CHAPTER 11

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"**Computer** Interaction Through Voice **Recognition**"

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INTRODUCTION

The focus of this design project is to develop a computer interaction through voice recognition system to help cerebral palsy patients in a database processing **working** environment. The **project is** accomplished by developing voice commands for the manipulation of input data. The design modeling approaches of this project are:

1) Develop a menu-driven program to manage an employer's payroll system which includes employee, customers, production codes,-and timecard data.
2) Apply voice recognition as a mode of computer interaction for the developed software for use by disabled persons.

The results from this design project indicated that a voice-driven system is a vital alternative to other data entry methods in a database processing environment where a handicapped individual is **abled** to effectively contribute.

SUMMARY OF IMPACT

A computer interaction through voice **recognition** component (figure 1) has been developed to aid cerebral palsy patients in a database processing working environment. The computer based payroll manaaement system not only provides the opportunity to collect timecard data through voice recognition, but has the added advantage of drastically reducing the time required to manage payroll by comparison to a **manual-**driven system. From the collection and storage of timecard data to the pay period summary, the process is automated.

Although most clients have very unique and individual limitations and many cannot perform simple tasks without the aid of adaptive devices, this project so far has provided two developmentally disabled with improved database educational experiences and real work opportunity. With proper training and voice inputs, many off-the self programs can be easily updated and

Figure 1: Computer interaction through voice component.

used by the cerebral palsy patients. This can create many types of jobs from the surrounding community that UCPSH was not able to obtain previously . It is truly an exciting experience to be able to train and observe a client mastering the skill of using a computer through voice alone. Finally, the experiences learned from the speech patterns of cerebral palsy clients can provide valuable information in advancing technologies concerned with input/output computer interactive systems through voice recognition.

TECHNICAL DESCRIPTION

The project consists of three developmental phases:

1) software development,
2) voice recognition system configuration; and,
3) train cerebral palsy patients.

The software application, written in Microsoft FORTRAN for the IBM PC, or compatible, is developed to automate the payroll management system of UCPSH. The program menu hierarchy is displayed in figure 2. Data is entered from the existing timecards and stored in the program database. From this information. the program will summarize a pay period for a given client.

The voice recognition system configuration used in this project required an IBM PC, XT and AT compatible and a **Vocalink** Model SRB-LC board of Interstate Voice Products. The SRB-LC voice system consists of an IBM PC short expansion card, microphone, and accompanying utility software. It allows users to control operation of application programs and system functions through spoken commands. The model utilizes speaker dependent recognition. This requires that each operator first train the system to his or her voice for each word or phrase in the vocabulary. Voice templates derived from the spoken words are stored in the system's memory and saved on diskettes for future use. Recognition occurs when incoming speech is matched against the previously recorded templates. The output of SRB-LC is passed onto the operating system as if the data were typed at the keyboard.

The quality of computer interaction is more intensely magnified when used by the disabled whose diminished capacity is often a limiting factor in their ability to communicate. During the training of a cerebral palsy patient to enter daily timecard, a slight modification had to be made in the program vocabulary. This is due to the client's difficulty in pronouncing certain words. In general, the problems encountered in training the cerebral palsy patients are minimal because their speech patterns are both unique and consistent despite the fact that the speech is often impaired. With several training sessions, it was observed that the operator, using the voice recognition program, input daily timecards much faster than the client using the head stylus which is the present mode of computer input for the disabled.

The entire computer interaction through voice recognition unit costs two-thousands four hundred dollars ($2,400) to set up. Different voice cards are tested to improve the present system. One important aspect of the project indicated that a design which takes into account the needs of the disabled can often produce a better application related technology for the 'average' person.

