

Case
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Group



<mailto:cesg@po.cwru.edu> <http://www.cwru.edu/orgs/cesg>

Senior Project Opportunities

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To find out more about specific projects or to talk about what you're most interested in working on, contact Robert Schneider. Email: cesg@cwru.edu Office: Olin 101

Interdisciplinary

Assistive Checkers and other Games:

Introduction to Problem: Many board games could be more inclusive and enjoyable for many with physical difficulties if the physical components of the games were removed while preserving enjoyable physical board-game look and feel. Most of us don't think of the game of Checkers as a physical challenge, but for many people without the necessary amount of arm and hand ability, traditional board games pose an unnecessary disappointment. Imagine wanting to play a mild game of checkers, chess, monopoly, scrabble, etc. without the often overlooked component of physical hand and arm movement. If you could not move the pieces because of disability, the only alternative would be to hope the others would move your pieces for you. This could limit the enjoyment of the game for both the person that needs help and the helper, not to mention the many games such as scrabble or cards where there is a necessary component of secrecy. The goal of this project is to begin remaking common games utilizing alternative piece control that transfers the burden of physical movement to the game itself, thus allowing all players to enjoy the game.

Background on what's been done: Although computer games often offer a wealth of non-physical game-playing for persons with disabilities, enjoyment is limited when attempting to play multi-player games. Computer games that are played either individually or with multiple computers will certainly provide enjoyment for many persons with disabilities; however, the common board games enjoyed by groups of two or more are difficult to enjoy behind a computer screen. There are many factors of the original games that are impossible to emulate when limited by screen output. For instance, if the card game poker were to be played by four people on a PC, how would everyone's cards be concealed? It is unlikely that everyone is going to have or want to play poker on a separate PC when it is far easier to use an ordinary deck of cards. Other things lost in computer games is the closeness of the participants by playing facing each other. In chess, the traditional arrangement with each person looking over the board from their side and opposite their opponent is very important to the playing of the game. That explains why using simple computer versions of games is not always the answer. There also exists currently many electronic versions of board games such as chess. The main hurdle to the acceptance of these game types by persons with disabilities is obvious: their lack of customizable input methods keeps many of these games out of reach for many people.

CESG work thus far: A team of three Computer Engineering students designed and built a prototype checkers game with no movable pieces. The entire game is played with two electrical inputs which control LED lights on the physical board. The board can accept inputs from any switch, i.e. buttons, puff/blow switch, foot switch, etc.

Future work: There are many possible projects that one could work on as offshoots from this project:

Packaging: Design a cost-effective, durable, safe, and compact housing for the checkers board - Mechanical Engineering.

Voice control of the pieces: Implement a voice recognition system into the checkers game - EECS. Once this is proven in the checkers game, a common system can be implemented into many different games: chess, card games, scrabble, etc.

Design other alternative game systems to allow persons with disabilities to enjoy multiple person games. Keep in mind that those games that require a component of secrecy are extra important - EECS, Mechanical.

Assistive-Crawling Board:

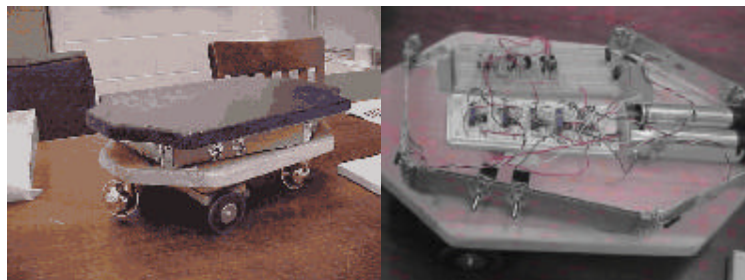
Why we should be interested in this: This project was begun out of the difficulty a baby born with some developmental disability had when trying to crawl. The baby couldn't crawl on her own, but the therapist had the idea that if the baby were to be aided in some way and rewarded with useful attempts to crawl, perhaps we could show her how to crawl. The concept was to create a board that the baby could lay on that would assist the baby in the direction the baby was trying to move.

