CHAPTER 10
NORTH DAKOTA STATE UNIVERSITY

Department Of Electrical Engineering
Fargo, North Dakota 58105

Principal Investigators:

Jake Glower (701) 231-8068

Dan Ewert (701)-231-8049

Val Tareski (701)-231-7615

PLAYSTATION INTERFACE

Designers: Charles Monson, Stephen Rambeck, Kevin Malinowski, Jeremy Lunke, Adam Swor
Designed for Anne Carlson School, Jamestown, ND
Supervising Professor: Dr. Jake Glower
North Dakota State University
Department of Electrical Engineering
Fargo, North Dakota 58105

INTRODUCTION

A child with poor motor skills needs to do exercises to increase motor abilities. The project attempts to integrate exercise with playing video games, typically a favorite activity of children. An electronic device was built to monitor the physical activity of the user. If the child is doing the required exercises, time is banked. Banked time can then be used to play a video game that is also controlled by this electronic device.

SUMMARY OF IMPACT

Children may be more motivated to complete their motor exercises if they are rewarded with time to play a video game. Future iterations of this design must address: 1) the type of physical activity to be monitored, 2) how the reward should be computed (what the ratio of play time to exercise time should be), and 3) how time spent playing the game should be regulated. Feedback from the staff working with the children using this device will be used to answer the above questions and determine the design of future devices.

TECHNICAL DESCRIPTION

The Playstation Interface consists of two main units. These units are the Activity Sensor and the Playstation Controller. The Activity Sensor (shown in the left side of Figure 10.1) monitors the exercising activity of the child. This circuit is a small, battery-operated unit that fits into a hat worn by the child. If the child is jumping, hopping, or doing sit-ups, the accelerometer sends a signal to the microcontroller. The microcontroller then filters the data to detect if the child is exercising. If so, a 1 kHz square wave is sent to an AM transmitter.

The second unit is the Playstation Controller. It monitors physical activity when in the Exercise mode and controls a Playstation when in the Play mode.

In the exercise mode, the Playstation monitors the signal from the AM receiver. If a 1 kHz signal is detected, a counter is incremented every 100ms. This counter then serves as the time the child has banked for later use.

In the play mode, the Playstation closes a relay, thus providing power to the Sony Playstation. While in this mode, the counter is decremented every 100ms until it reaches zero. When the counter reaches zero, the relay is opened, ending the child’s playtime.

The activity sensor uses an accelerometer and microcontroller capable of measuring +/-4G's with 10-bit accuracy and sampling rates in excess of 1000 samples per second. With more sophisticated software, this should allow the activity sensor to detect specific motion, such as doing sit-ups (0 to 1 G at about 1Hz), jumping jacks (0 to 2 G at about 1Hz), or any other exercise.

Although the software is too sensitive (allowing one to register activity by simply shaking the device), the device does appear to work well. It records time as the child exercises and enables the Playstation as the child plays.

The total cost of this project was $280. This price includes the cost of the Sony Playstation.

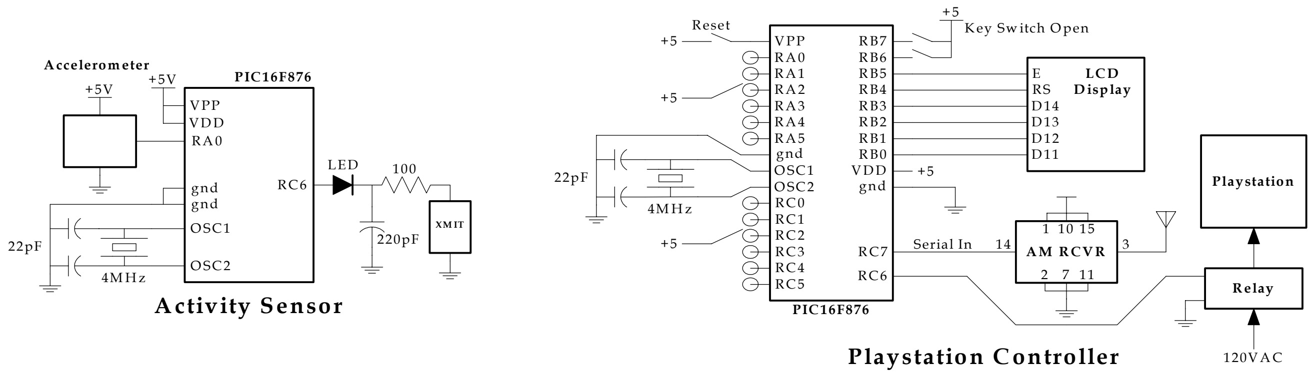

Figure 10.1. Playstation Interface Circuitry.