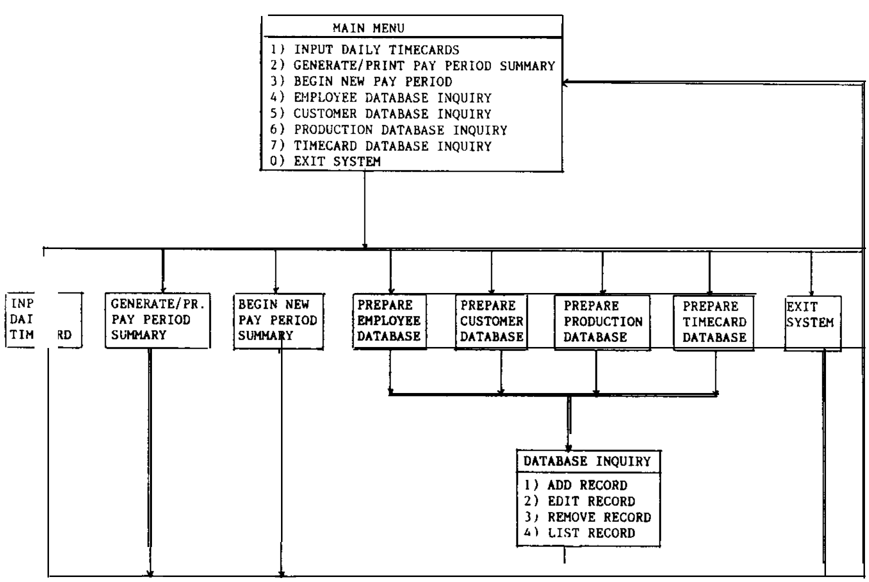

Figure 2: Program menu heirarchy.

"Card Reader"
An Adaptive Sorting Device for the Cerebral Palsy Patient

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INTRODUCTION

Voice recognition through computing systems is the process by which specific human speech patterns, such as spoken words or phrases, are understood by a computer. Being one of the most natural and effective methods of human interaction, speech offers distinct advantages over the more conventional methods of computer interaction. It does not require the use of the arms and hands as does the operation of a keyboard. In this aspect, it is ideally-suited for the cerebral palsy patient and the accessibility of the given system is increased. Since most of the cerebral palsy clients have no control of their voluntary muscles and in order to build a complete voice interaction computing system, a simplified card reader was designed to help sorting timecards in the database processing working environment. This will solidify the client's independent computer work station.

The device will be used by a cerebral palsy patient to transfer timecards, one at a time, for computer inwut wurwose. It is not cost effective and is difficult to find a sorter developed for the commercial market which is directly suitable for the cerebral palsy patient.

SUMMARY OF IMPACT

A simplied card sorter (figure 1) was designed to help a cerebral palsy patient in the database processing working environment. Before the development of the card reader, the client depended solely on the disabled coordinator to turn each daily timecard to input information. This process not only ties up the coordinator's time, the goal for the client to input fifteen timecards in the period of one hour with one hundred percent accuracy was not achieved.

Because of the development of the voice recognition payroll management program, the card sorter unit and the client's substantial progress, United Cerebral Palsy Center has sent the Pay Period Summary to Automatic Data Processing to print out the checks for the employees of the center. The total process can be handled independently by the cerebral palsy patient.

Figure 1: Simplified Card Sorter and Voice Recognition Unit

TECHNICAL DESCRIPTION

In order to build a card sorter, an aluminum tray apparatus where various sizes of timecards are transferred is first to be designed. The adjustable stone and urethane roller on the aluminum tray apparatus where the cards are transferred for reading purposes are the key devices that permit one card to be transferred at a time. A 1/10 horsepower, 60 rpm motor was used to drive the shaft of the card reader tray. For a 1/10, 60 rpm motor, the maximum torque of 8.75 ft-lb can be calculated from the equation:

$$T = 5252*hp/N$$

where, hp is the horsepower and N is the rpm. This satisfies the torque requirement since a 8.75 ft-lb torque will not be reached with this device. Also, it is necessary to use a low rpm motor so that timecards will be transferred slowly enough to be easily controlled by the client with a switch activating the mechanism.

Proper bushing, V-belt and pulley were selected to drive the shaft of the mechanism with the output shaft of the motor. The pulley and V-belt arrangement reduces the output speed of the 3/8 inch diameter shaft to about 20 rpm. Figure 2 shows the simple schematic of the entire mechanism when all put together. The aluminum tray is mounted on a wooden base, which is clamped to the patient's wheelchair. Also, the motor assembly is bolted to the computer table and remains stationary.

The entire sorter unit costs one-hundred twenty five dollars ($125) to build. The switch mechanism which starts the motor to drive the 5/8 inch diameter shaft is to be modified so that it can be activated by voice command.

