any time.

- The product should be as durable as any electronic product . It has to be esthetically interesting and pleasing. The appearance of the TNC should be similar to any other consumer product.

- The maintainence of the TNC should be as easy as it is now to care for the top of-the-line TDD model. The newer power supply will not be restricted, and it is easier to use with a rechargeable battery and a DC adapter which connects directly to any wall outlet.

- The price of the product will probably be initially higher. The current top-of-the-line TDDs range between $400-550. The new TNC will probably run as high as $500 - 650, but the price will be close to the present top-of-the-line TDD model . Some states offer some kind of program for deaf people where they can get the TDD for free or pay a small fee.

TABLE 3

COMPARISON OF TTD AND TNC

DESCRIPTION	TTD	TNC
SIZE	BULKY AND HEAVY	SLEEK & LIGHT WEIGHT
STORAGE	NO PROTECTION FROM DUST	PROTECTION FROM DUST
DIGITAL DISPLAY	BUILT IN SCREEN ONE LINE CHARACTER	ADJUSTABLE LCD SCREEN TEN LINES CHARACTER
ANSWERING MACHINE	LIMITED MEMORY	20 MEGS OR HIGHER OF DIGITAL MEMORY
PRINTER	STANDARD SIZE 2.5" WIDE	STANDARD SIZE PAPER 8.5X11 (OPTIONAL)
RELAY SERVICE	PRESENT UNITS USE R.S.	R.S. WON'T BE NEEDED
CARRY CASE.	BRIEF CASE STYLE	LIGHT WEIGHT, NO CASE NEEDED
TELEPHONE	LIMITED	BUILT- IN PHONE SYSTEM

CHAPTER 4

DESIGN DEVELOPMENT

Form was explored for the Teletype Network Communication on the basis of the present TDD and the combination of other electronic home products. The first stage of design research was to analyze many present and past TTD models and other home products. I applied product semantics as a form determinant.

Product semantics, which explores the symbolic qualities of form is gaining popularity within the design community. People can easily understand a new concept whose appearance connects it to an already existing concept. Today, the faceless technology doesn't give any information about the product, such as its function and its usage, unless a designer expresses it through the form of the product. According to Michael McCoy, "One of the product sematics most appropriate uses in product design is on products where the mechanical design does not give any clue to the object's meaning, as in micro - electronic components." [3]

I designed the Teletype Network Communication for the deaf from the metaphorical and semantic perspective. In the early part of the design process, I wanted to be more abstract to create some new design ideas. The idea sketches were two dimensional designs on paper. Next, I used models to show them in a three-dimensional form. After experimenting, the design concepts were either out-dated or just not in the right time to present this new idea.

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3 Michael McCoy, ":Defining a New Functionalism in Design". Innovation, IDSA, Spring1984,16.

I moved away from abstract ideas to traditional form with a contemporary flair. This process developed the look of the TNC. In this stage, I used models and some two-dimensional sketches with color. The sketches which were made included studies of three-dimensional form and human factors.

I designed six different models and two-dimensional renderings and some perspective rendering ideas of the TNC. The final design form was based on a combination of each mock-up to create the final design concept of the future TNC.

Functional Benefits of form

The functional benefit of the design was to bring out a stronger and an updated design for the new product. The present designs are old and need to be redesigned. The present design is simple and boring. A lot of modern, home electronic products or phones have interesting appearances. The goal for the TNC was to make it light weight , small, and sleek with an attractive appearance. This new design concept will demonstrate that products designed for the future can be modern and attractive. Also, a goal of the development process was to expand the usage of machines for the deaf. The deaf want to have as many benefits as hearing people in the world of communication. My goal was to give the best of what we have in technology today. The biggest improvement would be the voice and digital translation on the TNC.

Form Exploration

Originally, in the early design development, the TNC was to have a soft carrying case. The reason for this was to be cost effective, also to move away from carrying the delicate TNC and exposing it to the elements (dust,water, etc.). The simplicity of the design, with few extras, is important. There is an option for consumers to buy a carrying case of their own choice. The TNC can be placed in a briefcase, small bag or can be carried around anywhere without a bag and still be protected.

Color

I decided to use neutral colors for the variety of markets the TNC will address. This is a product targeted to all age groups of deaf people from the age of twelve and up. The exterior of the product is a dark grey surface (Pantone 325-2). The reason for this color is that it is neutral; also dark grey doesn't show much dirt. The yellow gasket (Pantone 9-1) between the two halves of the case helps to seal the inner parts and prevent moisture inside the unit. Also, it gives it an attractive appearance and a sporty look to show this product can be used outdoors as well as at home or at the office. It gives an impact to the design. The key pads and function keys are darker grey (Pantone 325-2). The reason for this is to emphasize the focus area of the key pads. Also, dark grey (Pantone 325-2) does not show much dirt from pressing the key pad. The surrounding of the key pad surface area is lighter grey (Pantone 325-4).

White lettering on the key pads helps to clearly identify the keys. Overall, the colors are neutral and appealing to all ages of consumers.

Logo

I decided to combine the brand name, Teletype Network Communication and the abbreviation, TNC, on the product. To clarify the meaning of the of the word "Teletype": it means using telephone and typing on the keyboard to communicate. Network means communication or connection. I used plain text, Times font .

