CHAPTER 23
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UNIVERSALLY DESIGNED COMPUTER WORKSTATION

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Client Coordinator: Tonia Peterson, DELEG MRS-Business Network Unit/DM Program
Supervising Professors: Dr. Robert F. Erlandson, Dr. Donna Case
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INTRODUCTION

Our client, a young man aged 24, obtained a C4-C5 spinal cord injury in a motorcycle accident. He is a computer engineer and both he and his employer want him to continue to work from his home until he is able to return to his office. Michigan Rehabilitation Services provided him with an eye-gaze mouse control system and Dragon Dictate. Fig. 23.1 shows the original setup.

There are significant problems with the original set up. He cannot sit in his wheel chair for very long and he spends about 80% of his time reclined or in bed. This pattern of use will change over time as our client begins to recover. This means that someone has to reposition the computer monitor for each new position. This can cause problems because the eye movement mouse control system requires a nearly perpendicular eye gaze angle to the pickup camera. Also, he sits very high in his wheelchair and is relatively low when in bed or reclined. Consequently he has a very difficult time with the eye gaze system. He cannot work in another room. Therefore he is confined to his bedroom for long periods of time. He wants to be able to move the computer system to another room to work. This computer is also the shared home computer and therefore he requests a design that allows his children and wife be able to use.

SUMMARY OF IMPACT

The workstation has thus far satisfied all of the client's requirements. The combined adjustability of all the components enabled the client to very quickly gain control of the eye-gaze system and hence computer operations. Being able to adjust the top shelf height and pull out the keyboard enables the client's family members to access and use the

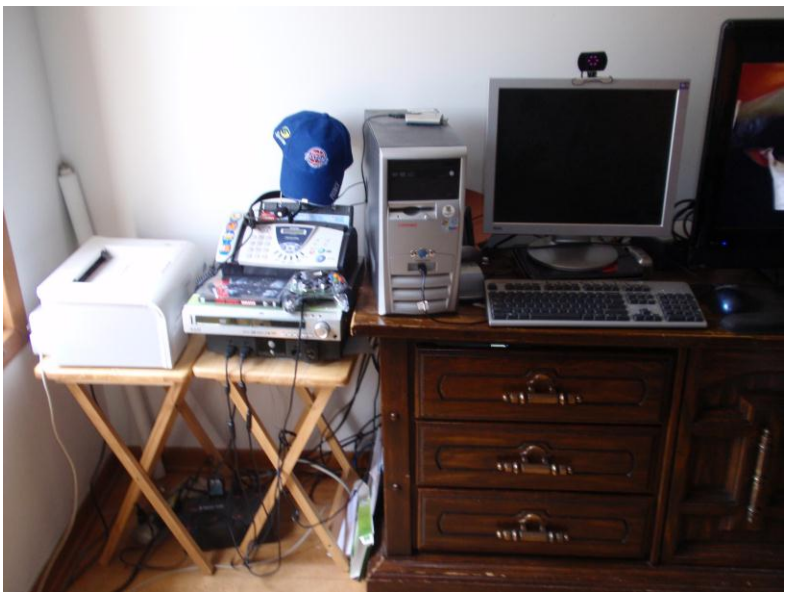

Fig. 23.1. The original setup in the client's bedroom.

computer. Being self-contained with one power cord and on casters, the workstation can be easily moved into other rooms of the house allowing the client to work outside his bedroom. By satisfying all these requirements the workstations exemplifies a universal design using agile systems technology (Creform).

TECHNICAL DESCRIPTION

Figure 23.3 shows the new workstation. The workstation frame is made from Creform, a pipe and joint technology. The cost of the workstation, monitor mount, power strip, plastic shelving, and retractable drawer assembly is approximately $1,920. Fig. 23.2 shows the monitor mount. It costs about $80.

The electronically controlled hydraulic lift system is the most expensive component, $789 of that total. The ability to easily and quickly adjust the height of the workstation is essential given the relative frequency of the client's working position and accessibility requirements for other family members, especially his children.

Fig. 23.2 The flexible mount for the computer monitor.

