CHAPTER 7

SOUTHEASTERN MASSACHUSETTS UNIVERSITY
DEPARTMENTS OF ELECTRICAL & COMPUTER ENGINEERING
AND ELECTRICAL ENGINEERING TECHNOLOGY
NORTH DARTMOUTH, MASSACHUSETTS 02747

Principal Investigator(s):

Lester W. Cory (508) 999-8482

Philip H. Viall (508) 999-8214

TALKING LARGE SCREEN TYPING SYSTEM

Designer: Mark Easterday
Disabled Coordinator: Maureen Canner, Bridge Program
Supervising Professor: Professor Philip H. Viall
Electrical Engineering Technology Department
Southeastern Massachusetts University
North Dartmouth, MA 02747

INTRODUCTION

The Talking Large Screen Typing System is a combination of hardware and software which enables a severely visually impaired girl who also has Cerebral Palsy to produce printed documents. The system consists of a computer, a voice synthesizer, a printer capable of producing large, bold letters and the Talking Large Screen Typing System program.

Every character which is typed is both spoken by the synthesizer and displayed on the monitor screen. The monitor reproduces each character in 2 inch high letters and is capable of displaying 5 lines of text with 8 characters per line. The user can backspace to make corrections.

The contents of the screen is sent to the printer by pressing the "print" key. The printer is configured to print up to 40 characters (one full screen) of enlarged characters on each line.

SUMMARY OF IMPACT

The user of the Talking Large Screen Typing System is a 13 year old girl who has Cerebral Palsy. She is almost totally blind and lacks fine motor control. She is unable to write with a pencil and she cannot read normal size text even with glasses. She is able to see bold type double size letters by holding them within a few inches of her eyes and she is able to read the 2 inch high letters on the TV screen from a distance of about 2 feet.

Prior to receiving the Typing System, she had no way to produce legible written work. No effort had been made to teach her to type because she could not see the keys nor could she see the letters produced by typewriters. All of her school work was dictated, a process which was made difficult by her severe speech impediment. Her reading was at least several years behind grade level.

It has taken her some time to find her way around the keyboard but she is doing well. Large letters were glued over the key caps which she could see by bringing her face down to within a few inches of the keyboard. As the letters gradually fell off, they were not replaced.

Today she is able to do most of her writing without assistance. Her sight word vocabulary has quadrupled and she does more reading on her own. For the first time, she can write a letter unassisted, something she is doing with greater frequency.

TECHNICAL DESCRIPTION

The system uses a Radio Shack TRS-80 Color Computer, a 21 inch television receiver, a Votrax voice synthesizer, a line printer and the Talking Large Screen Typing System program.

As keys are pressed on the keyboard, the text appears in large print on the screen. The information is also sent to the speech synthesizer to be spoken. The synthesizer is sent three types of data: data to be spoken, commands, and data to be sent to the printer. If the synthesizer is sent a command to speak the data it is sent, it will echo each key as it is pressed. For example, if the "A" key is pressed, the synthesizer will speak "A." If the "," key is pressed, the synthesizer will speak "comma." This gives immediate feedback to the user, so she will be aware if she presses a different key than intended. If an error is made, there is a backspace function key which will delete the last character pressed. This key is also echoed by the synthesizer which speaks the word "backspace."

In this way, the user can fill the screen with text. The screen can hold 5 lines with 8 characters to a line. At any time the entire screen full of text can be spoken by the synthesizer, or it can be sent to the printer. When the print key is pressed the synthesizer is sent commands by the computer which tell it not to speak the following data, but to send it on to the printer. Before sending the text, the synthesizer first sends control codes to the printer which set it to print in quadruple size bold letters. Once a portion of text is printed, the screen can be cleared by pressing the clear key and the user can then begin typing a new line. This allows for documents much longer than the 40 characters which the screen can hold.

As is the case with other systems described in this chapter, the system software was burned into EPROM so that no loading of tapes or disks is required.

