CHAPTER 18

WRIGHT STATE UNIVERSITY
COLLEGE OF ENGINEERING AND COMPUTER SCIENCE
DEPARTMENT OF BIOMEDICAL AND HUMAN FACTORS ENGINEERING
DAYTON, OHIO 45435

Principal Investigators:

Chandler A. Phillips (513) 873-3302

Blair A. Rowley (513) 873-3302

"Motorized Slant Board"

Designer: Carol Brunsman
Handicapped Coordinator: Peter Lanasa, Gorman Public School
Supervising Professor: Dr. Blair Rowley
Department of Biomedical and Human Factors Engineering
Wright State University
Dayton, OH 45435

INTRODUCTION

The motorized slant board is a tray that supports various keyboard and communication devices at many different angles. The angle of the board is controlled by a motor that is user-activated by a switch. In this way, the angle of the slant board can be adjusted so that the student can most easily see the monitor and keyboard without the need to change his position.

The device will be used by a student with athetoid cerebral palsy for keyboard activities.

SUMMARY OF IMPACT

A student who is affected by athetoid cerebral palsy has difficulty using a computer keyboard and other such devices due to a visual impairment that prevents him from accurately seeing narrowly defined areas on a flat surface. This inhibits his ability to press keys. Presently, he has to change positions to see the monitor, then the keyboard, and then to press the key. The student would be more efficient in keyboard activities and more academically productive if this problem was solved. The board was designed in close communication with the occupational therapist and teacher of the student, so that the board will best fit the needs of the student and school.

TECHNICAL DESCRIPTION

A slant board has been designed to stabilize a number of keyboard devices or books of many sizes. This slant board is adjustable to several angles by a motor controlled switch accessible to someone with a disability. The board also has a system to anchor it in one place on the workstation. The board is of suitable size to be used in various work places.

The design work and electrical assembly were done in the laboratory provided at Wright State University and at the home of the designer. The box and parts were fabricated and assembled by Tri-State Engineering in Cincinnati, Ohio. The criteria for an acceptable solution was a simple, inexpensive, easily implementable design that meets all specifications as developed by the teacher, occupational therapist and designer.

After the design specifications were developed and the state of the art was examined, the design work began. This design involves six basic systems, including: the box, a keyboard stabilization system, a system for stabilizing the box on a table, a tilt mechanism, a limit switching system, and the electrical system. The box size was determined by the places it would be used and the uses it. would have. The keyboard is supported on the lid of the box in two ways. First, a fiddle is attached at the bottom of the lid. Then, Velcro strips will be placed on the surface of the lid. The keyboards and communication devices that will be used with this slant board will have Velcro attached to the bottom. This will prevent the student from accidentally knocking the keyboard off the slant board. The tilt mechanism uses an AC reversible motor to turn a screw. The next system to be examined is the limit switching. A switch bar on the end of the pillow block hits the oval plate of the switching mechanism which opens or closes a lever switch that determines the direction of the motor. The final system of the device is the electrical system. When the user closes his switch, the motor has power and turns in the direction specified by the switch. Two covers have been added to the inside of the box to cover the electrical equipment. This is to prevent someone from receiving a shock by accidentally touching some of the electrical parts.

The motorized slant board cost six hundred dollars ($600) to build. Since the device has an adapter to connect to any of various accessible switches at the Gorman School, it. can be used by many students. We would like to thank the National Science Foundation for partially supporting this design project.