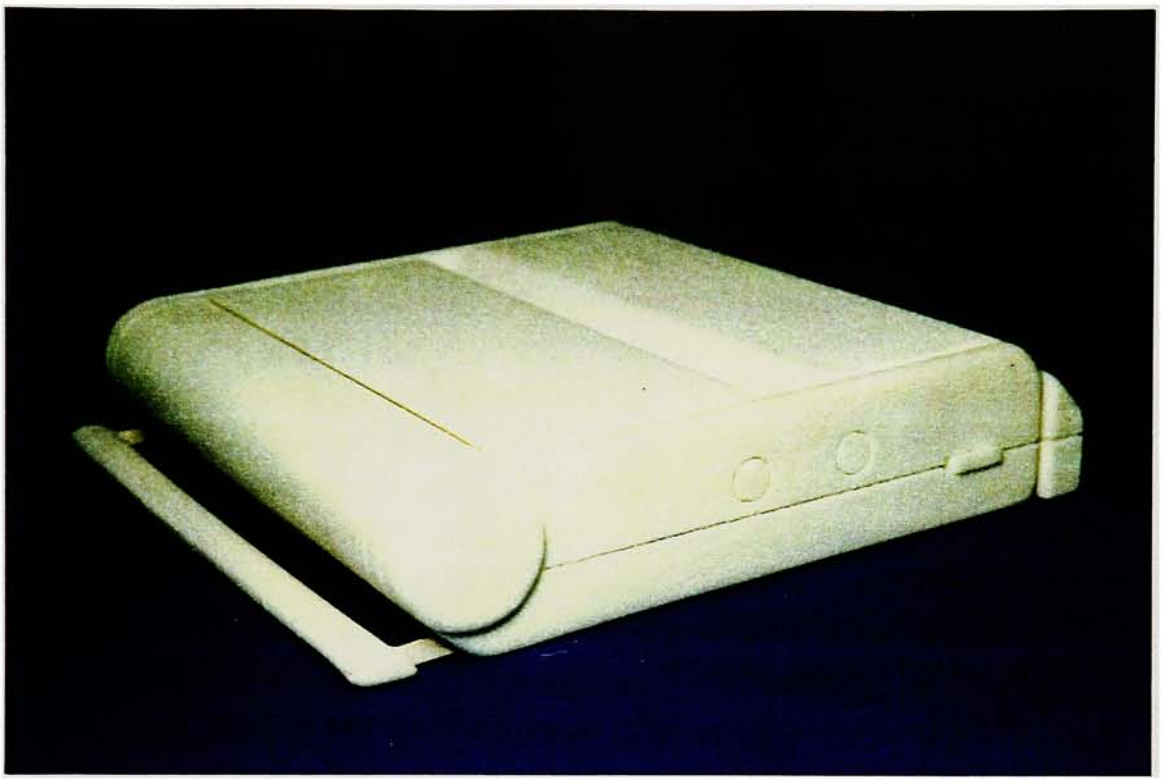


Fig.1 Mock-Up, No.1 Closed View

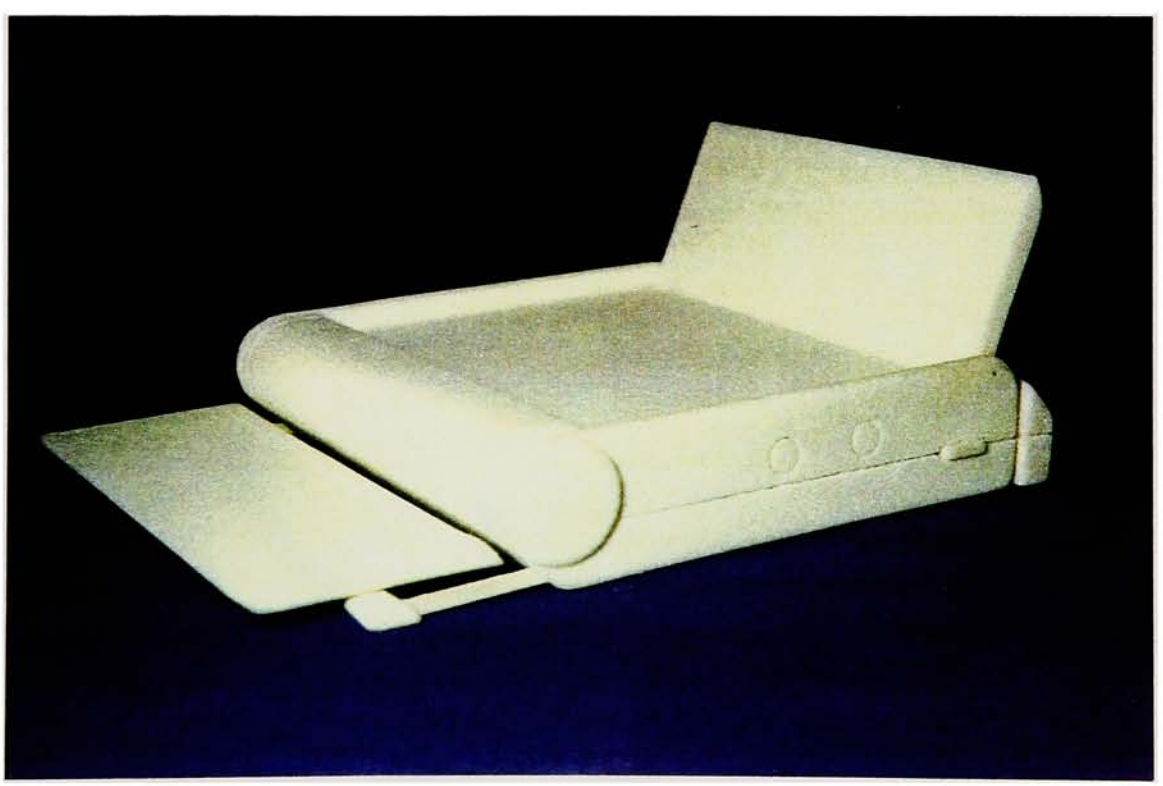


Fig. 2 Mock-up, No.1 Open View

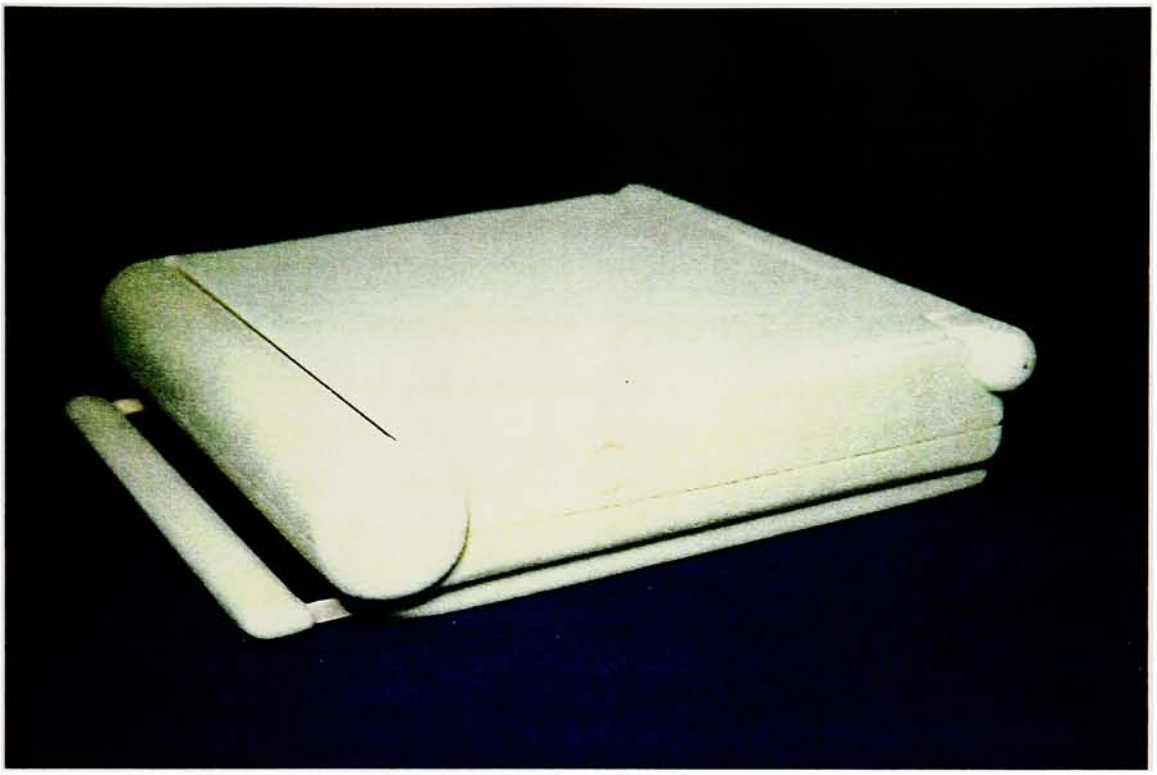


Fig.3 Mock-Up, No.2 Closed View

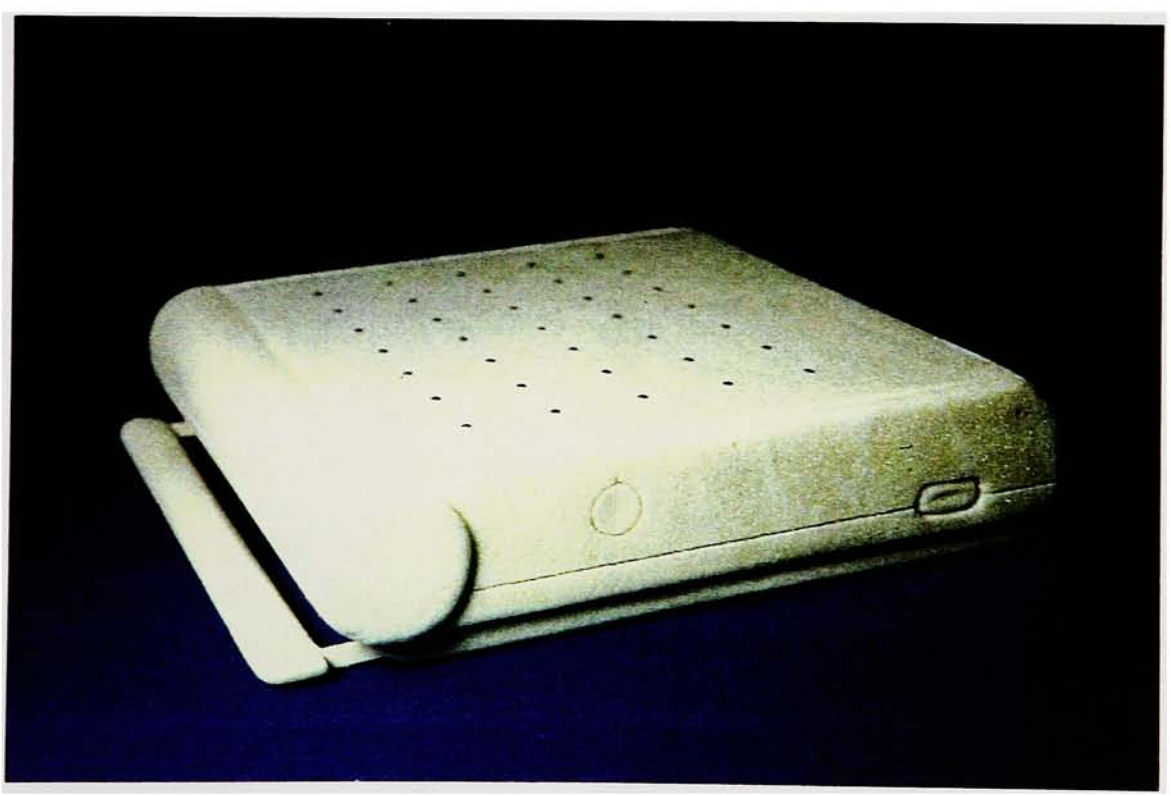


Fig. 4 Mock-up, No.3 Closed View

Fig.5 Mock-Up, No.4 Closed View

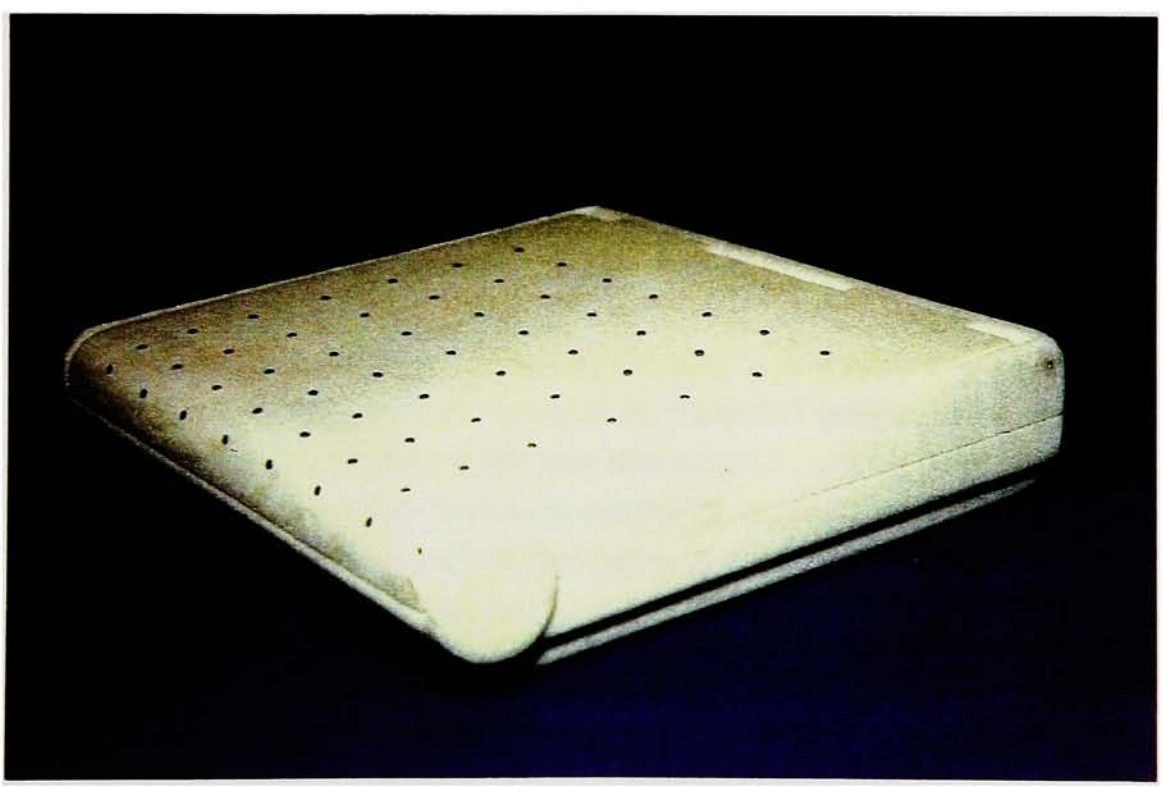


Fig. 6 Mock-up, No.5 Closed View

CHAPTER 5

PRODUCT DEVELOPMENT

Components

The following section explains the physical makeup of the Teletype Network Communication device. All of the physical components were researched simultaneously. However, for clarity, each component is examined individually.

LCD Screen

There are four different types of display screens available: cathode ray tubes(CRT),electroluminescence displays (EL), gas plasma displays, and liquid crystal displays (LCD). Each type of display has its own strengths and weaknesses.

The CRT displays offer a relatively high quality picture in terms of resolution and color rendering capabilities. However, when weighed against aspects of portability, a CRT falls short. Its size and weight are too great to be easily carried and it consumes too much power to be powered by a small battery.

EL displays are small in size, light in weight, and picture resolution is good. However, color rendering is poor for blues and greens, and power consumption is too great for a portable application.

The gas plasma displays work like the EL displays. EL displays electronically excite particles in a membrane to make them glow at different hues. gas plasma displays excite gases to achieve the same end. Gas plasma displays are small and lightweight, but like EL displays, they consume too much power for portable applications.

The LCD is the best solution. It is small, lightweight, and has low power consumption. It works by changing the shape or structure of a liquid crystal contained in a thin membrane. Changes in shape cause ambient light to be absorbed in certain areas and reflected in others. This variation produces light and dark areas, and because LCD screens refract light, they can be viewed in very bright environments. A light-emitting display, such as the CRT, would lose resolution in a brightly lit environment.