The total system will cost about $825 to duplicate not including the television receiver which was donated.

DEAR PROF CORY

THANK YOU VERY MUCH FOR MY COMPUTER. I USE IT FOR EVERYTHING. NOW I CAN WRITE A LETTER TO YOU AND SAY THANK YOU LIKE THE OTHER KIDS DO. THANK YOU VERY MUCH.

SHERI

"TYPING TUTOR"

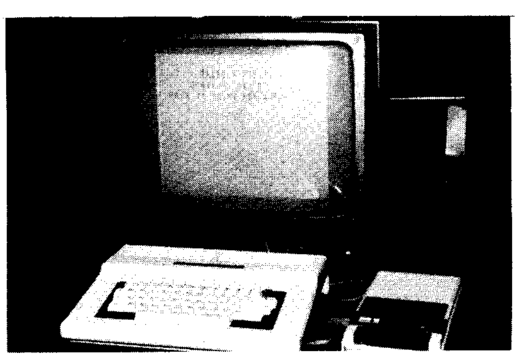
Designer: Leonard Bean
Disabled Coordinator: Laurie John, James L. Maher Center
Supervising Professor: Professor Lester W. Cory
Electrical and Computer Engineering Department
Southeastern Massachusetts University
North Dartmouth, MA 02747

INTRODUCTION

The typing tutor is a hardware - software system designed to enable a person to practice accurate typing. Its purpose is to give a disabled person, who lacks the physical ability to write using a pencil, the opportunity to improve his typing skills with the objective of securing employment.

The program displays sentences one at a time on the computer screen and waits for the same sentence to be entered from the keyboard. Each time a character is pressed, the computer responds with a tone. There are two different tones, one for correct entries and one for incorrect entries. Only correctly typed characters are displayed on the screen.

When a sentence is completely entered, the user presses the ENTER key and the system displays the number of characters typed and the percentage typed correctly. Another sentence is then displayed and the computer continues to calculate and display the user's cumulative score.



SUMMARY OF IMPACT

A 25 year old man with Cerebral Palsy was offered employment as a telephone switchboard operator provided that he could demonstrate that he had the ability to route incoming calls to the proper extension and take messages for those unavailable to answer the phone.

He is able to speak and he has the dexterity to handle the buttons and levers on the call director. The problem came in taking messages. Not only was he unable to write legibly with a pencil, he had never learned to type. A computer system was custom designed for him with pre-programmed names of employees and frequent callers and stock messages which can be printed with the touch of a single key. Most messages can actually be taken and printed with only 4 key strokes including the message, the callee's name, the caller's name and verification of the caller's phone number. Nonstandard messages can be tape recorded for transcription later. The system didn't work out because he couldn't find the keys he needed in a reasonable time. Commercially available typing programs didn't seem to help.

The Typing Tutor worked well. The sentences were chosen to capture his interest and they did. The score box let everyone who went by know how well he was doing and also how much. He worked hard to get the numbers in the score box as high as possible each day.

The system accomplished its objective. Today he is employed for the first time in his life and he is doing well. The Typing Tutor changed his attitude from "I can't" to "I Can."

TECHNICAL DESCRIPTION

The program (shown below) is written in Basic and runs on a Radio Shack TRS-80 Color Computer, although it is sufficiently generic to run on most small computers which accept Basic. The system uses the computer's standard keyboard for input.

When the program is first run, one of 150 sentences is randomly selected and displayed on the screen. The sentences are up to 32 characters long and contain no punctuation. The user is expected to duplicate the sentence by typing it one letter at a time directly under the displayed sentence. The program waits for input from the keyboard, and checks each character as it is typed to see if it is correct. Capitalization is not checked. Incorrect keyboard entries are responded to with a low frequency tone only. When the correct key is pressed, a different tone sounds and the character is displayed on the screen. A typed character will only appear on the screen if it is the correct entry in the sentence.