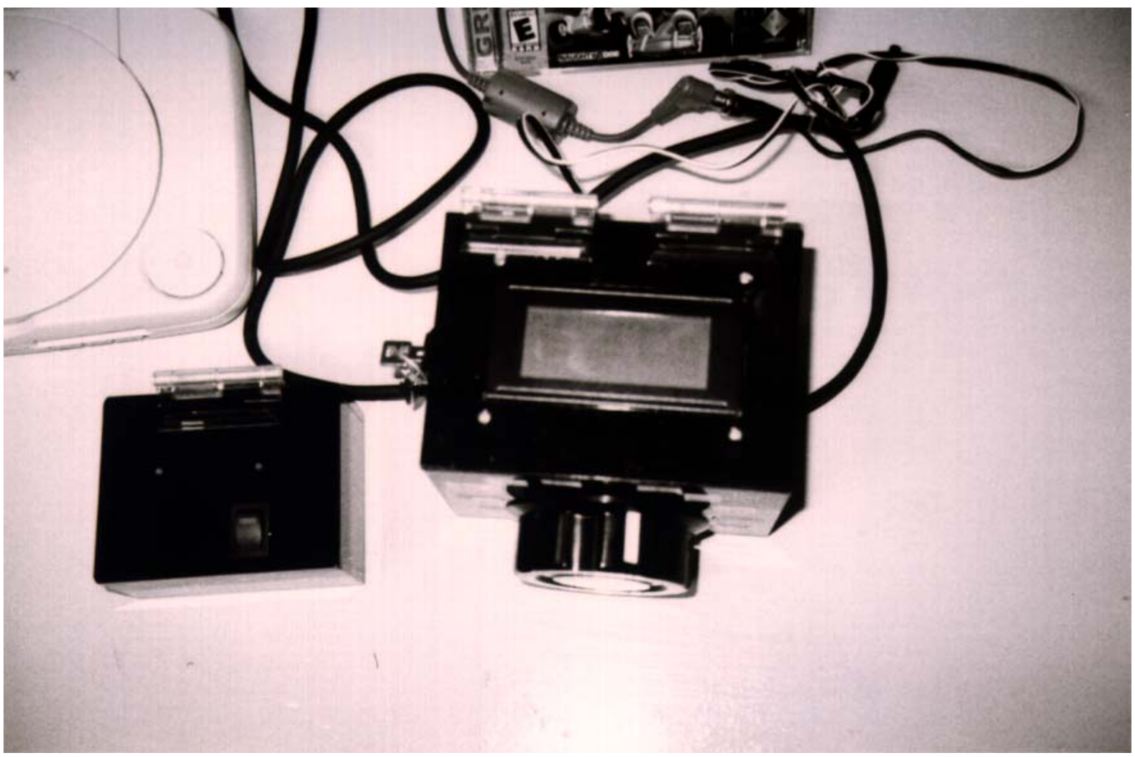

Figure 10.2. Activity Sensor and Playstation Controller.

CAMERA FOR PEOPLE WITH VISUAL IMPAIRMENTS

Designers: Joe St. Sauver, Dan Desrude, Brandon Slettland
Client: Designed for REM Rehabilitation Associates, Fargo, ND
Supervising Professor: Jake Glower
North Dakota State University
Department of Electrical Engineering
Fargo, North Dakota 58105

INTRODUCTION

A camera for people with visual impairments was designed to help them identify objects out of reach and use their sense of touch without being able to actually feel the object being identified. The concept is that the camera captures an image of an object and then this information is analyzed, and a tactile approximation of the object is produced. Unfortunately the solution is not as simple as the concept, and therefore only preliminary work was completed to test different design concepts.

SUMMARY OF IMPACT

A camera that transforms a visual image into a textural image would give people with visual impairments the ability to see out a window, observe a painting, or locate people in a room. Such a device would require a large number of pixels and a considerable investment to design. Before making such an investment, it is important to develop a good design. While conceptually simple, two previous design groups found that the implementation of this design was not as simple as it first appeared. In this project, the feasibility of using stepper motors and H-bridge amplifiers was tested.