"Switch Controlled Page Turner"

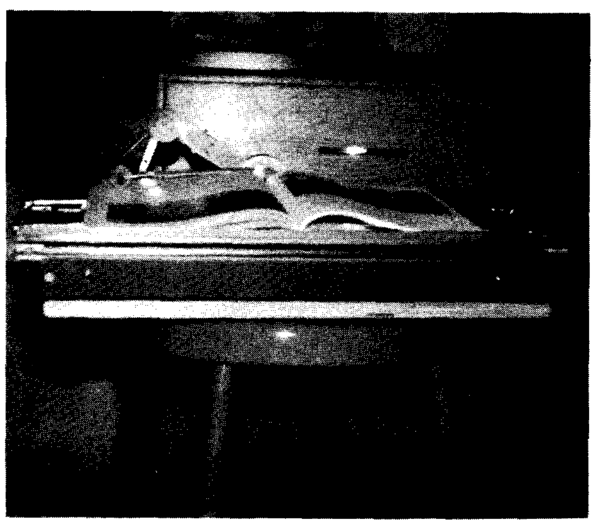
Designer: Angela Obert
Handicapped Coordinator: Peter Lanasa, Gorman Public School
Supervising Professor: Dr. Blair Rowley
Department of Biomedical and Human Factors Engineering
Wright. State University
Dayton, OH 45435

INTRODUCTION

The switch controlled page turner has the capability of turning the pages of a book one at. a time in the forward direction. The student controls when the page is turned by closing a switch. The device stabilizes various sized books at several angles and also turns one page at a time. The angle can be manually adjusted by an attendant. Another way of changing the angle would be to have a motorized slant board that would be activated by the user closing a switch. This project was to make improvements on the page turner that was supplied by Gorman School.

SUMMARY OF IMPACT

This project was designed for individuals who have limited arm and hand control due to any physical handicap which hinders their ability to hold and turn the pages of a book. Since the user no longer needs the assistance of an attendant to hold and turn the pages of a book, the user will become more independent. This device also allows the attendant to help others more effectively. This device is designed to be used with various switches so that it can help any individual who has limited arm and hand coordination.



TECHNICAL DESCRIPTION

This project was to make improvements on the page turner that was supplied by Gorman School. The improvements that were addressed in this project were: 1) to stabilize books of various sizes better than devices on the market, 2) to set the device at various angles rather than two different angles, 3) to reduce the AC voltage out to the user switch, 4) to make the device switch independent, -and 5) to make the device turn the pages of a book reliably.

I used a tracking system in which four stabilizers and a bottom book brace can easily glide so they can be set for various sized books. A test was run to determine if the color of the page turner was reasonable. To find this out, I talked with Dr. Caccioppo, a Human Factors professor. He checked the reflectivity of the surface and found that it was 94 - 108 lux. This, he said, was a reasonable range of reflectivity. The noise level of the page turner seemed to be a problem. Again, I went to talk with Dr. Caccioppo. First, he measured the noise level of a relatively quiet environment and found the measurement to be 55 dB_A. Then he measured the noise level with the page turner on. The dB level only increased to 58 dB_A. Therefore, the problem is the frequency of the "hum" and the noise level. The frequency is 60 Hz which is due to the normal hystersis of the motor. Therefore, no improvement on the noise level of the page turner was needed. To make the device switch independent, a jack that can be used with various switches (which Gorman School uses) was installed in the device.

Each book was tested with the device to see if it could accomplish the following specifications. 1) The device had to turn pages reliably, one page at a time, when the switch was activated. 2) The device had to hold the books so that the pages did not flip on their own when the book was set on the slant board at various angles. 3) The device had to work with several switches that had 1/8 inch plugs. 4) The noise level of the device had to be minimal. 5) The page turner had to be operated by ordinary house current which was grounded. The result of the testing was that the device was able to meet all of the specifications.

The switch controlled page turner cost six hundred dollars ($600) to improve. This device can be connected with any switches currently in use at the Gorman School. We would like to thank the National Science Foundation for partially supporting this design project.