When the entire sentence has been typed**, the message "press ENTER to continue" appears on the screen.** Once **the ENTER key is pressed, the numeric results are updated and displayed at the top of the screen. The first number displayed is the total number of characters typed and the second is the percentage of these which were typed correctly. The next sentence to be typed is also displayed, replacing the previous one.**

After each sentence is typed correctly the results are updated and displayed. The displayed data is cumulative, showing the total number of keystrokes since the system was turned on and the percentage of those which were correctly typed. To reset the scores, the program must be stopped and restarted.

The program was converted to tokens which were then loaded into an EPROM. The EPROM was then placed in a socket which had been previously "piggy backed" over the Extended Basic ROM. A jumper in the cartridge port causes the system to boot from address C000 **which was loaded with a routine to boot strap the tokens into RAM and begin program execution. Thus the program comes up running each time the system is turned on with no need to load anything from tape or disk.**

The only cost incurred was that for the computer, the EPROM socket and the EPROM. A borrowed TV set was used as a video monitor. Total cost is $175.

```
10 REM  ** TYPING TUTOR  **
12 CLEAR 3000,32512
14 CLS :PRINT@165,"TYPING TUTOR"
16 N=100' # OF SENTENCES (150 MAX)
18 DIM A$(150) 'SENTENCE ARRAY
20 NT=1 'TOTAL # 0F KEYSTROKES
22 NC=1 '# OF CORRECT KEYSTROKES
24 FOR I=1 TO N:READ A$(I):NEXT
26 X=RND(TIMER):X=RND(N)
28 CLS:PRINT@40,"TRIES =";NT
30 PRINT@70,"SCORE =";INT(100*NC/NT);"%"
32 PRINT A$(X)
34 FOR I= 1 TO LEN(A$(X))
36 R$=INKEY$:IF R$=""THEN36
38 NT=NT+1
40 S$=MID$(A$(X),I,1)
42 IF R$<>S$THEN SOUND 50,1:GOTO 36
44 NC=NC+1:SOUND 145,1:PRINT R$;
46 NEXT I
48 PRINT:PRINT:PRINT
50 PRINT"PRESS enter TO CONTINUE"
52 R$=INKEY$
54 IF R$<>CHR$(13) THEN 52 ELSE 26
56 READ A$:N=N+1:GOTO 56
58 REM ** 150 SENTENCES FOLLOW **
60 DATA A PENNY SAVED IS NOT WORTH MUCH
62 DATA NOW IS THE TIME TO HAVE A PARTY
64 DATA ARE WE HAVING FUN YET
66 DATA IS IT TIME TO GO HOME YET
68 DATA LETS MAKE POPCORN
70 DATA WHAT TIME DOES THE BOSS LEAVE
72 REM ** THE REST IS ALL DATA **
```

"Talking Press-The-Picture Communicator"
A Direct Select, Multiple Page Communication Device for a Non-Reading, Non-Speaking Person

Designer: Susan Toland
Disabled Coordinator: Ronald St. Martin, Fall River Public Schools
Supervising Professor: Professor Lester W. Cory
Electrical and Computer Engineering Department
Southeastern Massachusetts University
North Dartmouth, MA 02747

INTRODUCTION

The Talking Press-The-Picture Communicator was designed to enable a physically disabled, speech impaired person who can not read but who has some manual dexterity to communicate by selecting from among one hundred and twenty different user - appropriate, pre-programmed sentences. The system consists of a Radio Shack Color Computer, a TV/monitor, a Votrax speech synthesizer, a TRS-80 Color Computer Electronic Book, a custom fabricated switch box, a set of ten custom overlays, custom software, and suitable interconnecting cables.

The user or therapist first turns to one of the ten pages in the Electronic Book, each of which contains twelve pictures. The user or therapist then rotates the ten position page selector switch to the position which corresponds to the page number of the chosen page. The user may now cause the system to speak by pressing on one of the twelve pictures on the page. Each picture is associated with a corresponding sentence in the computer's memory which will be spoken by the speech synthesizer when selected. Pressing on the picture of a drinking glass will cause the system to speak, "May I have a drink, please?," for example.