TECHNICAL DESCRIPTION

The design for the Camera for People with Visual Impairments follows closely with that of previous design groups and is presented in Figure 10.3. Because concentration of this design is on the actuator, the sensor design from a previous group was used. Here, a lens focuses an image of four photovoltaic cells. These convert light intensity to a voltage, which is amplified by four instrumentation amplifiers and read at the A/D input of a microcontroller.

The microcontroller then drives four stepper motors according to the light level on each sensor. Although the microcontroller was more than capable of driving these four motors without any interface circuitry, shift registers were still used to expand three data lines into 16. This was done for two reasons. By reducing the number of I/O pins used, a smaller, cheaper microcontroller could be used in future designs. In addition, cascading more shift registers and latches together allows any number of pixels to be driven by this circuit.

The software for the microcontroller is also simple. For each sample, the light level is read on the analog inputs. This light level is then compared to counters in memory. If the light is brighter than before, the count needs to be increased. If the light is dimmer than before, the count needs to be decreased. Once the target count for each pixel is obtained, the drive signals are sent to the shift registers and latches. These signals cause the stepper motors to turn clockwise one step if the corresponding count is to be increased, and counter-clockwise if the count is to be decreased. This action is repeated until each stepper motor has gone the number of steps equal to the count obtained from the A/D readings.

The shaft of the stepper motors consists of a 10cm long screw. This screw causes the rotation of the stepper motor to be a translational motion, resulting in a peg sticking above a board proportional to the light level received from the corresponding light sensor.

Although this circuit did work, it was very slow. Stepping the motors 1024 times (the maximum vs. minimum brightness) took an average of 70 seconds. In addition, the power consumption was high, using approximately 1800mA to drive these four motors. As a result, this design is not ready for miniaturization. Future design groups will need to improve the speed, power consumption, and size of this device.

The overall cost of this unit was $280.

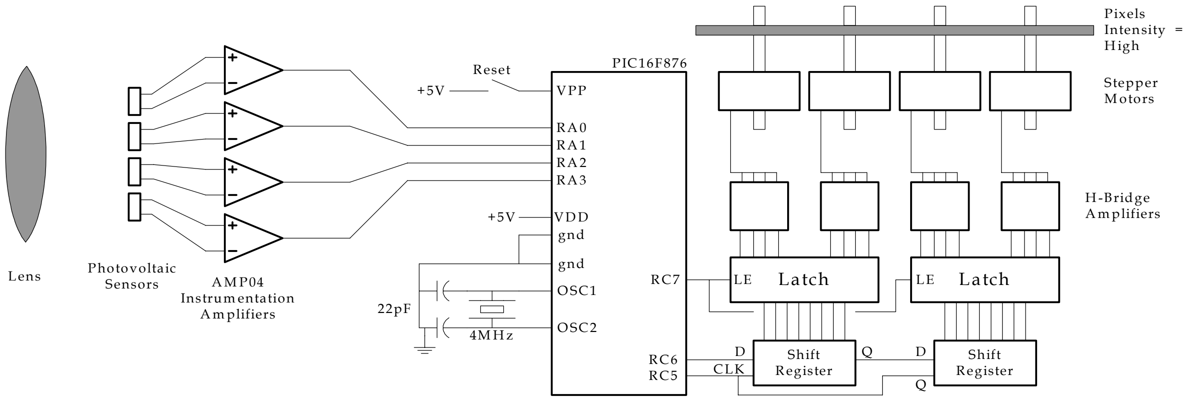

Figure 10.3. Schematic of Camera for People with Visual Impairments.