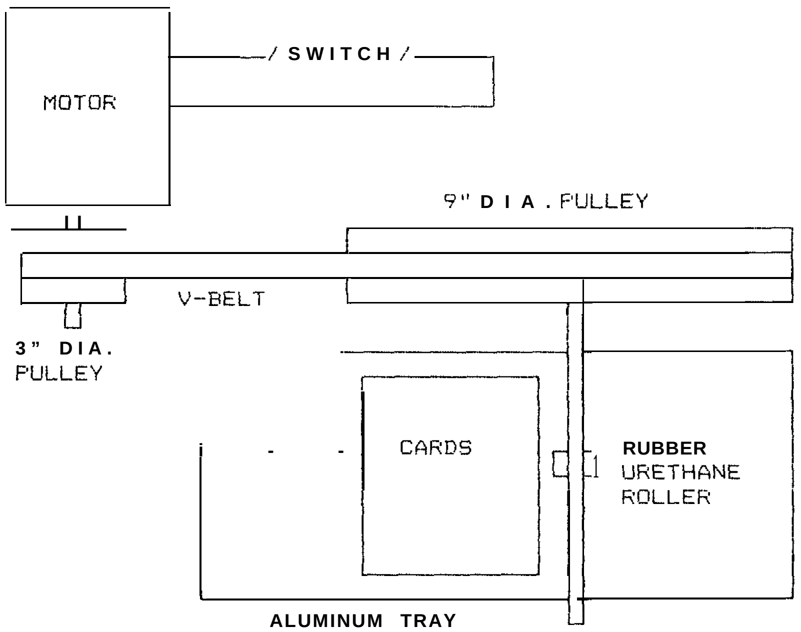

Figure 2: A schematic of the card sorter unit

"Silk Screen Fabric Stretcher"
An Adaptive Screen Printing Device for the
Cerebral Palsy Patient

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INTRODUCTION

Screen printing is a process during which ink ıs forced through screen mesh openings onto a transfer medium. The procedure is fairly simple and is used commercially for large runs of T-shirts, labels cardboard notices, and political advertisements. It is also used in the area of printing electronic circuit boards. One of the major activities of UCPSH of Akron is to provide cerebral palsy patients with sub-contract works of silkscreening and printinq. This type of activity helps the cerebral palsy patients to develop a positive self worth atitude which is just as important as developing their working skills. The major objective of this project is to design a fabric stretching machine used in screen printingq. This machine is necessary for stretching various sizes of screen fabric over wooden frames to achieve drumlike tension, which is difficult to do by hand. The design is to be simple enough so that it is useable by cerebral palsy patients.

SUMMARY OF IMPACT

The UCPSH Center of Akron provides cerebral palsy patients with a variety of work proqrams to promote community awareness as well-as developing independence for the handicapped. The printing of silkscreen T-shirts and labels are sub-contract works they received on a constant schedule. The fabric stretching machine (figure 1) was designed to improve productivity of the workshop.

Existing procedure requires that silk fabric be stretched by hand over a frame. This process is cumbersome and often leads to wrinkled fabric membrane. For some applications, synthetic fibers require a screen pressure of about 140 psi, which cannot be achieved by hand stretching. Also, stretching devices used by the UCPSH center consist of two separate frames, one was for the large screen printing and the other for the medium to small frames. The present fabric stretching machine desiȧn not only ẉermits adiustable frame sizes, it provides an even-fabric surface while simplifyinq the stretchinq method.

Early testing-of the fabric &retching machine has proved that it is easy to use with good tension results. The design is simple but quite effective, and the hardware used is readily available should repairs be necessary. Many cerebral palsy patients have used this device with satisfactory results.

TECHNICAL DESCRIPTION

The basic design criteria for this fabric stretching machine is that the fabric is to be stretched with even tension without tearing the material, which often occurred with the orevios desiqn. The device is a four-piece stretching frame, made with thick member pine wood, into which the screen printing frame is placed.

In order to grip the screen fabric evenly and reduce its tendency to slip during tensioning, each stretching frame member contains a circular groove into which a quarter inch metal rod encased in rubber tubinġ is ,placed. This allows the fabric to be easily set in place with the fibers parallel to the frame. With the fabric 'in place, the rubber encased rod placed into the groove holds the material while being clamped. The rubber tubing accounts for any surface irregularities and creates a good friction surface to grab the fabric fiber. The clampinq force is applied by using four bar linkage De-Sta-Co clamps that lock into position at adjustable settings. This makes for quick clamping without overtightening and damaging the wood.

To simplify the stretchinq process, two adjacent sides of the stretching frame are fixed and tensioning is accomplished by ẉullinġ the remainina free movina frame members. A free standing wooden-table (fiqure 2) holds the fabric stretching machine was designed to be integrated-as a work station.

For applying an even tension force along the moving frames, a steel cable is attached at both ends of the frame member with a pulley in between to self adjust so that equal tension is applied at each cable end. The cable is attached to a back plate of the frame with eyebolts. The tension force is transmitted through the threads of the bolt to the wooden frame by washers.