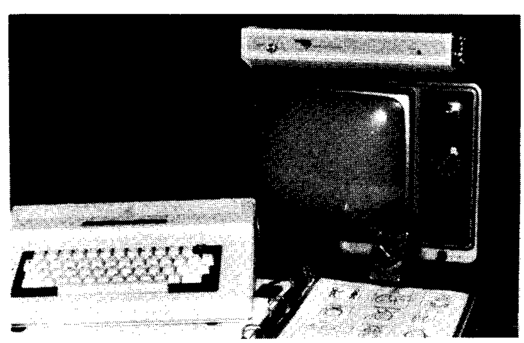
Nine of the ten pages are "fixed" in that the user cannot change the sentences on these pages without modifying the program. Page 10, however, comes up blank each time the system is turned on and is programmed each day by the teacher or therapist with sentences appropriate for that day's activities.

SUMMARY OF IMPACT

The Talking Press-The-Picture Communicator was designed to enable a severely disabled, non-vocal youngster to express his basic wants and needs and to enable him to respond to questions. The youngster has Cerebral Palsy and is moderately retarded. He is unable to speak, write or gesture. He has not learned to read but he does recognize a few words and some numerals. He communicates "YES" and "NO" through a combination of eye motion and guttural sounds. His teachers have been frustrated in their attempts to elicit reliable, meaningful responses.

The Talking Communicator has met with almost immediate success. Although the user lacks the physical dexterity to independently turn pages, he is able to indicate through eye gaze and facial expressions when he needs to have pages turned. He seldom initiates communication but he does use the system appropriately to respond to questions. Perhaps the most valuable feature of the system is the teacher-programmable page. This is used on a daily basis to teach such concepts as size, shape and colors.

The system has made it possible for this youngster to communicate with his teachers and therapists and even with some other students in his classroom. It is the first system in which he has shown any interest and the first which he has demonstrated the ability to use. For now it is an appropriate device but it is hoped that eventually he will outgrow it and move on to a more sophisticated system.



TECHNICAL DESCRIPTION

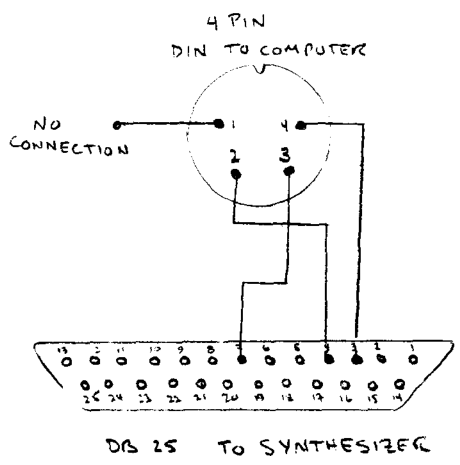
The system consists of a Tandy Color Computer with custom software loaded into an EPROM, a speech synthesizer, a Color Computer "Electronic Book" similar to a Koala Pad, a custom fabricated switch box "page selector" and interconnecting cables. If facilities are not, available to transfer the software to EPROM, then the software can be loaded into the computer's RAM from tape or disk. The software is sufficiently non-system specific that it can be transported with little modification to other "Basic speaking" computers. Except for the custom EPROM pack which was implemented by soldering a socketed EPROM directly over the Extended Basic ROM, the computer is unmodified.