CESG work thus far: A mechanical Engineering student worked on the project as a senior project for two semesters, designing and building a working prototype. The prototype utilizes a wheatstone bridge system of strain gauges to sense the desired motion and send a signal back into the system of two electric motors to provide the appropriate drive.

Future work:

The current prototype lacks the appropriate sensitivity to allow for gentle yet effective motion control. The result is a motion that is too jerky for practical purposes. Another problem associated with the current prototype is that of the need for a spring back into neutral position with the absence of a continual baby force. This may be implemented with the current system of strain gauges, but an alternative force/direction sensing method is worth considering. For instance, is it necessary to supply the aid-force such that it is proportional to the strain or would it be sufficient to always apply a predetermined aid-force? This would be much easier to implement, in that one could utilize a joystick-like system of sensing and control. In other words, we could treat the board that the baby lays on as a large video-game controller that feeds the info back into a simpler on/off system or a more complex proportional system.

With the above approach mentioned, an improved physical board needs to be designed that incorporates everything from the control method to the drive train and overall packaging concerns.



Power wheelchair modifications:

Why we are interested in this: There are many alternative ways in which one can control an electric wheelchair, such as with mouth controls. Another way is for people to use a series of switches, one for each forward, reverse, left, and right. The switches can be placed anywhere such as near one's hands, feet, or around the head. The switches defeat the proportional control capability of the wheelchair due to the on/off nature of the commonly employed switches. Proportional switches can be utilized as well, although controlling for proportional switches proves difficult for anyone, especially those usually in need of this kind of wheelchair power. So, normally, the switches employed are simple on/off type, and they are configured for basic control by the user to attain motion. For even a simple switch interface to be added onto an existing wheelchair, the cost is substantial.

CESG work this far: Two electrical engineering senior project students designed and begun building the prototype for a non-contact, head-controlled drive system based on antennas and interfaced with the wheelchair's proportional controller.

Future CESG work: Continue the design of the non-contact, head-controlled chair and implement using an Invacare power wheelchair. Also build in the capability to easily switch between head-control, switch control, and joystick control. You can talk to an alumni who worked on the project last year to get up to speed on what he has done.

-Mechanical aspects include the mechanical design of the head controller mount and other wheelchair mounting compatibility issues.

Voice Amplification / Clarification – This technology would assist someone who has difficulty speaking with enough volume and clarity to allow most people to comprehend their speech. The goal would be to produce a device that would, in addition to basic amplification, convert the spoken sounds into “clarified speech”. Unlike current devices that may convert typed input into speech, the input here is the actual speech of an individual. (Initial idea – algorithms could be developed for acoustic digital signal processors. The algorithms could be “trained” to match the input of spoken sounds or words, from a particular individual, with the output of the correct, clearly spoken, desired speech.) Work on this project with an experienced engineer from the community who is associated with LEAP (Linking Employment, Abilities, and Potential) and who is interested in this concept.

Mechanical Engineering

Laundry Aid:

Why we are interested in this problem: For many wheelchair users, trying to use laundry machines proves a great difficulty since it is impossible to reach inside of top-loading machines when seated. Front loading machines can also prove difficult. One solution to the problem would be a grip extender designed to reach over the top of the machine and down the basin and to allow sight into the basin. The problem was presented by a staff member of “Linking Employment, Abilities, and Potential (LEAP) at a joint meeting with CESG.

CESG work thus far: There are many available “grabbers” on the market to extend the reach of people using wheelchairs or with an otherwise compromised reach. None are available that could serve the laundry purpose. No work has yet been done by CESG on this project.

