

CHAPTER 19
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JOYSTICK MODIFICATION FOR BARBIE POWER WHEELS JEEP

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INTRODUCTION

Commercial Power Wheels vehicles cannot be easily controlled by children with poor muscle control. This project involved the modification of a Barbie Jeep for use by an 8-year-old girl with cerebral palsy. A joystick control and supportive seat were added to facilitate use and to promote independence.

SUMMARY OF IMPACT

The modified Barbie Jeep (Figure 19.1) will allow the client to gain experience for future operation of joystick-controlled wheelchairs and will allow the client to have increased independence. The modifications allow the client to practice fine motor control and visual-spatial skills, and enable her to participate in active play and outdoor activity. The joystick controls allow forward or reverse motion, with future additions to include left or right control. The modified seat (Figure 19.2) provides leg and torso support and a seat belt to ensure child safety.

TECHNICAL DESCRIPTION

Analog-based circuitry (Figure 19.3) was chosen to provide a comparable driving experience when operating the car. The original 12V battery that comes with the car is maintained to operate the original propulsion motors, which require high currents. Two 9V batteries are used to power the joysticks and circuit components in the modified design. The batteries are located under the hood and have a power switch to turn the system on and off in order to preserve the batteries.

The joystick outputs a speed signal corresponding to the position of the lever. The signal range of the joystick is +2.6V to -3.0V as it moves along the y-axis. A comparator checks whether the signal is positive (forward motion) or negative (reverse motion), then relays number one and two are



Figure 19.1. Modified Barbie Jeep with Supportive Seat and Joystick Control.

triggered to set the selected direction of motion for the motors.

The maximum speed of the modified car is slightly less than before the alterations. The speed is distributed evenly over the range of the joystick and seems to be a safe velocity for both forward and reverse movement. The proportionality of the control will eliminate any jerky motions from the motors and provide for a smoother ride and acceleration.

The main limitation of the car is that the joystick does not control the left or right motion of the car. Due to possible client challenges in operating the manual steering wheel, a parent or therapist must control the steering.

The seat of the car is specifically designed to provide torso support and hip support. A six-inch semicircle is used to separate the client's knees and an armrest is positioned on the left side to better joystick control. The base and back are 1/8' plywood and 1" x 6" quadrilateral pieces of wood were used for the hip supports.

Comfort and aesthetic value were important when incorporating the seat. (Figure 19.2) Two layers of foam were added to each surface that contacts the client and the foam was covered with pink vinyl to match the color of the jeep. This redesigned seat has the same dimensions as the original seat.

The approximate cost of the modifications to the car was \$110. This excludes the price of the car itself.



Figure 19.2. Modified Seat.