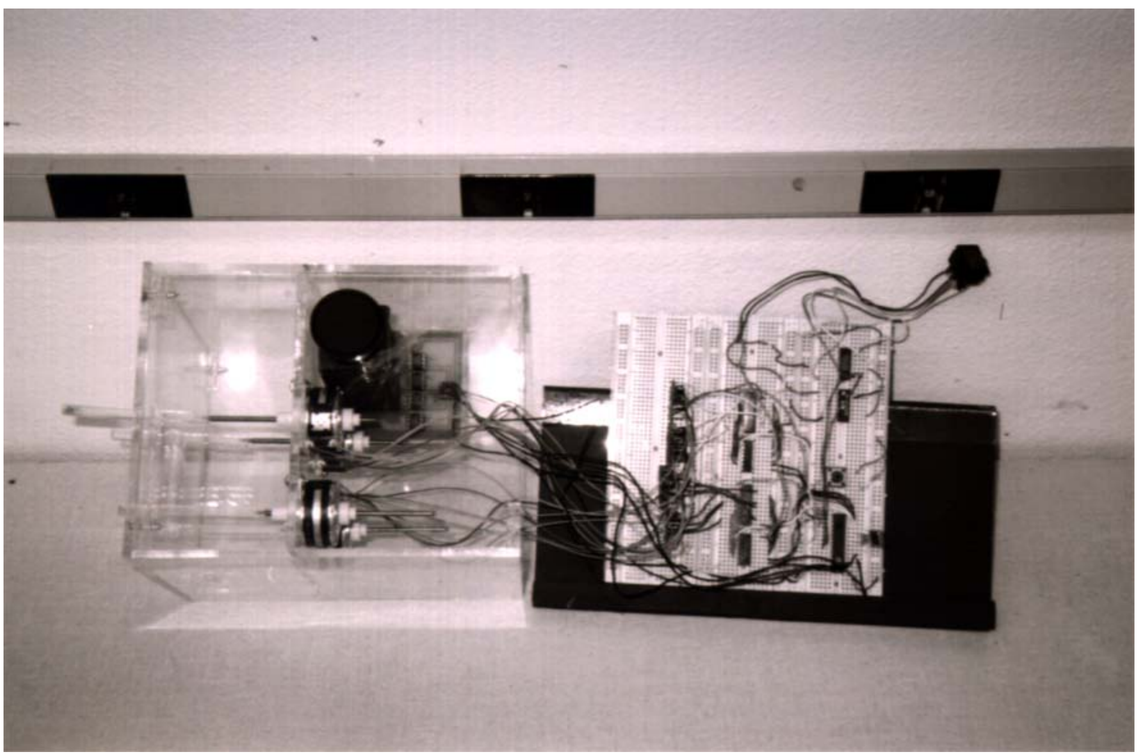

Figure 10.4. Camera for People with Visual Impairments.

GPS VOICE OUTPUT

Designers: Kurt Peterson, Neil Peterson
Client: Human Communications Associates, Fargo, ND
Supervising Professor: Floyd Patterson
North Dakota State University
Department of Electrical Engineering
Fargo, North Dakota 58105

INTRODUCTION

Most canes used by people with visual impairments do not tell them the direction they are heading, their exact location, or how far they are from their destination. The standard cane can only tell people what is in front of them. A seeing-eye dog cannot provide this information either. The GPS voice output device will provide this information to the user.

SUMMARY OF IMPACT

Ideally, the operator of this device will be able to hear a variety of types of information by pushing a button. This information includes the following: the coordinates of their current position in degrees latitude and longitude, the direction in which they are traveling, the distance to their destination, and directions to this destination.

The user will also be able to save the coordinates of a position into the device's memory, name the saved positions, and use these saved positions to reach the destination again later. The device will output warnings telling the user if the battery power is low, or if satellite transmission is weak or lost.

TECHNICAL DESCRIPTION

The overall block diagram of the GPS Voice Output is presented in Figure 10.5. To collect GPS information, a Magellian GPS receiver was used. This unit is relatively inexpensive (approximately $100), fairly reliable, and has a serial output port. The serial port of this unit is connected to the SCI port of a PIC16F876 microcontroller. Through the serial port, the microcontroller can program the GPS unit to send position, speed, and heading every 1 to 5 seconds. It can then log these data as they are received.

The keypad consists of large buttons for the operator. These buttons are monitored by the microcontroller. They are programmed to output the GPS position, heading (degrees from North), speed, distance to a desired location, and directions to this location.

In addition, operators can record their present position as a waypoint so they can find their way back.

The microcontroller consists of a pair of PIC16F876 evaluation boards (see Figure 10.6). These evaluation boards simplify the wiring and programming of the controllers by allowing one to display information (such as GPS data) on an LCD display. Future iterations of this design will presumably use a single microcontroller, because the LCD display will not be properly functional to the intended operator.

A V8600A Speech Synthesizer is connected to the microcontroller using 8-bit parallel communications to generate voice outputs. This device allows one to spell out words in ASCII text, and this text is then converted into intelligible words when fed to a speaker.