"Communicat ion Hoard"

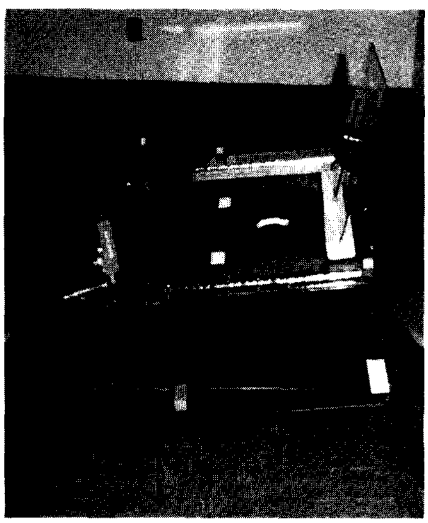
Designer: Kelly Doyle
Handicapped Coordin3tor: Bonnie Wilson, Fairacre School
Supervising Professor: Dr. Chandler Phillips
Department of Biomedical and tluma n Factor sEngineering
Wright State University
Dayton, OH 45435

INTRODUCT 1 ON

This project involved the custom design and construction of a communication board for a student at Fairacre School. The board had to meet several specifications. It was to be incorpo rated with or easily attached to the student's wheelchair tray so as not to limit working space or obstruct vision. The board contains a buzzer and a dial which are each activated by the student's elbow. With the activation of the switch. the dial is turned in a circular fashion pointing at various pictures of items the subject may want. to choose. For example, the picture may be of a toy the subject likes, food, clothes, a diaper, or people. The huzzer is activated in some manner by the subject indicating that she needs help or wants to communicate.

SUMMARY OF IMPACT

The communicat inn board was designed for a twelve year old girl who attends Fairacre School. The student is diagnosed with cerebral palsy and is nonverbal and nonambulatory. However, the student is able to move her arms to activate a switch through pressure applied by the elbow. Present ly, when a choice is given to the student, it is automatically decided by another person since the subject cannot communicate with others. The board will enable the student to communicate much more quickly and efficiently. With this improved communication ability, the student will be able to control choices which are made for her. As a result, her educational level will vastly increase.



TECHNICAL DESCRIPTION

There were several problems that had to be solved since the board was custom made for the subject taking into account all of her physical disabilities. The dial had to rotate slowly and contain an arrow that is easily seen. This enables better tracking of the dial and takes into consideration the subjects reaction time. The elbow switch had to be designed and adjusted so that it is easily accessible and meets the muscular characteristics of the subject. A way to activate the buzzer had to be found. Finally, the manner in which the board is attached to or incorporated with the wheelchair tray had to be determined.

There are several communication systems that exist on the market. However, none of them can be used directly by the subject without modification due to her specific handicap. There are existing devices that relate to certain parts of my design. I decided to purchase these existing devices and modify them for use in the project. After these devices were purchased, they had to be mounted to the wheelchair tray. It was determined to attach two elbow switches to the tray with L brackets that can be moved in three planes. The Chime Alarm and Dial Scan battery box were mounted underneath the tray with a very strong Velcro called Dual Lock. The face of the Dial Scan is mounted in a slot of a block of wood which is attached with Dual Lock to the tray.

The entire device was made easily transportable by cutting a hole in the tray so that the face of the Dial Scan will lay flat on the tray when removed from the block of wood. Two clear polycarbonate coverings were hinged to the sides of the tray. When the Dial Scan is not in use. the coverings are closed and a flat useful surface is available to the subject.

Once the method for mounting the devices and making the project easily transportable was determined, the project was constructed at Hamilton Health Aid Services.

The cost of this communication board was one thousand two hundred fifty dollars ($1,250). We wish to thank the National Science Foundation for partially supporting this design project.

"Youth Lift Chair"

Designer: Jinous Vafaie
Handicapped Coordinator: Peter Lanasa, Gorman Public School
Supervising Professor: Dr. David Reynolds
Department. of Biomedical and Human Factors Engineering
Wright State University
Dayton, OH 45435

INTRODUCTION

The objective of this design is a youth seat which aids the student in standing up so that minimal motor skill or energy is expended. The method of solving the problem involves a lift chair which operates with the use of a very slow speed (geared down) motor under the chair that is connected to a shaft (under the seat). The seat is hinged in the front so that with the use of the motor it can raise to the angle that is desired. Activation by an overlarge switch will slowly move the seat up or down to the desired position.