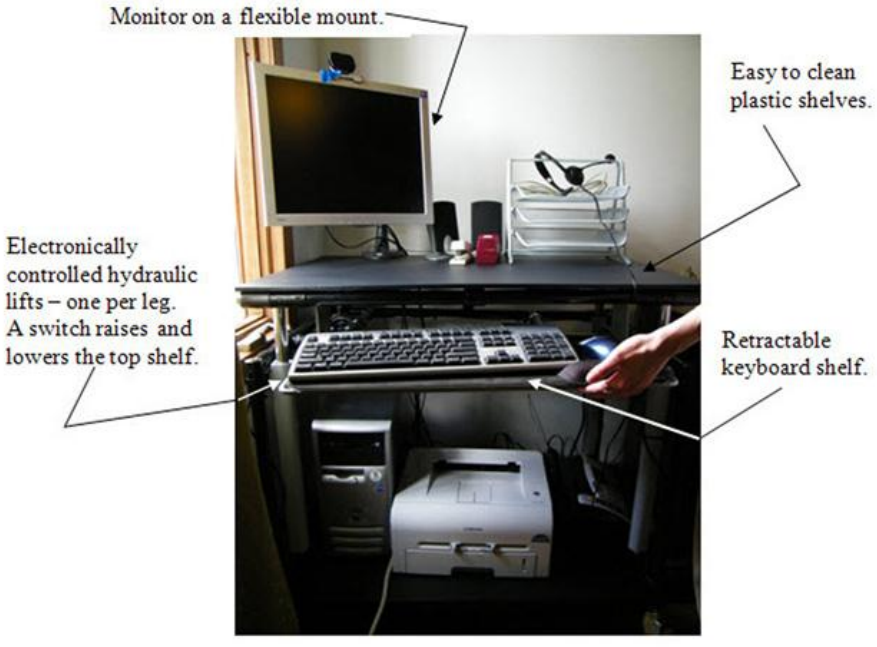

Fig. 23.3. The mobile adjustable computer station with casters.

ERROR PROOFING SYSTEM FOR PACKAGING

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Client Coordinator: Alan Talluto, Supervisor, Goodwill Industries of Greater Detroit
Supervising Instructors: Dr. Robert F. Erlandson, Santosh Kodimyala
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INTRODUCTION

Goodwill Industries of Greater Detroit (GIGD) has a spectrum of programs and services for individuals with disabilities. In particular GIGD has a strong automotive section which provides employment for a variety of jobs including the packaging of license plate installation kits. The majority of these kits contain 2-3 different parts, typically 2-4 plastic nuts, 2-4 metal bolts, and 2-4 metal rivets. The number and quantity of parts varies depending on the associated vehicle. These kit packaging jobs require anywhere from 200 to 2,000 kits per day with very strict quality control requirements.

This project designs and builds a prototype error-proofing system for the licensing plate installation kits. The original packaging process included a workstation with a heat seal plastic bagging capability. A worker would place a handful of nuts, bolts, and rivets on the workstation top and then count the required number of each sliding the parts to a funnel which directed the parts into a plastic bag. Stepping on a foot switch activated the bag sealing step and advanced the next bag. This process resulted in too many errors. The new system promises to reduce errors and improve productivity.

SUMMARY OF IMPACT

The prototype error proofing system functions very well. With this system the worker is relieved of the task of keeping count for each part. The worker only needs to concentrate on adding parts to each funnel until the LED corresponding to each funnel turns yellow. Each time a worker error causes an over count, a resettable electromechanical counter is incremented. This allows the supervisor to monitor worker performance. With the old system, workers stop when 100 bags are filled and visually inspect each bag. This is time consuming and still does not catch all the miscounts.

With the new system the workers are purposely slowed down in counting by the dispensing and channel configuration. However, the instrumented counting eliminates the necessity for a visual inspection after every 100 bags, thereby greatly increasing overall productivity and reducing errors.

Goodwill staff note design modifications that they believe will further enhance quality and productivity. Based on the prototype design Goodwill staff have started a bidding process to build between 10-15 error proofing systems

TECHNICAL DESCRIPTION

The prototype system is shown in Fig. 23.4. Three dispensing tubes, one each for nuts, bolts and rivets, present workers with inventory at the entrance to a channel. Each channel leads to a funnel which is instrumented with an infra-red sensor to count parts as they fall through to the plastic bag. A process controller can be programmed with the required part count for each channel. An indicator light on the dispensing tube is green until the correct number is counted and then turns yellow. It turns red if there is an over count.

CATIA software is used to design the funnels, the channels, workstation layout and wiring harness layout. Four funnels are designed; one for each channel and one large collection funnel dispensing into the plastic bag. Commercially available inexpensive plastic funnels and channels are used for prototype evaluations. The error proofing system is mounted on a Creform support that is designed to be disconnected from the bag sealer, thereby making it easy to perform required periodic maintenance on the bag sealer.

The process controller is realized by using standard CMOS 16 bit decimal and hexadecimal counters in conjunction with one-shot chips and comparators. The design of the circuit enables an accurate pulse

width detection to minimize and/or eliminate erroneous part counts. Setup of the device is easy – the count for each part is set by the use of one button per channel and one button to confirm all the three set values. The set values are retained even when the power is turned off. When the correct number of parts has been dropped through the funnels into the bag, an LED indicates that the foot pedal connected to the sealer can be pushed to engage the bag sealer. An under or over count will prevent the sealing of the bag.

