
CHAPTER 18

UNIVERSITY OF FLORIDA

College of Engineering

Department of Aerospace Engineering, Mechanics, and Engineering Science

Gainesville, Florida 32611-2031

Principal Investigator:

Robert J. Hirko (904) 392-0961

A Visual Assessment Program and Video Game for a Cerebral Palsy Patient

Designer: *Nasim Zahran*

Disabled Coordinator: *Art Wallen*

J. Hillis Miller Health Center

Supervising Professor: *Dr. Robert J. Hirko*

Aerospace Engineering, Mechanics, and Engineering Science

Gainesville, FL. 32611

INTRODUCTION

Visual Assessment Programming (VAP) is a tool that is intended to perform several functions. It directly allows for the testing of eyesight, light/dark discriminations, and the identification rate of geometric objects. In another mode it permits the user to be entertained by a simple track and follow game while vision and skills are being evaluated. The VAP system is based on a PCjr computer with color monitor, and BASIC programming. This project was designed to help a specific young man with cerebral palsy. His specific visual sensitivities were not known, and it was thought that interaction with others could be improved through a visual modality. However, assessment of his current capabilities needed to be done. It was decided that a computer and video display was the best approach since he showed some interest in these and would be likely to concentrate on them.

SUMMARY OF IMPACT

Mr. Jeffrey Jordan is a 25 year old man who has severe visual and physical impairments, and scores within the moderately impaired range of functioning on standardized intellectual assessment devices secondary to his sensory and motoric disabilities. His vision has been described as severely impaired with sufficient residual acuity to assist him in functionally operating his joystick-controlled motorized wheelchair within familiar contexts. Jeff's physical impairments result from spastic quadriplegia and are manifest in his non-ambulatory status, severe contractures of his extremities, limited functional movement of his hands, and restricted vocal articulation skills. Along intellectual dimensions, Jeff's score was significantly affected by his physical and sensory impairments and are only a minimal estimate of his cognitive potential, as he demonstrates strong learning characteristics when discriminations are set up through auditory, tactile, and olfactory routes.

He has exceptionally good social and problem-solving skills, and can understand most of the everyday conversational speech spoken in his presence.

Of considerable import at this juncture of his habilitative process is the development of vocational skills that enable him to enter either sheltered or competitive employment on at least a partial participation basis. In order for this to occur more readily, Jeff would benefit greatly from technologies that promote development of his residual vision. The Visual Assessment Programming curriculum is specifically designed to assist a user with Jeff's type of disabilities to undergo training with computer assisted curricula that are programmed to refine and extend his ability to functionally access his visual learning modality while prosthetizing his access to keyboard control through use of a joystick. The specific programs that have been written include shape and color conditional discrimination training, visual discrimination training of shapes and colors, and delayed matching-to-sample across modalities (visual to verbal). This type of training can lead to enhanced visual scanning skills, development of concise figure-ground configurations that assist Jeff in making visual discriminations, and will promote use of his residual vision through meaningful tutorial-based interactions and with entertainment oriented programs.

TECHNICAL DESCRIPTION

Design of this program, out of necessity, had to consider testing visual skills over a very wide range of visual parameters. Although Jeff would sometimes give correct answers to questions involving something visual, it was occasionally suspected that he was guessing. As a result it was not known where to start in evaluation. Since visual resolution was in question, we decided to begin with full screen presentations, and work toward

smaller and smaller presentations until the limit of recognition was reached.

Discrimination between guessing and honest answering was another initial concern. It seemed unlikely that useful information could be had by presenting a full screen circle and asking Jeff if he saw it. We therefore decided to orient the testing phases to presenting several choices of an answer to a question and letting him select the correct one. It was believed that Jeff could recognize a few basic colors, so the beginning test was color based.

Four basic colors (blue, red, green, and black) were associated with the four corners of the joystick travel. When the stick was in one of these four positions, the computer screen was made to display the appropriate color. When being evaluated Jeff would be asked to make the screen color "X". If he knew the color, he would move the joystick until the proper color appeared. It would then be absolutely clear whether he was guessing. The four colors that are possible can be reassigned at any time within the palette options of the computer.