In dark environments, where there is no light to reflect, an LCD has the option of being back-lit. Color is available in good quality, and resolution is sufficient and constantly improving.

The weakness of an LCD is in the viewing angle. The LCD has only one optimum viewing angle, and resolution at any other angle is poor. There is a tuning device incorporated with many LCDs. The tuning device allows people to change the optimum viewing angle to one which accommodates their vision. Tuning takes a few seconds and can be changed at anytime. However, due to the small range in the viewing angle, the screen cannot be viewed by more than one person at a time.

The screen shapes can vary greatly. I have chosen a rectangular screen which is 3x7 inches. The screen also has an anti-glare material producing a matte finish on the screen surface.

Keyboard

The keyboard is compact with easy reach, and it is also well separated from the other function keys. The key pad is a minimum size, but easy to type with. The lettering on the keyboard is readable. The key pad is dark grey with white lettering which will make it easy to read and will give it a clean and sharp look. If the keypad were light in color, it would show dirt easily.

Strobe light

The strobe light is not something new. The device is currently used at the dorms of Tower A, B and C at Rochester Institute of Technology. It has also been installed for security purposes in the Lyndon Baynes Johnson building at the National Technical Institute for the Deaf for security purposes. It is commonly used for emergency warning in buildings, police cars, etc.

The strobe light comes in different sizes. The TNC strobe light is considered small, but the light will still be strong enough to get one's attention. When the phone rings, the light will flash at the same time.

Antenna

This will be the first device with an antenna. The TNC can be used anywhere in the world without a phone outlet. This can be done with the use of a an external or internal battery pack. The antenna is thin and sleek to give it a simple look, and can be hidden internally into the antenna pocket when not in use. If it needs to be used, it can be operated by a button on the side of the TNC.