SUMMARY OF IMPACT

The student has Duchenne's muscular dystrophy. which is a progressive muscular disorder that can make transitional move-- ments (i.e., coming from sitting to standing) difficult and fatiguing. Puchenne 's muscular dystrophy is characterized by weakness of the affected muscles. The youth lift chair is designed so that the student will need less strength to change positions from sitting to standing. This will make changing positions easier for the student and will allow him to save some energy for other activities.

TECHNICAL DESCRIPTION

To solve this problem, I have designed a youth seat that aids the patient in standing up so that minimal motor skill or energy is expended. The method of solving the problem involved a lift chair which operates with the use of a very slow speed (geared down) motor under the chair that is connected to a shaft (under the seat).

A regular chair was bought and a wooden base was placed under the seat. The bolt used in hinging the seat was placed under the seat such that the subject would not be pinched. A three way switch was used (placed on one of the arm rests of the chair) so that the subject could go from sitting to standing and also vice versa. The shaft had an 8" rise; and the shaft and motor had to be placed no more than 8" from the hinge point.

The motor used was type U62 Fasco Industries, Inc. It had the following specifications: volt: 115; Hz: 60: amp: 2.7; 3200 rpm. A capacitor (PSU3630) was also used and set up as specified on the motor.

The chair is now being painted at the machine shop and is ready to be given to the student at Gorman School.

The youth lift chair cost six hundred dollars ($600) to build. We wish to thank the National Science Foundation for partially supporting this project.

"Supportive Floor Seating"

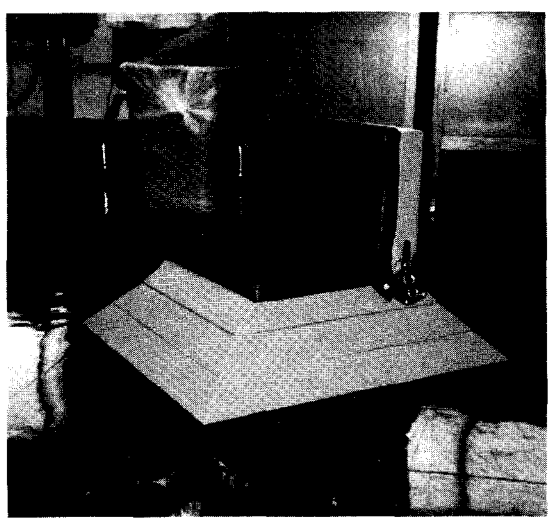
Designer: Vera Osidach
Handicapped Coordinator: Peter Lanasa, Gorman Public School
Supervising Professor: Dr. Chandler Phillips
Department of Biomedical and Human Factors Engineering
Wright State University
Dayton, OH 45435

INTRODUCTION

This supportive floor seating unit was designed to meet the needs of a child who could not sit comfortably upon the floor. The child was observed at Gorman School with and without the aid of an assistant. Without an individual behind for support, the child would roll backwards onto his back. It was decided that a small, lightweight chair could be designed to assist the child. The chair would provide back support and also allow for variation in height from the floor, thus easing pain in tight leg muscles. The presence of this unit would allow the assistant more time to provide for other children and thereby increase productivity and efficiency. The unit would be lightweight enough to be portable, yet heavy enough to provide stability.

SUMMARY OF IMPACT

This project was individualized for one particular child who demonstrated a need for assistance in everyday school activities. The child was unable to support himself when seated upon the floor during playtime. An assistant was constantly required to sit behind him and provide back support. In addition, the child could not remain seated on the floor for any amount of time due to the occurrence of pain in his spastic hamstrings. Furthermore, when exited, the student flexed his leg muscles resulting in a force being exerted on the floor. Due to this extra energy. the seating unit would be designed to avoid any possible tipping when the child became excited. Ultimately, the seating unit would enable the child to participate normally during playtime. He would be able to reach out and move about, but mostly to remain seated comfortably on the floor.