To pull the floating frames, the cable is attached to an angle iron that pivots about one end. By using the leverage of the bar, adequate force can easily be applied to tension the screen. A triangular block wedge is used to lock the stretcher while the material is being stapled. The wedaes can also be tapped with a mallet to increase screen tension if pullinq becomes too difficult. This desian can stretch a screen for frames up to 28x28 inches, which is in the range of screens commonly used.

There are many fabric stretching machines available on the market. The most elaborate machine consists of a rigid inner frame and a floating outer frame between which a rubber bladder exists. The screen is fastened to the outer frame and air pressure put into the bladder causing the outer frame to expand, insuring even tension throughout the screen. The wooden frame is then placed underneath the stretched frame and stapled. However, the price of this machine is in excess of one-thousand five hundred dollars ($1,500). The entire unit of our stretching machine costs less than three-hundred dollars to build. Detail construction of the stretching machine can be obtained from the principal investigator.

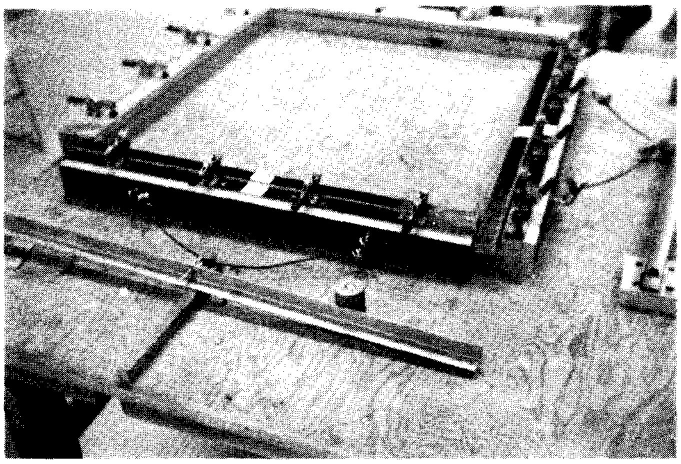

Figure 1: Fabric stretching device.

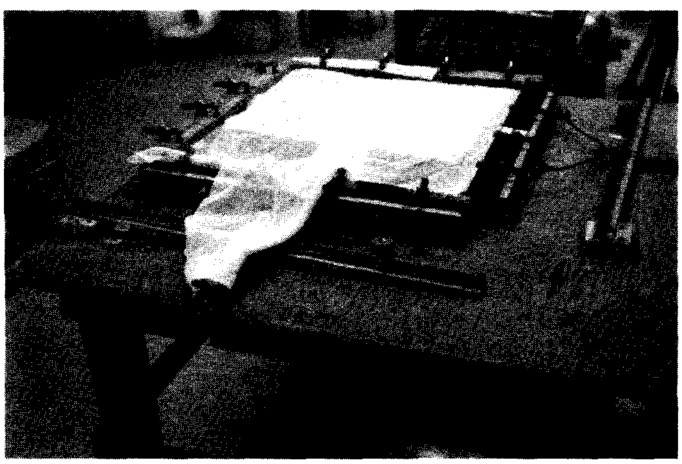

Figure 2: Screen printing work station.

"Mechanical Feeder"
Modifications of a Self Feeder Device for the Cerebral Palsy Patient

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INTRODUCTION

In this design, a mechanical feeder, owned by the UCPSH center, was to be modified to have an additional degree of motion. This additional degree of motion is to allow the spoon of the feeder to move forward towards the cerebral palsy patient after it had been raised from the plate with food. This modification is **necessarv** since several of the user's had difficulty leaning forward and reaching the spoon at its original position. **With** this modification, the goal is to extend the use of the feeder to many other individuals who previously could not use it because they lacked the balance to lean forward and reach the spoon.

In the design of the feeder, several factors were taken into consideration. The first concern is that the control of the additional mechanism has to be simple to manipulate because the users are assumed to have less than average manual dexterity and muscle coordination. Another consideration is that the forward movement of the spoon had to be as smooth as possible. This requirement is necessary to insure that food will remain on the spoon as it moves toward the user. The final consideration is to maximize the forward distance travelled by the spoon.

SUMMARY OF IMPACT

The mechanical feeder shown on figure 1 is modified to included an additional degree of motion so that the spoon can move forward toward the user. The additional mechanism was easy to implement and is cost effective. Cerebral palsy patients, who previously cannot use the mechanical feeder, are able to operate this modified adaptive device. Also several other patients are to be trained to use this mechanical feeder.

Figure 1: Modified mechanical feeder.