Answering Machine

The answering machine will work just like any regular, digital answering machine. There will be no time limit on the use of the answering machine. Most deaf people prefer no time limit to give the user on the other end enough time to leave a message. The digital device will provide up to two and a half hours of messages. It will cover approximatly twenty messages on the answering machine, depending on the message length.

Memo & Battery Light

The lights will have two different colors, one green and the other red. The green light indicates that there is a message on the answering machine. When pressing the memo button, the message will appear on the screen along with the number of calls the sender left. When the red light appears, it indicates the battery is running low on the TNC machine and needs to be recharged. The warning light will go off fifteen minutes before the sender is interrupted.

Phone System

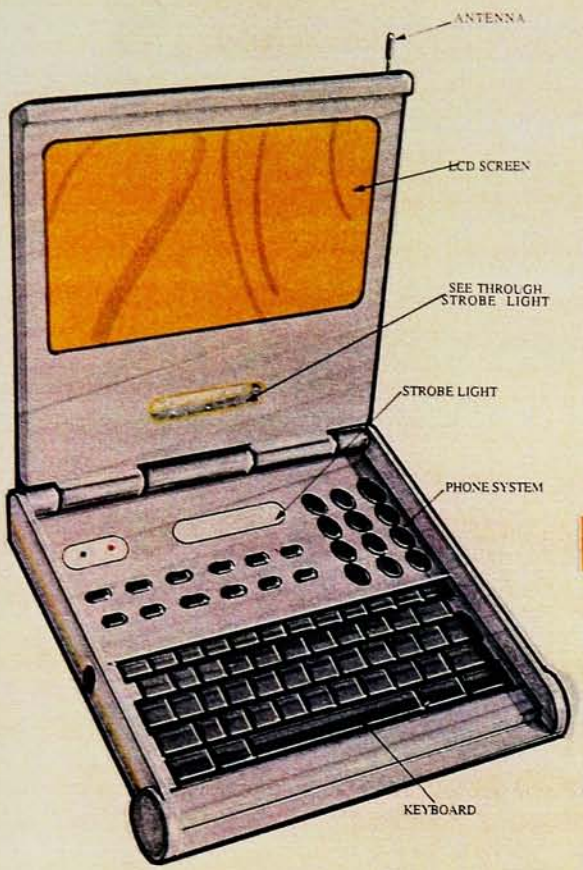
There is a standard phone dialing system. There is no phone handset, but it is an option to people who can hear the phone pretty well. Most deaf people don't hear the phone well and don't need a handset.

Battery Recharger

Power is supplied to the TNC unit by a rechargeable battery. I have incorporated a custom, internal, rechargeable battery pack which can be used for over four hours of communication usage. I have also incorporated an adaptor connection for the TNC. This will enable the unit to hook up to line power in order to minimize battery consumption.

Monitor & Printer Attachment

A monitor and a printer are some of the options which can be attached to most computers. The purpose of a 15" or larger screen is to be able to see the screen clearer and to be able to read more lines at one time compared to a 1X6 inches screen. The printer can be a big help printing all received messages on the TNC or for recording a phone conversation.



PERSPECTIVE

DATA CHART

DESCRIPTION	PRESENT	NEW SOLUTION
SIZE	BULKY AND HEAVY	SLEEK & LIGHT WEIGHT
KEYBOARD	NO PROTECTION FROM DUST	PROTECTION FROM DUST
DIGITAL DISPLAY	BUILT IN SCREEN ONE LINE CHARACTER	ADJUSTABLE LCD SCREEN TEN LINES CHARACTER
ANSWERING MACHINE	LIMITED OF MEMORY	20 MEGS OF DIGITAL MEMORY
PRINTER	STANDARD SIZE 2.5"w.	STANDARD SIZE PAPER 8.5X11 (OPTIONAL)
RELAY SERVICE (R.S)	PRESENT UNIT USE R.S.	R.S. WON'T BE NEEDED
CARRY CASE	BRIEF CASE STYLE	LIGHTWEIGHT NO CASE NEEDED (OPTIONAL CASE COVER)
TELEPHONE	LIMITED	BUILT IN PHONE SYSTEM