TECHNICAL DESCRIPTION

TECHNICAL REPORT: The problem of the child's inability to sit comfortably upon the floor had to be solved. It was proposed that the device meet the following requirements: 1) comfort, 2) ease of adjustment, 3) back support (variation in tilt angle), 4) variation in height from floor, 5) stability, and 6) portability. Some features which needed to be considered while designing the unit were: a) the type of cushions needed: b) the type of head support required: and c) the type of back support desired.

Several ideas were developed, including an inflatable unit and a motorized unit, but the most cost-efficient device was determined to be constructed of wood with a manual adjustment device. Several manual adjustment devices were considered utilizing various materials, such as metals, plastics, and leathers. However, the most compact and easiest method was the addition of separate units when height adjustment was desired. The final design schematic consisted of a wooden body, a metal back adjustment mechanism, a safety belt, and one inch of hospital type foam padding on the backrest and seat.

To avoid any possible tipping of the unit, it was determined that the base should be angled so that it would be improbable that any movement by the child would provide a moment about any edge of the chair. Calculations were done for the chair without having an angled base and then on the chair with an angled base. The angle of the base was determined with a safety margin of three. It was also determined that the angle of the base along the back of the unit should be the same as the angles on the other sides to avoid tipping when the backrest is completely reclined.

After the wooden units were made but before they were padded or painted, the metal adjustment mechanism was attached; and the unit was taken to Gorman School for an initial trial with the child. The seat fit him quite well and promised minimal adjustments to the final product at a later date. It was at this time that the child stated that he wanted his seat painted green. He specifically chose a particularly attractive shade of emerald green and, therefore, the unit was painted green!

After all components of the product were completed (padding, painting, chrome-plating of the metal parts, attachment of the seatbelt), a final trial was done. The final trial went quite well; so well, in fact that no additional adjustments were required. The student was very happy with his seat and especially the color.

The total cost of the supportive floor seating unit was nine hundred fifty dollars ($950). We wish to thank the National Science Foundation for partially supporting this project.

"Walker Communication Table"

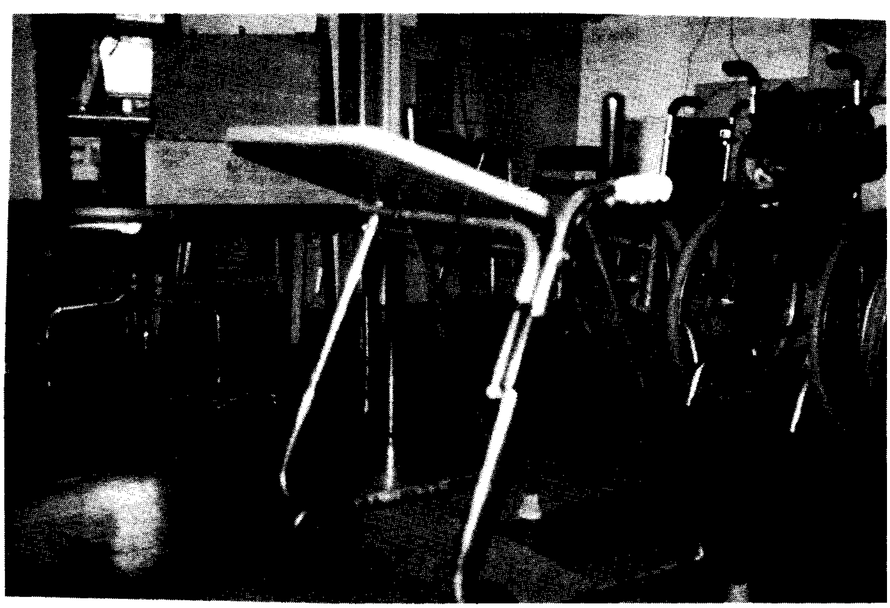
Designer: Dave Cartmell
Handicapped Coordinator: Peter Lanasa, Gorman Public School
Supervising Professor: Dr. Chandler Phillips
Department of Biomedical and Human Factors Engineering
Wright. State University
Dayton, OH 45435

INTRODUCTION

This project. is a device that., when mounted to a walker, will allow the versatility of making a speech communicator possible. The assistive communication device was provided by Gorman School. The project culminated in the design of a walker communication table. This table is a version of an assisted walker with a table attached which supports the communication device. Thus, the walker communication table allows for greater mobility for a speech impaired student.