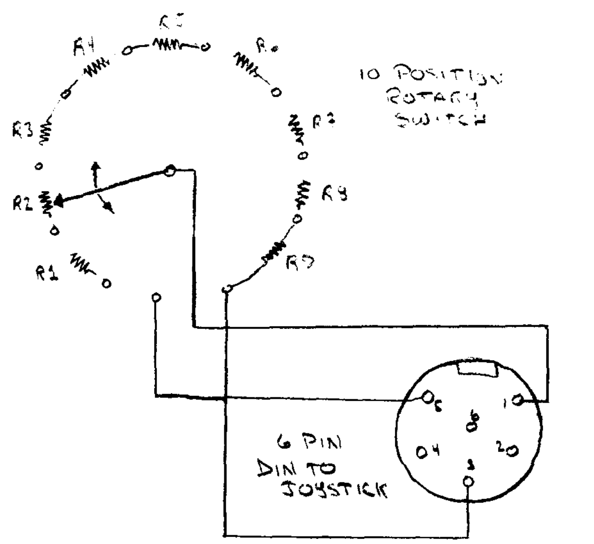
The speech synthesizer is a Votrax Personal Speech System Model 200 which is driven by the serial port of the Color Computer. Interface data from the 4 pin din plug of the computer to the DB-25 of the speech synthesizer is as follows: Pins 2-4 respectively of the male din plug are connected to pins 4(cts), 7(ground) and 3(data) of the male DB-25 connector. Pin 1 of the din plug is not connected. The 8 DIP switches on the rear panel of the synthesizer are used to select the proper baud rate, parity, protocol and interface ports. For interface to the Color Computer, the correct switch settings are 00100100 which selects serial transmission, 600 baud, RTS handshaking, 7 data bits, 1 start bit, 1 stop bit and no parity.

The Electronic Book is a touch pad which looks to the joystick ports like two 100K ohm potentiometers. Touching the upper half of the pad varies the signal at joystick port 2; touching the lower half varies the signal at port 3. The software causes the computer to repetitively scan ports O-3 looking for changes in either the setting of the page selector or in pressure on any of the 12 touch sensitive areas of the pad . A simulation of the Electronic Rook may be fabricated using discrete switches connected in parallel with elements of a resistor network. This scheme enables one to construct a touch sensitive pad of any reasonable dimension by choosing switches of appropriate surface area.

The page selector switch box connects to the computer joystick port 0 via a 6 pin din plug and a 3 conductor cable. The box consists of a network of 9 resistors connected in series around the circumference of a 10 position rotary switch. One end of the network is at ground potential (pin 3 of the din plug), one end connects to the 5 volt supply (pin 5) and the arm of the switch connects to the joystick input of the computer (pin 1). In theory, the resistors in the network should be of equal value. In practice, the two end resistors must be different in order to compensate for the internal current limiting resistor in the joystick circuit. If 10K ohm resistors are used for R2 thru R8 then R1 and R9 should be about 3300 ohms each. Some "trimming" of these values may be necessary due to variations in characteristics between different production runs of the Color Computer.

Copies of the system software may be obtained from the P.I.





"SINGLE SWITCH, ROTATING ARM
SCANNING PICTURE COMMUNICATOR"

Designer: David English
Disabled Coordinator: Jaryl Sciarrappa, Kennedy-Donovan Center
Supervising Professor: Professor Lester W. Cory
Electrical and Computer Engineering Department
Southeastern Massachusetts University
North Dartmouth, MA 02747

INTRODUCTION

The single switch, rotating arm, scanning picture communicator is a communication device for use by physically disabled persons who have the physical ability to operate a single switch. An appropriate switch can be chosen to match the ability of the individual user.

Users for whom the system is appropriate must have the desire and intelligence to communicate and the mental ability to associate pictures with the idea or concept to be communicated. It is presumed that system users are unable or unwilling to read.