1 TNC

TELETYPE NETWORK COMMUNICATION

MARK ADAM CLYMAN

Figure 7. Illustration Drawing, No. 1

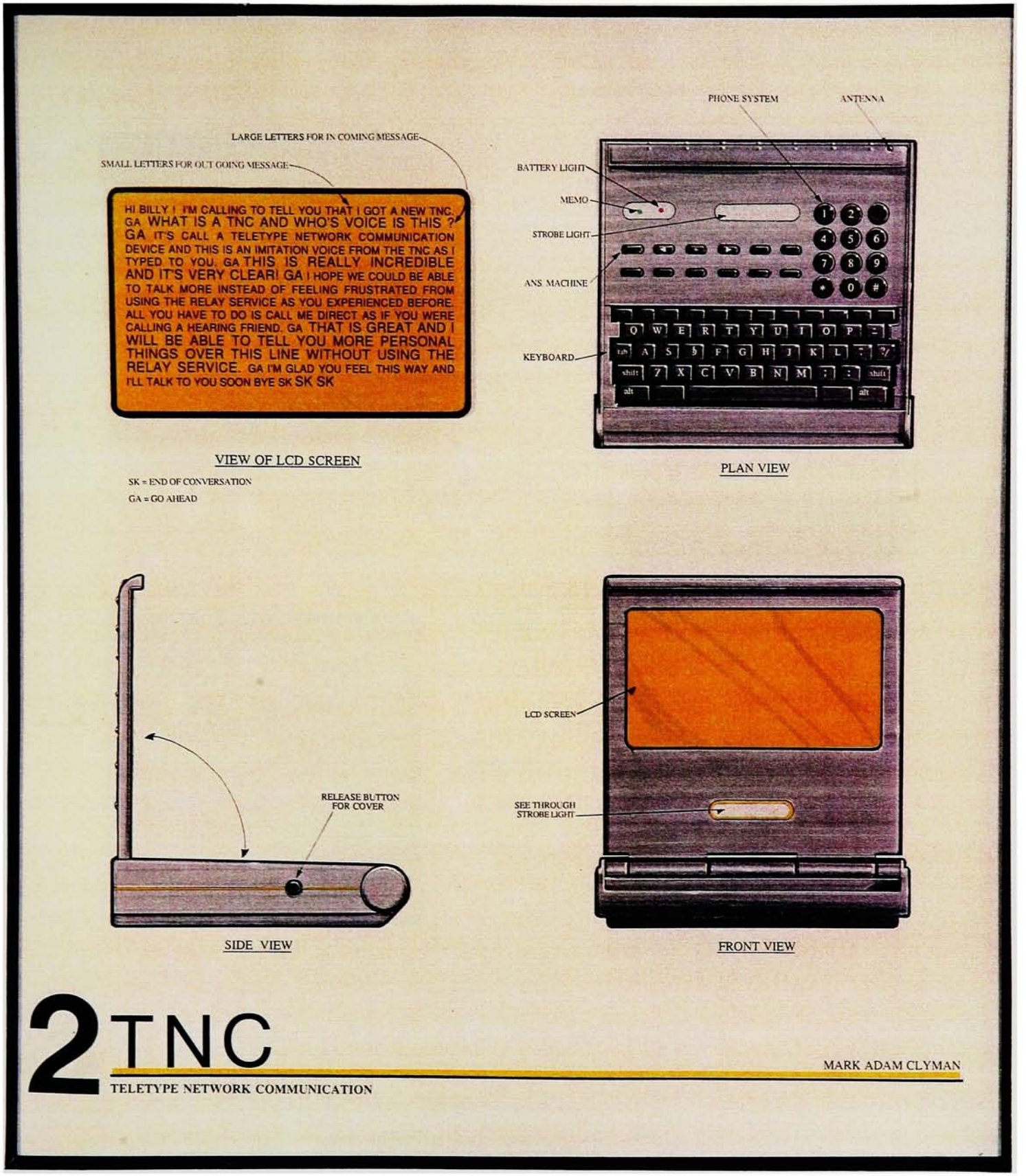


Figure 8. Illustration Drawing, No. 2

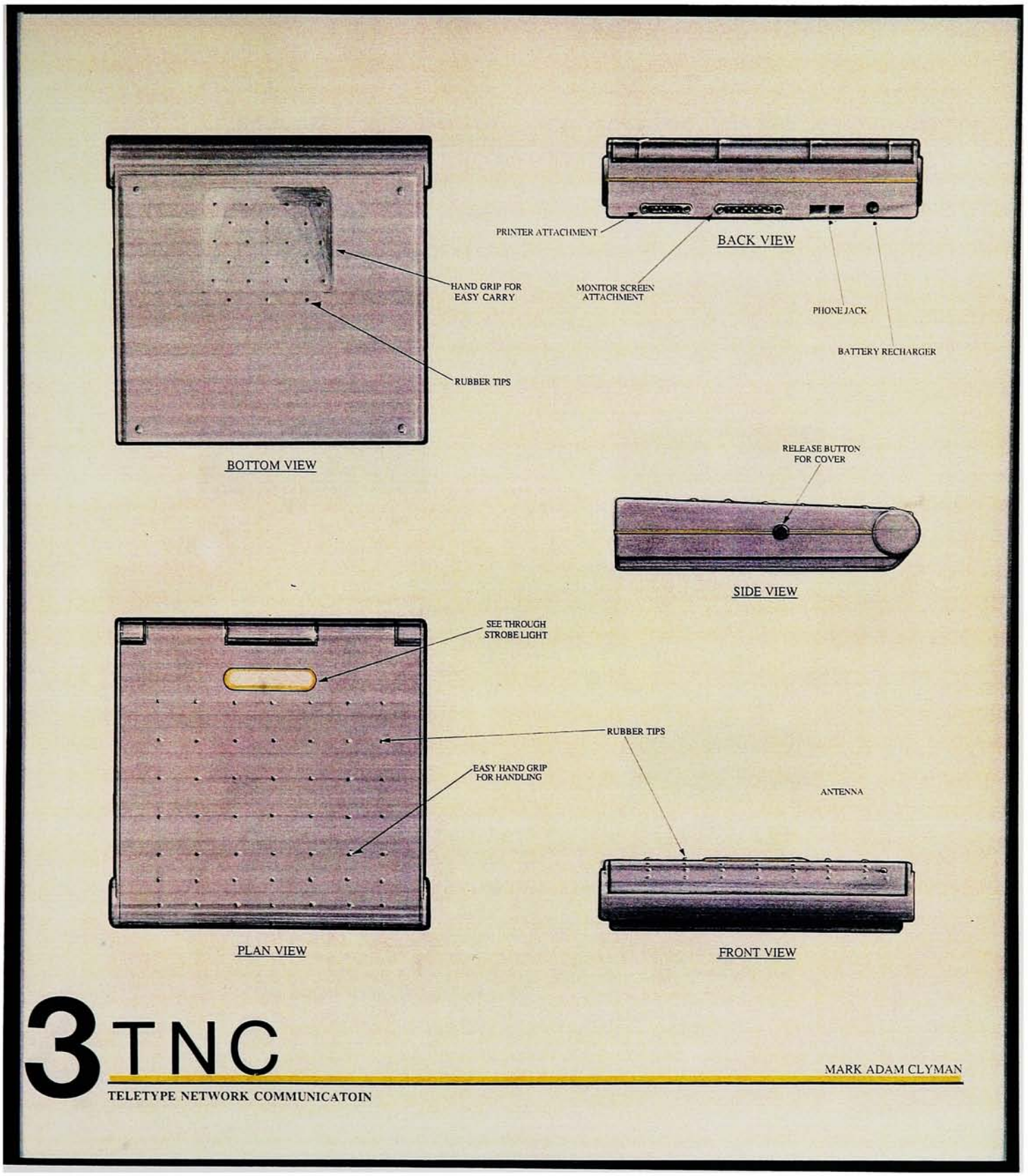
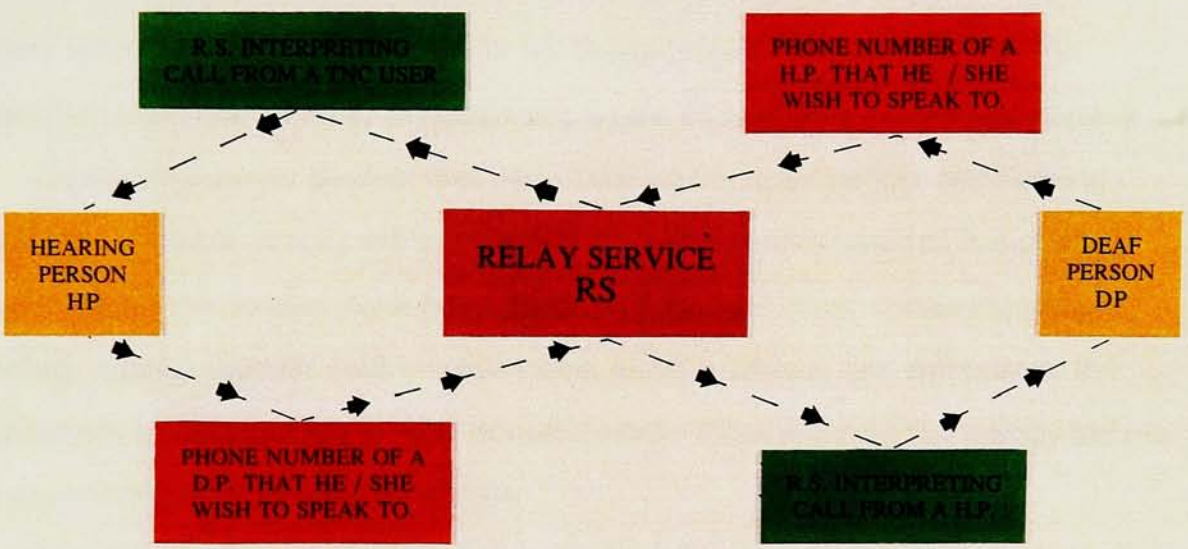


Figure 9. Illustration Drawing, No. 3

THE PRESENT SOLUTION NOW IS THAT A HEARING-IMPAIRED PERSON WHO WANTS TO TALK TO A HEARING PERSON CAN CALL A RELAY SERVICE WITH AN EIGHT HUNDRED NUMBER. THIS IS NOT A PERFECT SOLUTION BECAUSE THE RELAY SERVICE CAN BE VERY BUSY DURING CERTAIN TIMES OF THE DAY AND CAN BE IMPOSSIBLE TO ACCESS. WHEN A DEAF PERSON TALKS TO THE RS, THEY GIVE THEM THEIR HOME PHONE NUMBER, NAME, THE RS PUTS THROUGH THE CALL TO THE RECEIVING PARTY, IDENTIFIES ITSELF, ASKS THE RECEIVING PARTY IF THEY ARE EXPERIENCED WITH THE RS, EXPLAIN TO THE RECEIVING PARTY THAT THE RS IS INTERPRETING A CALL FROM A TDD USER AND WILL TYPE BACK THE RECEIVER'S RESPONSE. SOME HEARING PEOPLE FIND IT ODD AND UNCOMFORTABLE TO TALK TO THE RS INTERPRETER (THE THIRD PARTY) ON THE PHONE.