SUMMARY OF IMPACT

This project was designed for a student. at. Gorman School who was unable to communicate through speech. He used an assistive speech communicator that improved his relations with others. The student also required the aid of a walker . However, he was unable to use the speech communicator and the walker at the same time. The walker communication table allows him to communicate when he is mobile. This greatly increases his opportunities to communicate with other students or with the staff at his school.



TECHNICAL DESCRIPTION

This project is a device that. when mounted to a walker, will allow the versatility of making a speech communicator portable. Development of the project was initiated by visiting Gorman School where the assisting walker device was kept. A teacher demonstrated the mechanics of the walker and the communication aid called the "Wolf". The Wolf is a device that allows a speech impaired individual to communicate via a touch sensitive keypad and synthesized voice command.

The goals of the design were to assure static equilibrium and maintain all characteristics of the original walker.. These include light weight, ease of entry, and movability. With these specifications, a design was to be conceived and built to apply to the walker. After reviewing the known information and specifications, drawings and engineering methods were developed to apply to the project design. All ideas and concerns were discussed with Dr. Phillips for his input and approval.

The point of application of the device was the first decision that had to be made. It was chosen that the horizontal bar on the front of the walker would be used. After making this decision, it was necessary to design a component that would attach to this bar and provide a foundation for the rest of the design to be built upon. This component, termed "tube clamp," was developed by making rough sketches and then submitting 3-view, dimensioned drawings in the machine shop.

The next component to be designed was a horizontal tube that would attach to the communication table, allow for height ad justability, and permit the table to swing away from the walker entrance. This was also performed in the same manner as the tube clamp. The communication table and the clamps that attach it to the tube were easily designed after the above components were completed.

This project required seven hundred dollars ($700) to complete. We wish to thank the National Science Foundation for partially supporting this project.

"Wheelchair Lap Board"

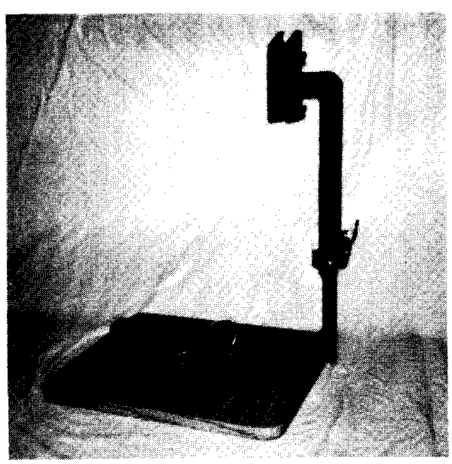
Designer: Amar Hamad
Handicapped Coordinator: Peter Lanasa, Gorman Public School
Supervising Professor: Dr. Chandler Phillips
Department of Binmedical and Human Factors Engineering
Wright State University
Dayton. OH 45435

INTRODUCTION

A student at. Gorman School likes to use his wheelchair independently with almost no help from others. This student needed a lap board to he installed on the wheelchair to carry a small communication device called "WOLF". The wheelchair lap board is a new lap board which holds the communication device and allows the student to move the wheelchair by himself. The new lapboard does not have to be removed to move the wheelchair. Also, the new desiyn is adjustable in any direction to make it easier to use and more efficient.

SUMMARY OF IMPACT

Currently, the student has an over-sized lap board which makes it difficult for him to use the wheelchair properly. If the student wants to move the wheelchair by himself, he must. remove the lap board. Doing so also requires that the communication device be removed, and the student cannot communicate with others. So, it is either to move the wheelchair and nor communicate or to communicate and not move the wheelchair. The new lap board enables the student to be more functionally independent since he can move and communicate at the same time. Since he is able to do more without the aid of an attendant, the attendants can focus more time on other students.