Future work ideas:

- Design a grip extender to reach into the top loading washers/dryers with a viewing capability.
- Design a stationary *hoist* capable of mechanically bringing all the clothes out of the washer and into the dryer and sequentially out of the dryer and into a basket. The hoist could be strategically mounted between the washer or be portable, etc.
- Mechanize the complete system of washing and drying of clothes - minimize the user's need to add physical energy.

Slide Board:

Why we are interested in this Problem: Transfer boards are used by wheelchair users to move between wheelchair and bed, toilet, etc. Current models are usually wood boards with handles on either end - very simple. The problem with these transfer boards is the skin abrasion and large force requirement that for some people may prove difficult. The problem was presented by a staff member of “Linking Employment, Abilities, and Potential (LEAP) at a joint meeting with CESG.

CESG work thus far: No CESG work has been done on this problem. Available alternative designs have rollers that got caught on clothing. Other methods of transferring people include free-standing and ceiling mounted lifts.

Future work:

Design a transfer board that improves upon current models, reducing friction for users without the possibility of catching clothes or otherwise inconveniencing or injuring the user.

Wheelchair-mounted clutch-jointed camera tripod:

Why we are interested in this project. This project begun out of a desire to help a specific person use his camera more effectively. The issue was that he couldn't hold the camera up while taking pictures. Another issue was that he couldn't adjust a regular tripod easily because of his disability. Thirdly, as a wheelchair user, he needed something that would mount easily on the wheelchair when he needed to use it and also be easily removed.

CESG work thus far: A mechanical engineering student worked on the project for one semester in which he designed and built a prototype. Each joint in his design utilized a joint system that relied on the force of a spring to hold together both halves of a pin and hole mechanism. This allowed for the user to adjust the tripod without turning any knobs whatsoever. He created a bracket that mounted on the wheelchair that the tripod could be easily slid into and out of.

Future work: There are many well defined problems on this project to create a good senior project or several smaller projects. An improvement over the currently used joint system would be to eliminate the pins and holes which prove not only hard to machine but also confine the adjustment of the joints to just those points. A better solution would be a friction-based clutch system. Additional future concerns are that the joint-to-arm connection needs a solid design, the wheelchair mounting style/system needs improvement (minimizing the size of bracket, universality of bracket, and durability). Also, expanding the design to more applications would be a great project as well.

Portable Ramps :

Existing portable ramps are heavy and awkward to transport. They are impossible for a lone person in a wheelchair to deploy. Design a self-deployable, wheelchair-contained ramp.

Protective Bumpers :

Current wheelchair design has protruding structures near ground level. These can strike furniture, cabinets, etc. and gouge these items. Design and build prototype bumpers to be fitted on existing wheelchair designs. Product could be sold as aftermarket product or directly to manufacturer.

Assistive Bowling Ball Ramp Modification/Redesign:

This currently available product was not designed for different sized people. Some of the kids attempting to use the ramp are left without an enjoyable experience because of the lack of a comprehensive set of design considerations. A redesign is necessary to (1) be adjustable so children of differing heights can reach the top of the ramp, and (2) have a mechanism that holds the ball sturdy at the top until the child wants the ball to go down.



Process Design (Jigs/Automation) for Vocational Programs for Disabled Youth and

Adults: If you enjoy working with people, you might like this project. Help someone gain more self-esteem by allowing him or her to perform a job they wouldn't otherwise be able to perform. Find creative solutions to a never-ending supply of job improvement projects for a job-school program for disabled youth and young adults. Creating novel automation for jobs can allow students to accomplish tougher jobs, thus gaining self esteem in the process.

- These projects vary in depth, but all involve helping students with varying physical and/or mental disabilities perform a given “job” that they would otherwise be unable to perform.
- They need creative jigs and one-of-a-kind equipment to allow people of all abilities to perform a variety of job tasks.
- The engineering solutions we can provide could allow vocational programs for disabled people to be a success. Without creative solutions to their everyday needs, their jobs would remain very limited, often contributing to one's lack of self-esteem.

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