The overall design of the GPS Voice Output appears to work very well. If the user is walking around outside, the GPS receiver typically has no problem picking up the GPS satellites. In addition, the voice output from the speech synthesizer is clear.

The overall cost of this device was $420.

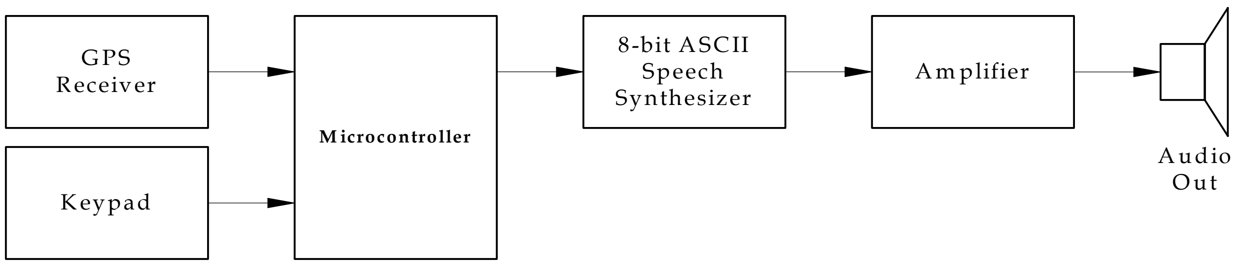

Figure 10.5. Block Diagram for the GPS Voice Output

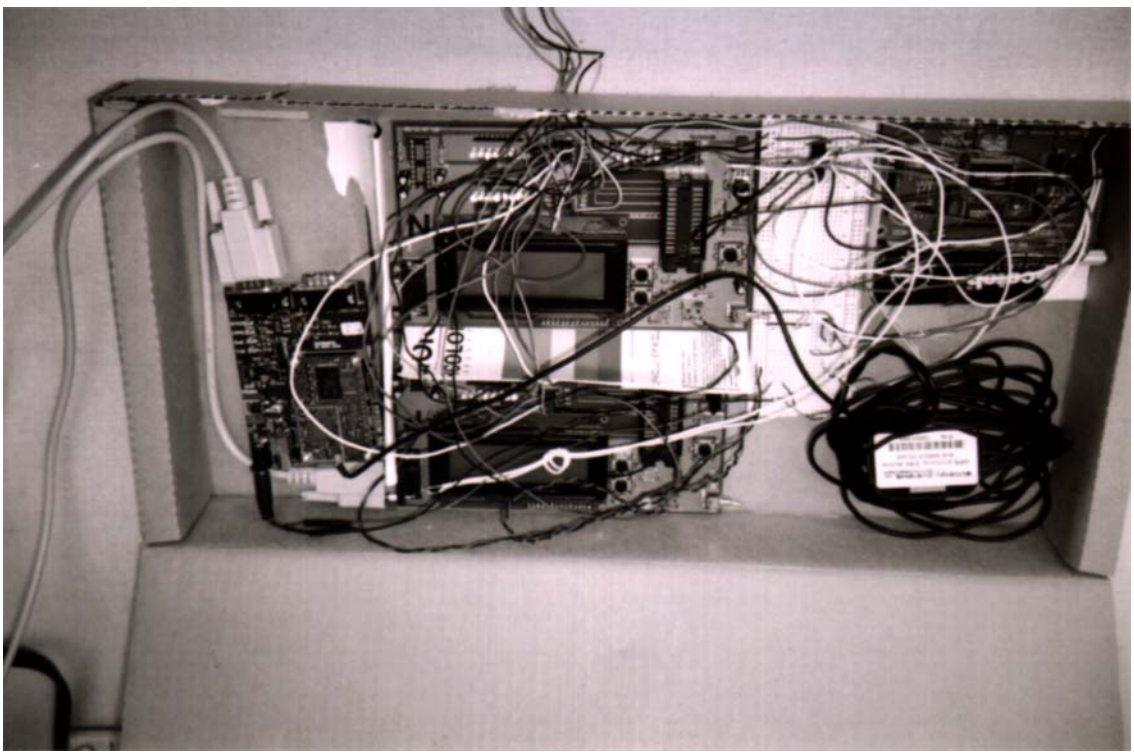

Figure 10.6. Final Design. A Second Design Group Will be making PCB's and packaging this device.