TECHNICAL DESCRIPTION:

Quarter (1): I chose one of the problems presented by Dr. Phillips to be my senior design project. I read the problem carefully and I started to think how am I going to approach that problem. Then I got an idea about how to design this project and the next step was to put that design on paper and try to visualize it. I also estimated what the cost would be to build it and how much time it should take to finish it completely. Then a proposal was written to get it approved by the Bio-Medical Engineering Faculty with all drawings and details I got at that time.

Quarter (2): The project got approved by the Bio-Medical Engineering Faculty. Then I had to make some changes on the design, like what shape and kind of pipes are best to use. These changes were made to lower the cost of implementing the design by ordering standard parts and avoiding any special orders. Then an Eleven Hundred form was filled out and signed by Dr. Phillips to order the parts needed through the Instrument Shop of the University.

Quarter (3): The parts were in stock by the beginning of the quarter and ready for work. We first took some measurements on the wheelchair to start building up the design in the Instrument Shop. After the design was almost completed, we did the first testing on the wheelchair. A problem came out, where the design should be hooked to the wheelchair, due to a small inaccurate measurement. So we had to go back and correct it, and it was ready by the next week. A second testing was done to see how the modifications were going to work. Fortunately, it worked fine, and then we had to take it back for final touches and polishing and painting it with the same color of the wheelchair. The last thing to do was to take some pictures for the records of the Instrument Shop, Dr. Phillips' final report, and some slides for the presentation.

The cost of the wheelchair lap board was seven hundred dollars ($700). We wish to thank the National Science Foundation for partially supporting this project.

"Hydrocephalic Head Support Device"

Designer: M. Al-Matri
Handicapped Coordinator: Bonnie Wilson, Fairacre School
Supervising Professor: Dr. Chandler Phillips
Department of Riomedical and Human Factors Engineering
Wright State University
Dayton, OH 45435

INTRODUCTION

This project was designed for a student with hydrocephalus and who needed head support. There are currently two different kinds of devices commercially available for hydrocephalus patients. One is a pillow type device that is placed under the patient's chin and around his/her neck. This device was found to cause difficulty in eating and breathing for this particular student. The student was using a "Molholland Positioning System" (MPS) which is designed to control the development of orthopedic deformities and enhance distal control. The MPS is designed with a head support which supports the head and upper body at 120 degrees from vertical. We wished to design a headrest to hold the head/upper body at 90 degrees from vertical.

SUMMARY OF IMPACT

This device was designed for a student who has hydrocephalus and sits in a wheelchair with his head supported by a halo/headrest device attached to the wheelchair. The halo/headrest is not well fitted to the student and thus required J redesign to provide a better fit. The new design enabled the student to be more comfortable and to be seated in a clinically designated position. Providing greater comfort will allow the student to interact more in the activities of his home and school.

TECHNICAL DESCRIPTION

Our project had the following designs :

(1) To prevent the irritation, we used one layer of foam, another layer of padding on the top of it, then both covered with a third layer of 'canvas' cloth, and all covered with a soft 'shearking fur' which will protect the specification of this device, as shown in figure (2).

(2) The halo has a knob-lock, which makes it impossible to unlock without a supervisor.

(3) Using the same kind of batting for the halo system, and changing its position from the one shown in the picture to be parallel with his/her forehead, will prevent the patient's head from sliding through the halo, and a new design has been added to the halo, where the halo will be flexible for enlargement to meet the patient's growth and development.

(4) Widening the upper neckrest's pad and placing it at the right angle (parallel to the back growth of his/her head) will minimize the irritation, design it to be adjustable several directions in order to maintain the long term support, and to insure the comfort of the patient.

(5) Widening the lower neckrest's pad, using the same batting, and the same adjustable ranges, will increase the stability of our device.

The cost of the redesign was seven hundred dollars ($700). We wish to thank the National Science Foundation for partially supporting this project.


S. VALENTA