THERE ARE A NUMBER OF REASONS WHY THE TNC WOULD IMPROVE THE LIVES OF HEARING IMPAIRED PEOPLE. THE TNC WOULD ELIMINATE THE NEED TO WORK THROUGH A THIRD PARTY SYSTEM. SINCE THE TNC WILL FUNCTION LIKE A TELEPHONE, WITHOUT ANY RESTRICTION...LIKE LIMITING PHONE CALLS, OR WAITING PERIODS, HEARING IMPAIRED PEOPLE WILL FEEL MORE CONFIDENCE ABOUT THEIR ABILITY TO ACCESS PUBLIC INFORMATION. BECAUSE THE NEW UNIT WILL BE PORTABLE, DEAF PEOPLE WILL BE ABLE TO CARRY IT WITH THEM WHEREVER THEY GO.

4 TNC

TELETYPE NETWORK COMMUNICATION

MARK ADAM CLYMAN

Figure 10. Illustration Drawing, No. 4

CHAPTER 6

CONCLUSION AND EVALUATION

As a deaf person, I wanted to improve communication between the hearing and deaf world. When I was in college, the Telecommunication device for the deaf (TDD) and the use of the relay services was becoming increasingly popular across the country. The ability to access relay services was becoming more difficult. This problem led me to redesign the TDD for my thesis project. The response by the students and teachers at NTID to developing a new product for the deaf was positive.

Developing a new product that helps hearing impaired people and hearing people communicate directly without the use of a relay service seemed like a timely project. Many new devices have been developed for deaf / hard of hearing people including: closed captions built into television, small notebook size computers, the development of text-to-speech and speech-to-text. All of this new technology led me to approach my project more realistically.

The sleek and lightweight design of the New Teletype Network Communication shows a dramatic change in the design and the use of the device. Making it appear as desirable as other consumer products was a major goal for this project. The previous design of the TDD needed a new look to "keep up" with the design world. When the TDD was developed, it was not the design but the function which was the focus. The design needed to be updated and the function changed.

Applying two different color schemes to the design was judged positively by its users. Applying two tones of gray and yellow color schemes to the design was judged positively.

The use of design as texture on the top and the bottom of the TNC gives a better grip when handling the TNC. Graphics in this design, including the logo of "TNC", should have been studied more to explore other fonts or custom font styles. The overall major improvement of the TDD (compared to the older model) will improve the life of deaf people greatly.

I asked deaf and hearing people who were knowledgeable about the TDD to evaluate my product. They said that they found the TNC interesting, were curious about how it would function, and wondered if the TNC would be available to be bought in the near future. The deaf people I interviewed would be interested in buying this if it were on the market. The only drawback today is the speech recognition technology. In order to bring this product to reality, speech recognition (large vocabulary, continuous speech) capability is required. Although speech technology is not advanced enough to combine the above mentioned characteristics at this time, the future prospect is bright.

Some of the deaf people interviewed felt that even if the speech-reconigtion is not available at the present time, they would like to see the new product replace the current TDD. This product would lead other products for deaf and disabled people into the next century.