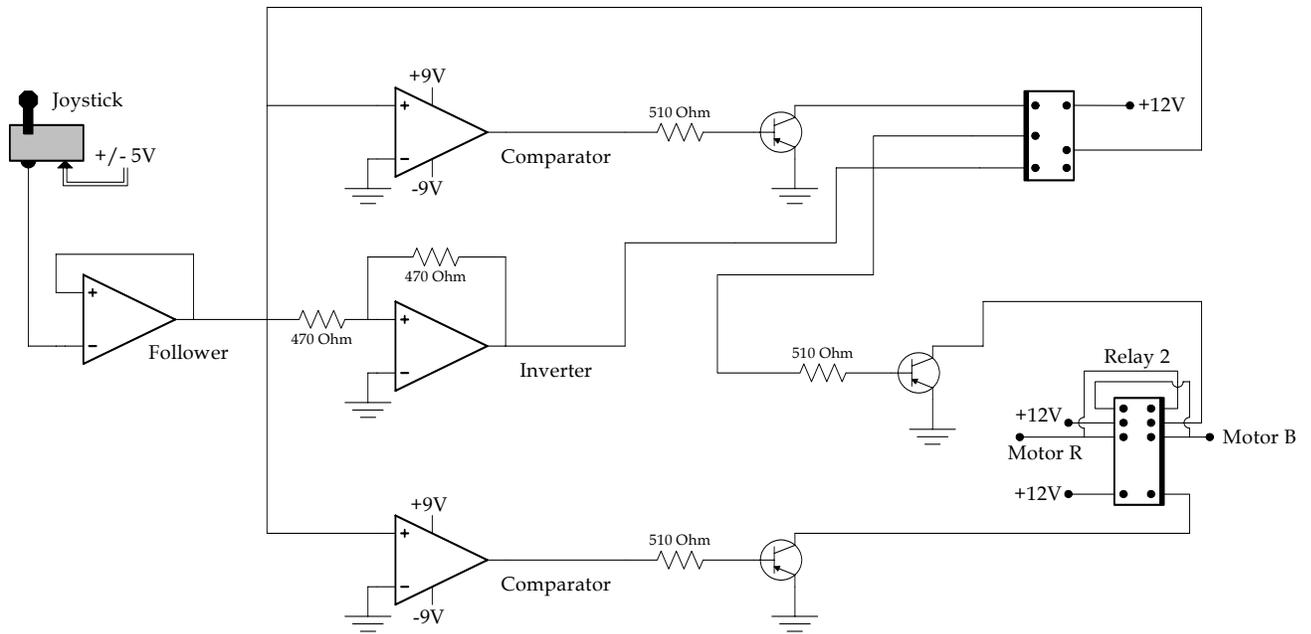


Figure 19.3. Wheel Propulsion Circuitry Located Under the Vehicle Seat.

INFANT PATTING DEVICE

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INTRODUCTION:

An infant patting device (Figure 19.4) was developed to simulate a hand patting motion during bottle-feeding in a neonatal intensive care unit (NICU). A hand patting motion calms the baby to facilitate bottle-feeding. It may also decrease the probability of food aspiration into the lungs during feeding. This device provides an easy, safe way to comfort the patients in the NICU, while providing relief to their caregivers.

SUMMARY OF IMPACT:

Some NICU infants require two nurses to feed them: one to hold the infant and the bottle, and another to pat the infant's back. This device performs the patting task, allowing a single nurse to manage all feeding tasks in a safe and timely manner. The patting, performed independently of feeding, may allow the infant to remain calmer for the duration of the stay in the NICU. Clinical approval of the device is currently pending.

TECHNICAL DESCRIPTION:

The system (Figure 19.6) works by providing puffs of compressed air to an inflatable bladder (Figure 19.5) that is held up to the infant. Compressed air sources are available throughout the NICU. An air input hose connects this air source to the system. A timer circuit turns a solenoid valve on and off to provide puffs of air. These puffs flow along the air output hose (25' long, 1/2" inner diameter) to the inflatable bladder that provides the patting motion. The bladder can be suspended in foam padding or placed directly on the infant. An escape hose attaches to the bladder to direct the airflow out of the bladder and away from the baby.

The system is encased in an aluminum project box (12" x 12" x 8") equipped with wheels to facilitate movement. There is a power switch and large knobs that allow the user to control the air pressure and patting rate. A commercial 24V wall transformer

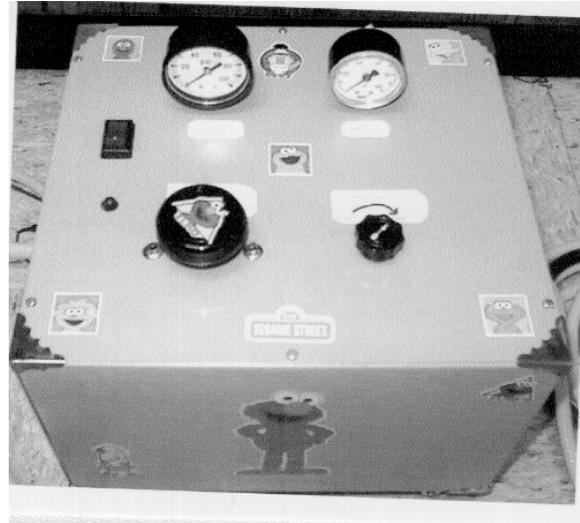


Figure 19.4. Infant Patting Device.

provides electrical power. Throughout the system, 1/2" diameter tubing is used, large enough to not restrict air flow.

The puffs of air are provided by a pressure regulator, timer circuit and solenoid valve. Since the compressed air source has a pressure of 60 to 85 pounds per square inch (psi), a regulator is necessary to lower the pressure. The user can adjust the regulator output pressure to the range of 2 to 60 psi. A solenoid valve opens and closes to provide puffs of air to the inflatable bladder. The solenoid has a large 5/8" aperture to maximize the flow of air and runs off of a standard 24V plug-in power supply. In order to switch the solenoid on and off, a 556 timer circuit is used. This timer uses a 5V power supply provided by a 24VDC to 5VDC voltage regulator. The frequency at which the timer operates is controlled by a potentiometer, which can be adjusted using the frequency knob on the box.

The patting motion is provided using a custom neoprene bladder. The bladder is circular with a 3

1/2" diameter and it has connections for an air supply and air escape hose.