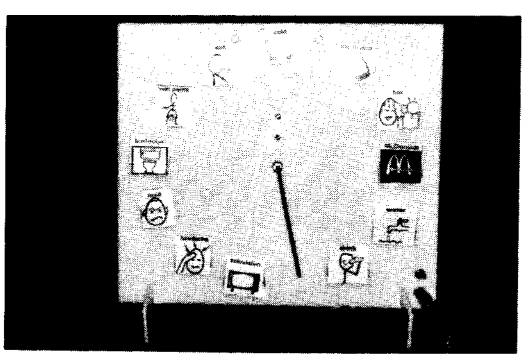
The communicator operates in one of two modes depending upon whether the therapist chooses to use a momentary control switch or a push on - push off switch. With a momentary switch in place, the arm turns for as long as the switch is held closed. Using a push on-push off switch results in the motor being turned ON-OFF with alternate pushes of the switch. In either case, when the switch is enabled, the arm rotates, passing over the pictures that are on the face plate. The user opens the switch when the arm is over the picture that conveys the idea that he or she is trying to communicate. The speed of rotation can be varied to suit the ability of the user.

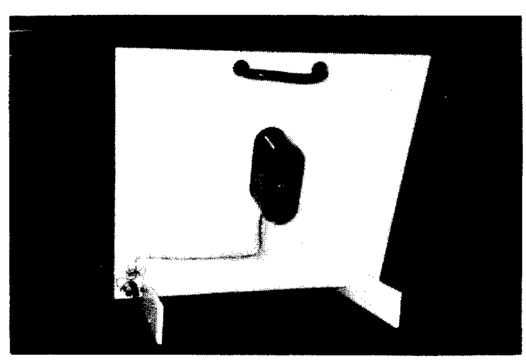
SUMMARY OF IMPACT

The Rotating Arm Scanning Picture Communicator was built for use by a non-vocal, multiple disabled child to facilitate basic communication, to introduce the concept of a scanning alternative communication device and to aid in proper control switch selection.

Initial use of the system has been limited to activity selection with drawings of activity choices being placed in four of the twelve pockets. With coaxing, the child is able to make appropriate use of the system to choose among alternative activities. In time, the use of the communicator may become more of an activity in itself.

The prime objective of having the child employ an alternative device for communication is being realized and the secondary objective of having the child develop dexterity in the use of an appropriate control switch is also being met.





TECHNICAL DESCRIPTION

The unit consists essentially of a drive motor which turns an indicator dial which points to any one of a dozen transparent pockets containing pictures or illustrations. The motor is started and stopped by closing and opening an external switch which is plugged into a jack on the front panel.

The device is light weight and battery powered and can be used in the home as well as in public to allow the non-speaking person to communicate needs, desires and feelings, or to respond to questions. The illustrations on the face plate can be changed as new ideas and thoughts are needed in the "vocabulary" of the user.

The face plate of the device is a 14" X 16" piece of white, scratch resistant Lucite. The face plate also serves as the mounting chassis for the remainder of the components that make up the device.

On the face of the communicator, the illustrations are held in place in a circular pattern around the rotary indicator, in the same manner that numbers are arranged around the circumference of the face of a clock. The individual pictures are slipped into transparent "pockets" made of clear vinyl which are permanently affixed to the face plate of the communicator. The indicator is attached through a hole in the center of the face to the shaft of the drive motor.

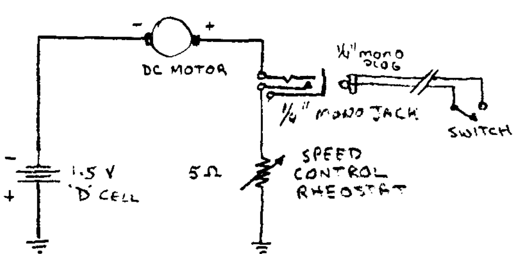
The drive unit of the communicator is an inexpensive DC motor that is sold for use as a barbecue rotisserie motor. The only power necessary to operate the unit is obtained from one standard "D" size battery. As supplied by the manufacturer, the motor has no ON/OFF switch. It is ON any time that the battery is installed. It is necessary to open the motor case and disconnect the wire leading from the positive terminal of the battery to the motor. This wire is replaced with a pair of wires about 15 inches long; one connected to the positive terminal of the battery, the other connected to the positive terminal of the motor. The free end of this pair is routed to the series combination of the input jack and speed control rheostat.