Fig. 23.4. The completed prototype of the error-proofing system.

RFID TAG "DEBIT" SYSTEM

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INTRODUCTION

Visions Unlimited is a post-secondary educational program operated by Farmington Public Schools. The school serves 18 through 26-year-old young adults with developmental and physical disabilities. The school day focuses on developing transitional skills from school to work. Emphasis is given on improving the students' life and work skills. Through classroom and community-based instruction, these goals are achieved. Vision Unlimited uses Positive Behavioral Support (PBS) principles. The staff wanted a system consistent with PBS strategies that would enable their students to gain experience with a "debit" card like process that uses a point system rather than money.

Students earn points as a "reward" for designated behaviors such as successful completion of jobs and appropriate behavior. Students can then "spend" their points at the school department store. The debit cards are passive RFID tag cards in the form of a plastic debit card. The schools PBS logo, a bulldog named Buddy is printed on the front of the card. The RFID card has limited read/write memory for holding a student's name, school ID number, and the current point count in the student's account.

Each homeroom has an RF Reader connected via a USB cable to the associated staff's computer. Only the staff can add or remove points from the students' debit cards.

All the computers are networked to a central server which contains the student account database. Figure 23.6 shows an RF Reader and debit card. The student account database contains a detailed record of all student transactions. A report of student transactions can be generated and printed by staff as required.

Transaction information includes a coded description of the transaction. Transaction descriptions include; job completed on time,

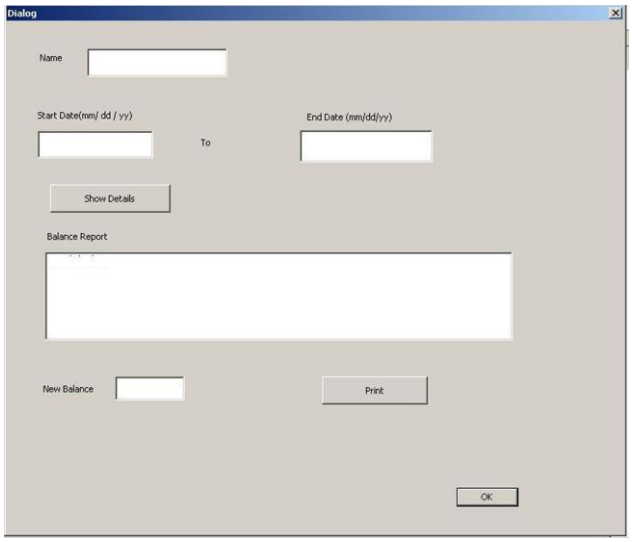

Fig. 23.5. The report generation screen.

reported to workstation on time, bought Milky Way candy bar at the school store, etc. The level of transaction detail is determined by the staff and any IEP (individualized education plan) student performance tracking requirements.

SUMMARY OF IMPACT

The system has just been installed and is not fully operational. After the installation, the staff requested some program modifications and additional features. Modifications will be made to the system during the summer and the system is planned to be operational by the beginning of the new school year. The initial reactions by both staff and students have been very positive.

TECHNICAL DESCRIPTION

The system uses a 13.56 MHz RFID Tag with at least 32 Bytes of user (R/W) memory. The project provides 200 printed RFID tags but at some point in the future the school will need to purchase additional RFID tags. The system's software is

written in Visual C++ dot Net. The drivers for the RFID reader are provided by the manufacturer as a library file. This library file is compatible with the Microsoft visual studio .Net IDE.

The program consists of three major sections; 1) RFID reader communication, 2) database communication, and 3) the user interface. Sufficient error handling is incorporated into the program. The program uses an MS Access 2000 database with several tables. These tables store tag information, points accrued or spent by students, and also purchase history. The database is stored on a shared drive on a server accessible by the desktop PCs used by the staff. Each desktop PC is secured by a username and password. Since the database is on a shared drive, communication between the desktop PC and the database is simplified and is accomplished using an absolute path to the database. In the application code, the database is accessed using the standard DAO control and the tables are read and written to whenever there is a debit card transaction. In the case of a lost tag, a new tag can be added to the system and associated with the previous tag thereby maintaining the points earned by the student.

The user interface is very simple and intuitive. There are four functional control screens; 1) adding or deleting a student, 2) creating a report, 3) adding or deleting a transaction, 4) an information screen for the students showing the student's name and current points. When a tag is to be assigned to a new student, it is read and is shown as read only and is populated by the RFID reader. The name and current points for the student are entered and stored in the database as a new entry. Figure 23.5 shows the report creation screen and illustrates the screen design.

The RF tag readers cost about $100 each and the tags cost about $1.00 each.

Fig. 23.6. The passive FID tag and the RF reader which connects to a PC via a USB cable.