Spatial discrimination using recognizable colors is done in the following manner. Half the screen is illuminated with the test color and the other half is a neutral background. The user is then asked to match the test color by illuminating the other half with the joystick selection. Again, attempts at guessing are obvious. Carrying this idea on further, the test and response areas are made smaller and smaller to find the limit of spatial discrimination.

So far no mention has been made about the actual attended operation of this program. Since an attendant is currently required to run the program for Jeff, text instructions as menus are printed on the screen at appropriate times. The attendant will read them and then instruct the user in what to do. Responses are all keyed to colors as described above. In addition to the visual evaluation four basic initial activities were tried. The initial menu asks the user to select from the following:

- (1) visual activity (BLUE)
- (2) color changes (RED)
- (3) flashing (GREEN)
- (4) quit (BLACK)

The user response routine reads the stick position in the X and Y coordinate form and can follow the movement of the stick. The BASIC STICK function as well as the STRIG function are utilized here. When the desired selection is made the trigger button on the joystick is pressed and detected by the use of the STRIG function.

The first choice on the menu is the visual activity routine. By selecting this function the user is given one of three geometric shapes: a square, a circle, or a triangle in a 4x3 array. Below the given array the user is asked to:

"Pick Shape, CIRCLE (BLUE),
TRIANGLE (RED), SQUARE(GREEN)"

This information is relayed to the user by the attendant. Again we are using color coded response. The objective is for the user to identify the shape by moving the joystick to the appropriate screen color and pressing the trigger button. If the user selects the correct screen color/shape the next shape is given in a 4x3 array. If the screen color selection is incorrect then the array decreases to 3x2 in which the sizes of the shape in the array increase. From a 3x2 array the following arrays are 2x1 and 1x1 respectively.

The second menu choice is called "color changes." The objective is for the user to learn to visually discriminate between the 3 shapes and 3 colors (red, green, blue). The screen flashes the objects randomly and assigns a random color to each shape. The trigger button must be pressed for the program to continue with the next shape and color. The last menu choice is called "flashing". After selecting the speed, at which the computer will flash out the shapes, three shapes are generated and assigned colors randomly. The program proceeds to ask the user a "yes" or "no" question that also has been generated at random. The question is in the format

"Did you see a (color) (shape)?"

where (color) can be one of our four colors and (shape) can be circle, square, or triangle. If the user were able to remember seeing a red square generated the appropriate answer would be "yes" if not "no."

Modification to these programs is currently being done as we gain experience in the desired testing procedures. We are hoping to make the program entertaining as well as skill building by presenting a moving target that the user must follow with a cursor. Size and color of the target and cursor of course depend upon the visual abilities of the user. These abilities will be determined through the testing procedures. In an attempt to ultimately make this system free to use without an attendant, we plan future work involving a speech synthesizer to speak the instructions to the user. The lions share of the cost of this project went to purchase the **PcJr**, which is a piece of equipment that will be useable for other patients just through new programming. We thus expect to see much more utility from this equipment than the project might indicate on the surface. Total cost of this project was about \$600.