When the valve is open, the puff of air from the solenoid causes the bladder to expand. The air leaves the bladder passively through an open tube. The tubing is 25' long to enable the nurses to freely move with the device and to ensure that the released air from the bladder flows away from the infant.

The system is safe for use and easy to clean and sterilize. The metal box provides an effective casing for the electrical equipment and it also safely separates the infant and the caregiver from the electrical circuits. Neoprene was chosen for the bladder to prevent any possible side effects from latex allergies.

Aesthetic concerns were addressed by decorating the plain aluminum box with child friendly, decorative Sesame Street® stickers.

The total cost of this project was \$667.

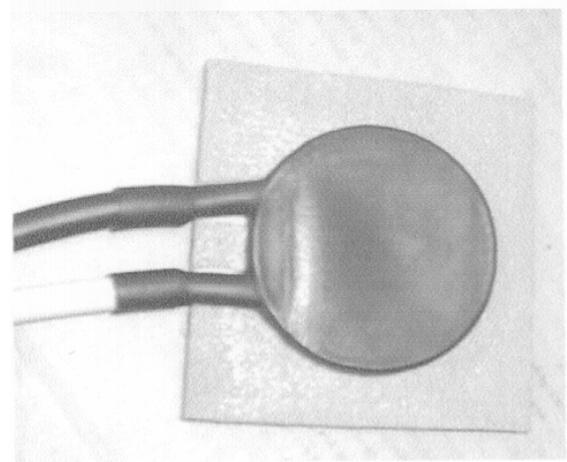


Figure 19.5. Neoprene Bladder.

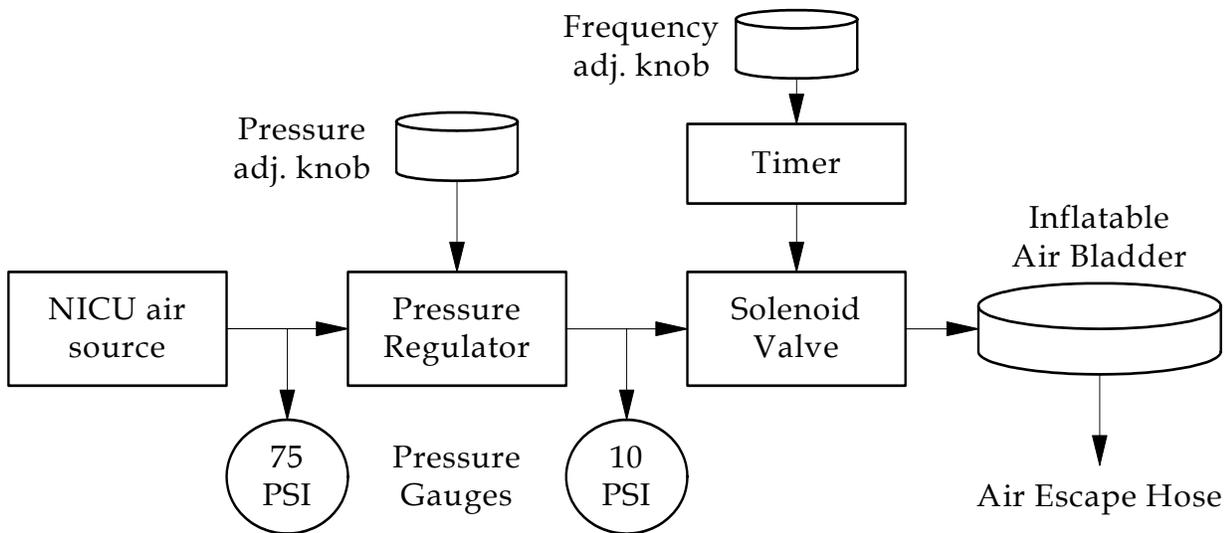


Figure 19.6. System Block Diagram.

HEARING LOSS SIMULATOR

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INTRODUCTION:

The hearing loss simulator is a computer program that modifies a sound clip based on a child's audiogram. The audiologist enters audiogram data into the program, characterizing the child's hearing loss. The program then records, modifies and replays a voice or a music clip as the child would hear it.

SUMMARY OF IMPACT:

This program provides a means by which parents of a child with hearing loss can understand what their child is capable of hearing. This program will help the parents have realistic expectations of the child's performance. Additionally, the program will aid in the formation of Individualized Education Plans by providing a more accurate representation of hearing loss. Hearing loss is often classified as profound, severe, moderate and mild. Most individuals have difficulty applying these general terms to what a child can hear. Current audio examples of hearing loss are not specific to the child and may give only an approximate idea of the sounds that a child is able to hear. This program gives a more specific, personal replication of the child's functioning.