TECHNICAL DESCRIPTION

Initially, two basic designs were considered. The first of these modifications involved using a lever actuated rack and pinion configuration to move the spoon. This arrangement not only insures smooth forward motion of the spoon, it also allows the user to manipulate the feeder easily. One of the difficulties of this design is that the lack of space under the wooden base of the feeder will not permit a great deal of room for additional hardware to be installed without major modification. In addition, the plastic base of the spoon assembly must be reconstructed.

The second modification option involved attaching a handle assembly to the front of the plastic base of the spoon linkage, as well as mounting two pins to its bottom. A slot would then be cut through the wooden base of the feeder. These modifications would allow the spoon to move forward by pulling on the attached handle, being guided by the slot and pins. This design was selected as the mechanism to be added to the feeder because the component is very easy to implement and the user can control the feeder easily. Also, it was felt that any efforts required to overcome binding or friction problems were more than offset by the ease involved with the installation of the associated hardwares.

The conceptual drawing of the mechanical feeder is shown on figure 2. A 5.125 inch slot was first milled through the wooden base of the feeder. This slot was made so that it would be parallel to the direction of the spoon's motion. Two holes were then drilled and tapped into the plastic base of the spoon assembly. These holes were made so that they would line up with the slot in the wooden base of the feeder.

Two steel bushings, each having one flanged end, were inserted through the slot in the wooden base from the bottom. Bolts were then inserted through the bushings, and screwed into the holes made in the bottom of the spoon's assembly base. A sheet-metal bracket was next fabricated with a small wooden knob fastened to it. The bracket was mounted on the front of the spoon assembly base. This handle bracket provided a convenient way to move the spoon forward toward the user. With these modifications, it was found that the spoon could be moved forward slightly over three inches. Due to size limitations of the wooden base, this is the maximum distance which the spoon can travel.

Excluding machinist's time, the entire unit costs less than fifty dollars ($50) to build. Detail drawing of the modified mechanical feeder can be obtained from the principal investigator.

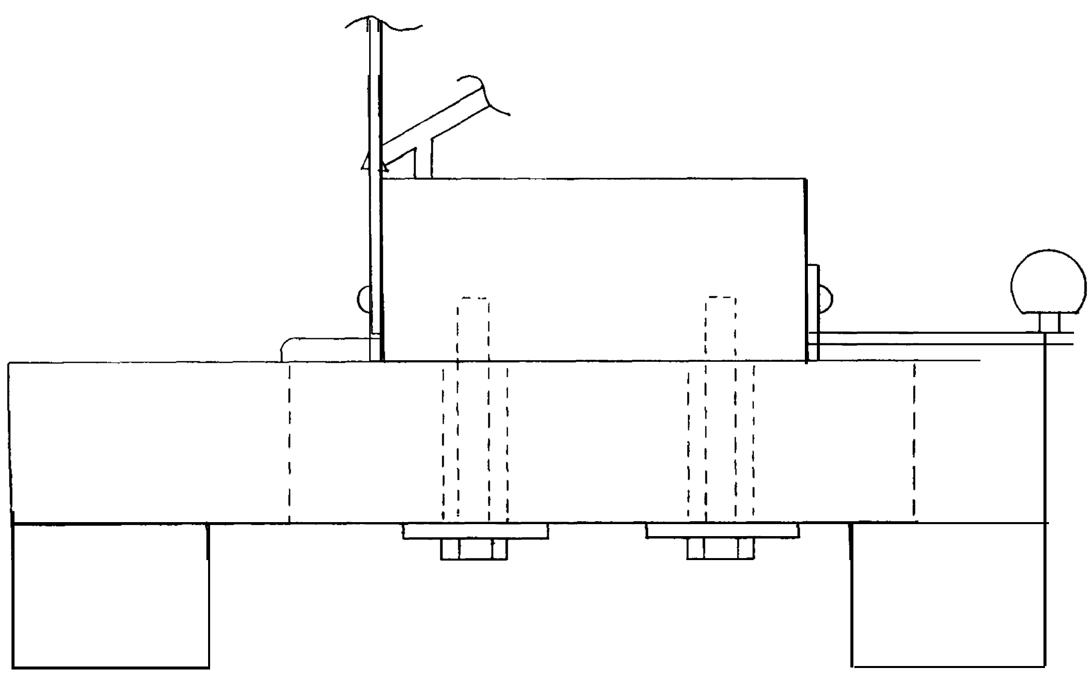

Figure 2: Conceptual drawing of the mechanical feeder.