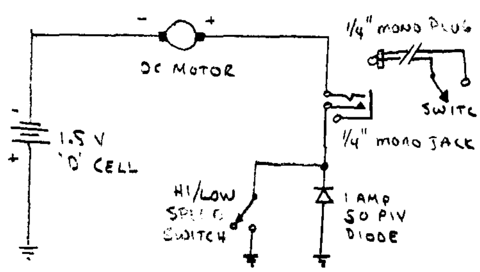
The input jack is a quarter inch phone jack mounted in the lower corner of the face plate. The speed control is a 5 ohm wire around rheostat rated to handle the starting current of the motor - about 300 ma. As the resistances is varied from 0 to 5 ohms the motor speed drops from about 4 RPM to about 1.5 RPM.

A less expensive way to control the speed is to connect a diode in series with the motor and connect a SPST toggle switch in parallel with the diode to switch it in and out of the circuit. With the switch open, the forward resistance of the diode is in series with the motor which drops the motor voltage to about 1.0 volts slowing the motor to about half speed. With the switch closed, the diode is short circuited and the motor runs at full speed.

A variety of momentary and two position ON/OFF switches are available on the market that can be modified to match the ability of the user. The switch is connected via a 1/4 inch mono plug to the jack on the face plate of the unit. When the switch is operated, the indicator turns, moving from one image to the next. When the indicator is over the picture that conveys the thought to be communicated, the user opens the switch, the connection is broken and the motor stops with the indicator pointing to the desired picture.

The Scanning Picture Communicator can be built for approximately thirty dollars ($30), including a simple array of control switches. The Communicator can be utilized to give many physically and mentally disabled persons the means to communicate simple wants and needs.





"'YES'-'NO' Talker"
A Diagnostic Device for the Communicatively Disabled

Designer: Ron Belanger and Mark Duncan
Disabled Coordinator: Jaryl Sciarrappa, Kennedy-Donovan Center
Supervising Professor: Prof. Philip H. Viall
Electrical Engineering Technology Department
Southeastern Massachusetts University
North Dartmouth, MA 02747

INTRODUCTION

The "Yes"-"No" Talker is a low cost, portable, battery powered device having two input switches. Pressing one switch results in the device speaking the word "YES." Pressing the other switch speaks the word "NO." Jacks for remote switches are provided.

The words "YES" and "NO" are stored as digitized speech in a memory chip. Because the words are essentially recordings of human speech (as opposed to synthetic speech), the words are reproduced with the same tone and inflection as when they were recorded. Simply by changing memory chips, the voice of the system can be changed From male to female to that of a child. One of the most important features of this system is that it can provide each of its users with an age and gender appropriate voice.

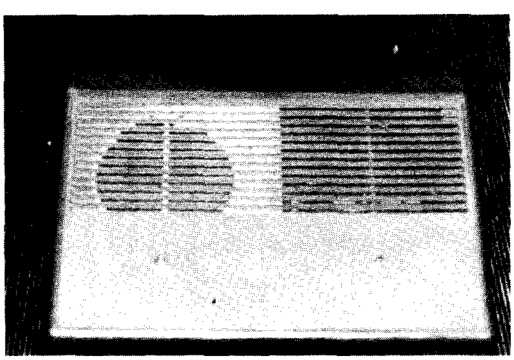
The "Yes"-"No" talker may be used as a diagnostic communication aid to achieve two goals. First, it provides a very elementary level of communication. Second, and more important, it provides motivation for an individual to communicate and to become proficient in the operation of a switch.