TECHNICAL DESCRIPTION:

The Hearing Loss Simulator consists of five primary components: a microphone, a PC, a sound card, a software program, and a speaker system.

The audiologist must first enter data from the child's audiogram into the simulator. A polynomial function is matched to the data points and then used to apply the appropriate attenuation at selected frequencies to a recorded audio signal. The PC receives input from the microphone via the sound

card. Contained within the sound card is an analog to digital converter that transforms information from the microphone into a form usable by a software program on the PC. Based upon information taken from a patient's audiogram, the program processes the recorded audio. This altered digital signal is then transformed back into analog format by a digital to analog converter housed on the sound card and ultimately played by a speaker. (Figure 19.7)

The programming is done using Visual Basic 6 and requires a computer running Windows 9x or NT at 266MHz or higher. In order to hear the modified sound clip, a 16-bit A or D sound card, a microphone and speakers are necessary.

Preliminary testing of the simulator has demonstrated that it is qualitatively accurate. Several simple scenarios, such as filtering all high frequencies or all low frequencies, have generated the expected results. The initial impression of professional audiologists is optimistic. Although further testing is needed to prove that the simulator is quantitatively accurate and clinically useful, the outlook is promising. The current limitation of the device is that only up to seven data points may be entered from an audiogram and that an auditory signal must be recorded and modified before being played back. One possible solution may be to allow the audio to be modified and played as it is being sampled, thus permitting a real-time system. As it stands, the Hearing Loss Simulator may be beneficial in communicating a child's level of hearing loss to a parent.

The total cost of this project was \$505.

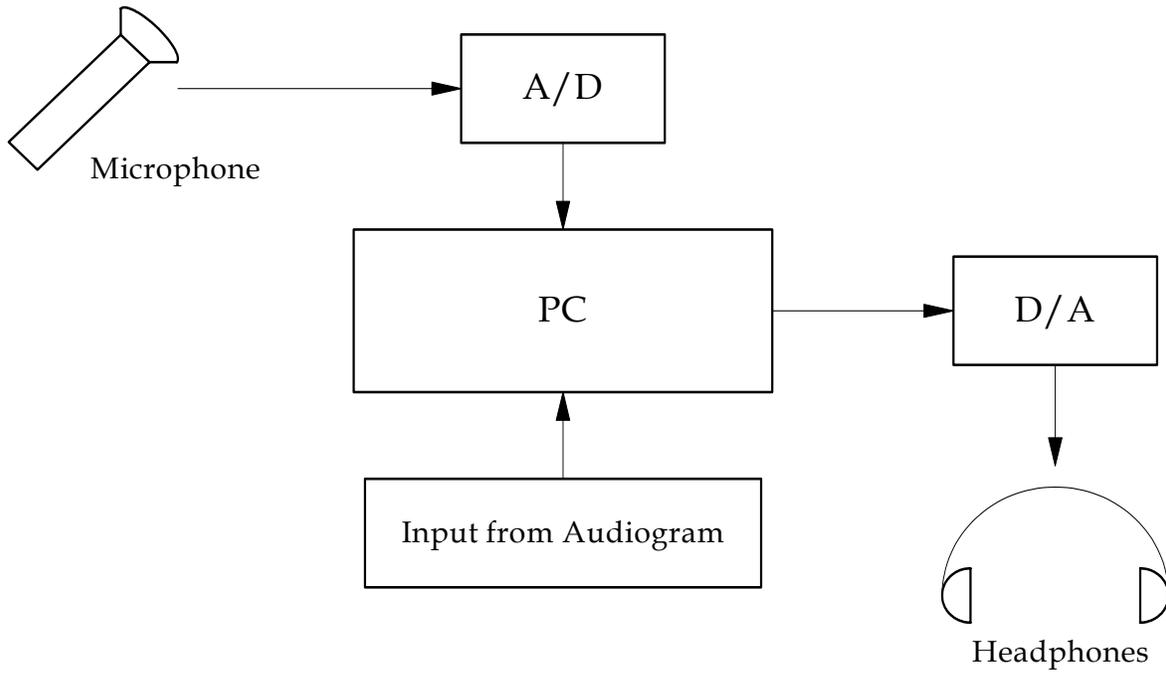


Figure 19.7. Hardware Used to Implement the Hearing Loss Simulator.