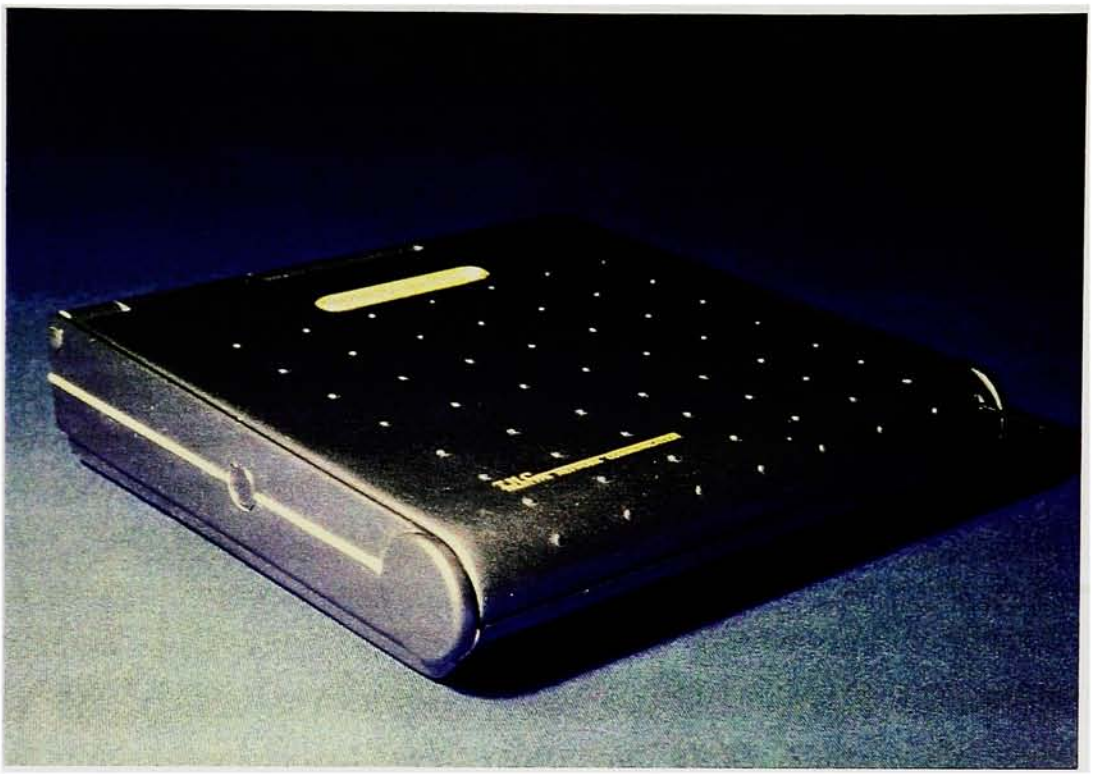


Fig.11 Final Model - Front View

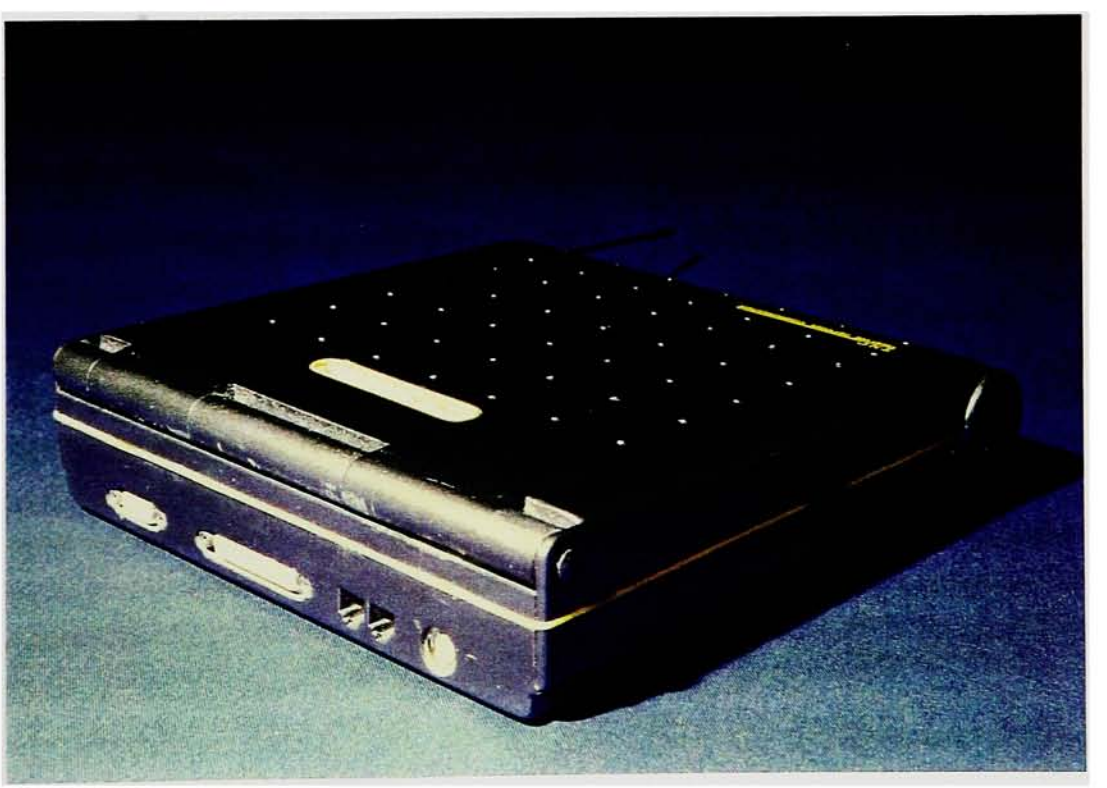


Fig. 12 Final Model - Back View

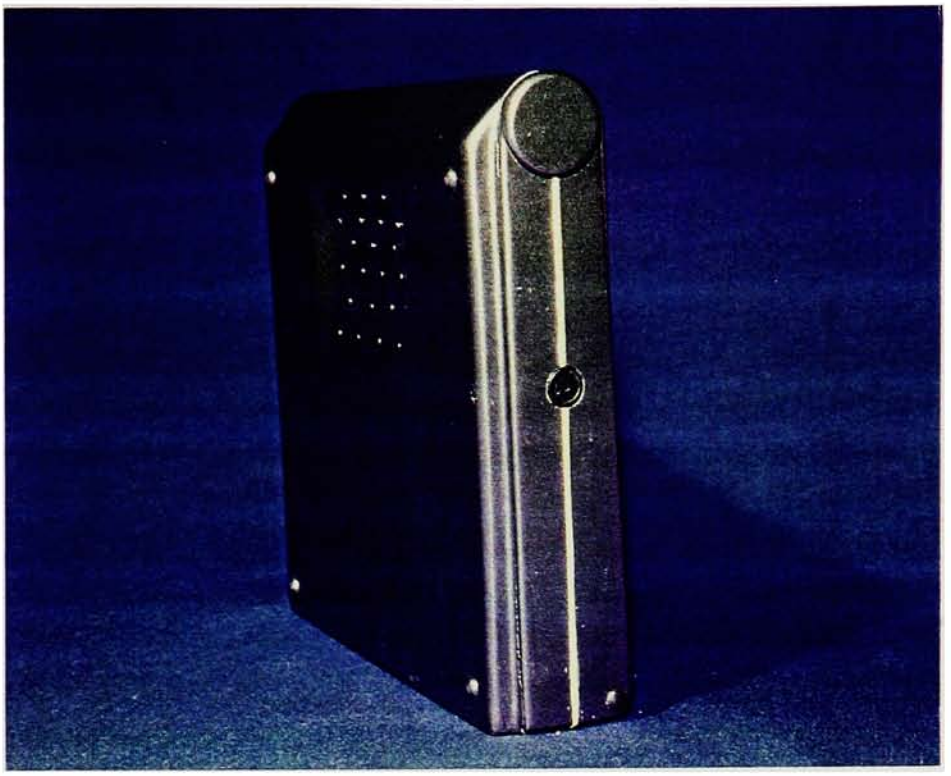


Fig.13 Final Model - Side View

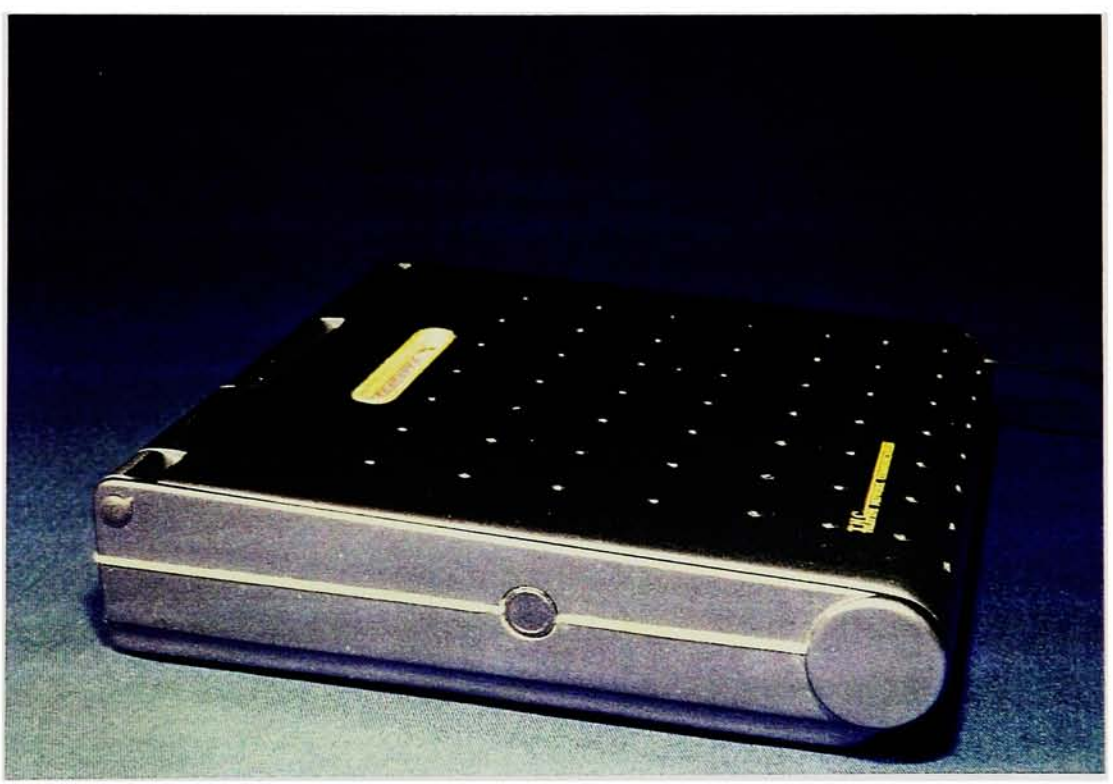


Fig. 14 Final Model - Side and Bottom View

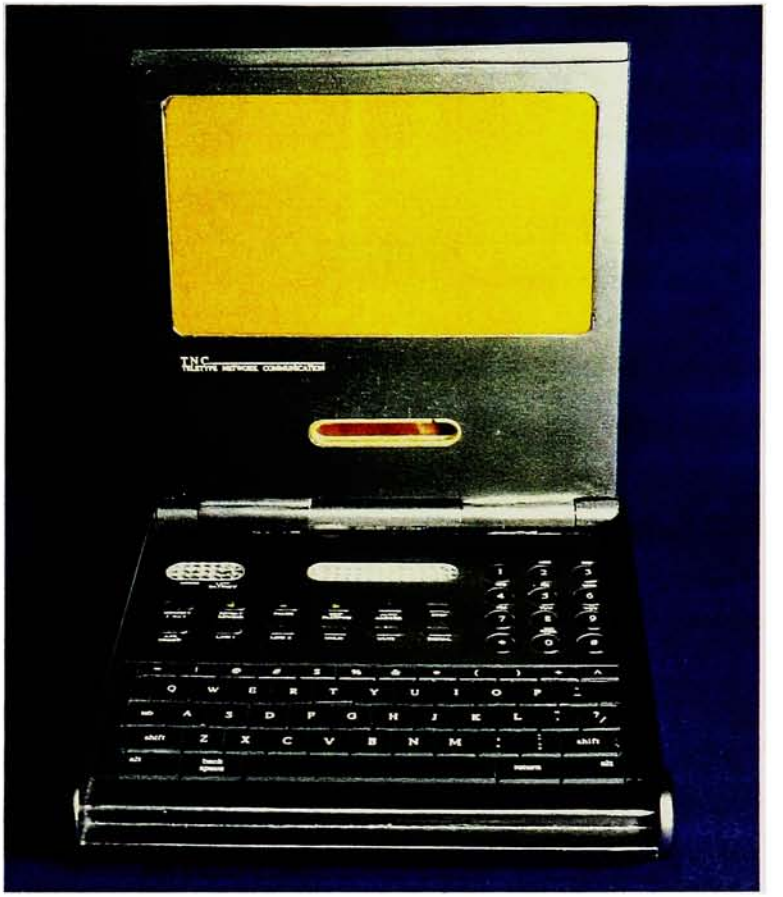


Fig.15 Final Model - Open View

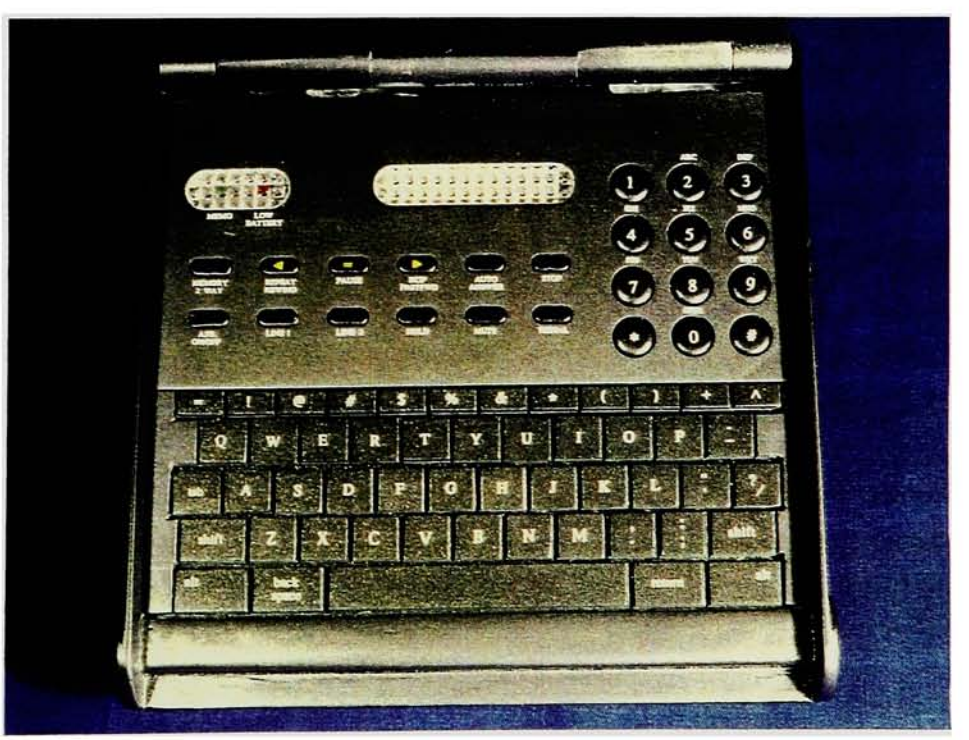


Fig. 16 Final Model - Key Board View

APPENDIX

HISTORY OF DEAF AMERICAN

Deafness was first documented in history around 355 B.C. The first permanent school for the deaf in in the United States was built in Hartford, Connecticut on April 14, 1817. "It was called **Connecticut Asylum for the Education and Instruction of Deaf and Dumb Persons**. It was founded by Thomas Hopkins Gallaudet and Laurent Clerc. This school was very successful and continues to this day to educate young deaf people. The name of the school changed to The **American Asylum** but today it is called the **American School for the Deaf** in West Hartford, Connecticut. Now there are many schools all around the country which service deaf people...elementary, secondary, training schools, etc. Many of these schools are built on the model of the American School for the Deaf. Many of these schools were founded by deaf people. While Abraham Lincoln was president of the United States, he signed a charter authorizing the **Columbia Institution for the Instruction of the Deaf**, in Washington, D.C., to grant college degrees to deaf persons." [1] This charter resulted in the founding of the National Deaf-Mute College in 1864, which was renamed Gallaudet College in 1884...the only all deaf liberal arts college in the United States.

In 1947, Emerson Romeroa, a deaf Cuban-born New Yorker, developed the concept of captioning films for the deaf.

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1 Clark R. Gannon. "A Narrative History of Deaf American," Deaf Heritage ,16.

He thought of the same methods that had been used in the old silent movies (popular before sound was developed) and incorporated that knowledge into his ideas for captioned films. He created a library of captioned films for the Deaf. "His first public appearance was in 1950 at the Lexington School for the deaf to show Dr. Clarence O'Conner his collection of captioned films. Dr. O'Conner was moved by this new idea. Romero was be able to establish Captioned Films for the Deaf, a non-profit corporation, with help from Lexington School for the Deaf as well as many other schools for the deaf". [2] This service became too costly for Romeroa to continue. The only way for captioned films to continue and survive was to get government support. Connecticut Senator William Purtell agreed to introduce a bill in Congress to establish a free-loan service to subtitle motion pictures for the deaf. "On September 2,1958, President Dwight D. Eisenhower signed P.L. 85-905 to establish Caption Films for the Deaf and this was enacted into a law". [3] In 1973 the National Captioning Institute (NCI) was born and was prepared to developed captioned programs for television. This was another new advancement for the deaf community. This advancement again helped deaf people feel that they could participate equally in society. To have access to the same news and programs as hearing people by using a close captioned decoder.