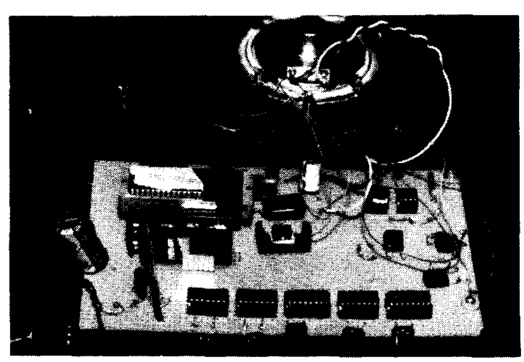
SUMMARY OF IMPACT

The "Yes"-"NO" talker was designed to be utilized as a diagnostic and teaching tool at a center which provides services for physically disabled and mentally retarded children. Often an individual's dexterity to operate a single switch needs to be developed before that person can make effective use of computerized menu scanning communication systems. When a menu scanning communication system is presented, even if the user understands what is required, the user may soon become frustrated if selections are missed, or if incorrect menu entries are selected.

The "Yes"-"No" talker gives the user a reason to make frequent use of a switch or switches. Once the ability to operate a switch reliably has been developed, a more elaborate communication system may be introduced. If the user is having trouble, one may always revert back to the "Yes"-"No" talker to determine the exact nature of the problem.

The "Yes"-"No" talker is an excellent <u>first system</u> for physically disabled children, particularly those of limited mental ability. It enables the therapist to introduce a system which a user can operate independently with minimal training and skill.





TECHNICAL DESCRIPTION

The box which contains the components is six inches deep and nine inches wide. The front (top) is sloped being four inches high at the rear and two inches high at the front. Two SPST momentary push button switches are mounted on the sloping surface. Pressing the left button results in the device speaking the word "Yes." Pressing the button on the right results in the device speaking the word "No." The device may be powered by either a 9V battery or a 9V D.C. power supply. A power switch is provided on the right side of the case. Two 1/8" mini phone jacks are provided on the back of the case for connecting a set of remote switches.

The device employs digitized speech stored in binary form in a 16K Byte CMOS EPROM. The EPROM is (logically) split into two halves. The bottom half of the EPROM is used to store the word "NO;" the top half stores the word "YES."

Speech was digitally recorded by using a Techmar Lab Tender board in an XT Clone. Speech was sampled at the rate of 8 KHz giving one second (8000 samples) of speech for each word. Each data sample was digitized into a one byte quantity by the Lab Tender board. The digitized data was then outputted via the serial port to a Data-I/O EPROM programmer.

More information on the development system may be obtained from the PI.

In order to speak one of the words stored in the EPROM, counter circuitry is employed to sequentially cycle through all combinations on address lines A0 through Al2 (all but the Most Significant Bit). The state of Al3 determines whether the word "YES" or the word "NO" will be spoken.

The counters are controlled by a 555 timer oscillating at 8 KHz (the same as the sampling frequency). The counters are initially cleared by an RC pull-up combination connected to the clear line(s) of the counters,

The MSB of the EPROM is controlled by a JK Flip flop (FF1) set up as a latch. Pressing the "YES" switch sets the flip flop, and pressing the "NO" switch clears it.

Pressing either the "YES" or "NO" switch causes AND1 to output a low which sets FF2. The "1" from FF2 is anded with the 555 timer output making the clock input to the counters an 8 KHz wave. The counters are now enabled to count. The outputs of the counters are routed to the address inputs of the EPROM.

The counters will continue to count until Al2 transitions from a high to a low (i.e. the outputs go from 1111111111111 to 0000000000000). A12 is connected to the clock input of FF3. At the 1 to 0 transition of A12, FF3 will change state, clocking F2 which then will send a zero to AND2, effectively disconnecting the counters from the 555 timer.

The eight outputs from the EPROM are fed into an AD558 Digital to Analog converter to convert the digital signal back into analog form. An LM386 is used to amplify this signal and drive a speaker.

The "Yes"-"No" talker costs approximately thirty-five dollars ($35) to build. It may be used by a people with a wide range of abilities. Its operation is extremely simple allowing even a moderately to severely retarded non-speaking person to use the device effectively.