S. VALENTA

Detachable Arm Support Tray for a Pull Trolley

Designer: Ananth Naman

Disabled Coordinator: Cathy Costello

Sidney Lanier Elementary School

Supervising Professor: Dr. Robert J. Hirko

Aerospace Engineering, Mechanics and Engineering Science

University of Florida

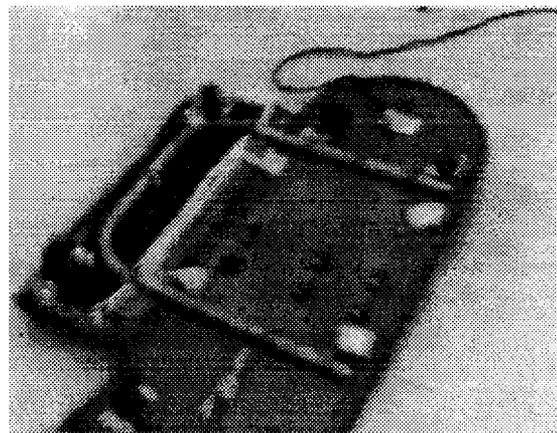
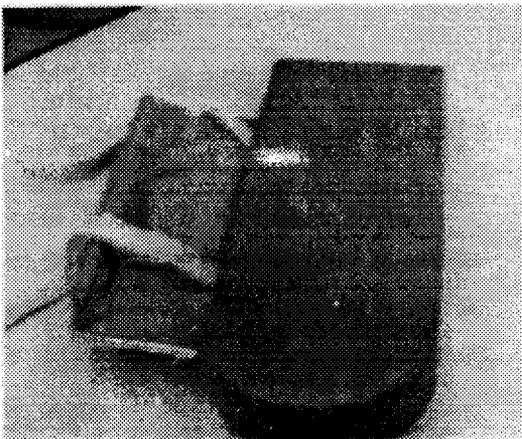
Gainesville, FL 32611

INTRODUCTION

A detachable arm-support tray was necessary to provide the patient in question with the ability to be transported without causing injury to both arms. Essentially the tray allows for the arm of the patient to be suspended at cart level, thereby preventing his arm from being dragged on the ground or run over during cart use. Additionally, the arm support acts as an outrigger for the trolley helping to maintaining its stability.

SUMMARY OF IMPACT

Sidney Lanier School is dedicated to the education of children with both physical and mental handicaps. In the daily handling of these students various commercially available as well as custom devices are used. The particular device in question for this project, a pull trolley, is used primarily for recreational purposes. Children with the strength and coordination in their arms can lay on the trolley and scoot themselves around the room, thus gaining a bit of mobility. The trolley also can be pulled by an attendant for transporting a student on an outing to another classroom or around the school grounds. In the case of David, the student in question, the trolley had to be pulled. David does not have complete control of his arms and thus is prone to having his arms drag over the side of the trolley. This resulted in his arms being prone to getting run over or dragged on the ground. Because of this problem, David did not get as much use of this device as we would have liked.



The primary goal of designing the arm support for our trolley was to allow David the ability to ride on the **pull** trolley without being injured. The arm support addition worked well in protecting David's arms. As an additional benefit, the extra caster wheels on the supports acted like outriggers and made the trolley more stable in resisting tip-over when being used by some of our larger and more athletic students.

TECHNICAL DESCRIPTION

Requirements that were the drivers for the design of this arm support were as follows. First, since more than one student used the pull trolley in question, any modifications that we would do had to be reversible. This was so that the trolley could be setup for the current user. These equipment setup changes needed to be simple enough to understand so that even one of the students with enough dexterity could perform them. This meant that the arm support should be designed to be lightweight, strong, and easy to install and remove.

Next, to extend the utility of the trolley, it was the intention to make the arm support function as an outrigger giving increased lateral stability. This would prevent tipping when the trolley was used by students who were accustomed to pushing themselves around on the device before they grew too large and athletic for its safe operation.

Finally the design dictated use of materials that were inexpensive, strong, and easily obtained in the

event that repairs had to be effected. With these requirements in mind the design hinged around the particular trolley itself. It measured 42 inches long by 16 inches wide, and was structurally based on a wooden plate supported by four castoring wheels. A foam pad covered in vinyl cushioned the user. (see sketch)

Since the primary function of the tray was to support David's arm, the location for the tray supports was calculated from his height. It was kept in mind, however, that for the more active users sufficient arm swing room, for propulsion, ahead of the support tray was necessary to permit their use. As shown in the sketch, the tray was fabricated from a sheet of Lexan polycarbonate bent at a 90 angle. Polyvinyl chloride electrical conduit was used to form the underlying support for the tray, which was also to be used to connect the tray to the cart. This support tube was formed from curved and straight sections of the conduit joined appropriately. It was fastened to the Lexan using conduit brackets. The same conduit fasteners were attached to the underside of the cart and formed receptacles for the tubing holding the arm support tray. This tray could be locked in place by using cotter type pins once it was installed under the trolley base. Attached to underside of the support tray were two wheels, one fore and one aft. Finally a foam sheet covered with vinyl was attached, covering the Lexan, to provide comfort and aesthetic value. The total cost of this project was \$159.00.