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2 Ibid., 266.
3 Ibid., 268.

Gallaudet University has been in existence for over a hundred years. Deaf people who have wanted a technical education have had few choices in the past.

"In 1968, then President Lyndon B. Johnson approved of a plan for establishing the first technical institute for the deaf in the United States. Congress passed a public law 89-36 the same year and the National Technical Institute for the Deaf (NTID) became a reality".[4] NTID found a home here at Rochester Institute of Technology (RIT) after looking at a variety of campuses around the country including University of Chicago, University of Tennessee, University of Miami, University of Southern California and University of Pittsburgh. RIT was chosen was because it had a large amount of land available and was expanding its technical programs and be-coming one of the top schools on the east coast.

The term "hearing impairment" is generic and covers a wide range of hearing impairments between deaf and hard of hearing. There are approximately 16 million Americans who are hearing impaired. Of this number, some two million people can be classified as "Deaf".

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4 Ibid., 57.

BIBLIOGRAPHY

Ainsworth, William A. Speech Recognition by Machine , London, Peter Peregrinus Ltd, 1988.

Arthur, Clarke C. "Voice: The Next Interface" ,PC Today November, 1991.

Decker, Nan and Montandon, Betsy. Captioned Media in the Classroom. Silver Spring, MD.: National Association of the Deaf, 1984

Gannon, Jack R. Deaf Heritage "A Narrative History of Deaf American" Silver Spring, MD.: National Association of the Deaf, 1981

Glen, James. "Speech to Text: Today and Tomorrow " , Proceeding of a Conference at Gallaudet Unversity, September, 1988. Washington, D.C.: Gallaudet Research Institute, Gallaudet Unversity, 1989. p.164.

Harkins, Judith E. and Barbara M. Virvan,"Speech toText: Today and Tomorrow", , Proceeding of a Conference at Gallaudet University, September, 1988. Washington, D.C. Gallaudet Research Institute, Gallaudet University, 1989.

Kurzweil, Raymond. The Age of Intelligent Machines , Cambridge, Mass.: MIT Press,1990.

Lee, Kai-Fu. Automatic Speech Recognition: The Development of SPHINX System , Boston, Mass Kluwer Academic Publisher. 1989.

McCoy, Michael. "Defining a New Functionalism in Design" , Innovation, IDSA, Spring, 1984.

Morgan, Nelson. Talking Chips , New York: Mc Graw-Hill, 1980.

Newton Steve J. Voice in Office Systems , The National Computing Centre Limited, Manchester, England. NCC Publication, 1985.

Singleton Paul J. "NationwideTDD Relay Standards: Partners in Progress", GRI Monograph Series, 1989.

Sanders, Mark S. and McCormick, Ernest J. Human Factors in Engineering and Design , New York: McGraw-Hill, 1987.

Witten, Ian H. Principles of Computer Speech , New York Academic Press, 1982.