High-powered Thermo-Electric Cooler

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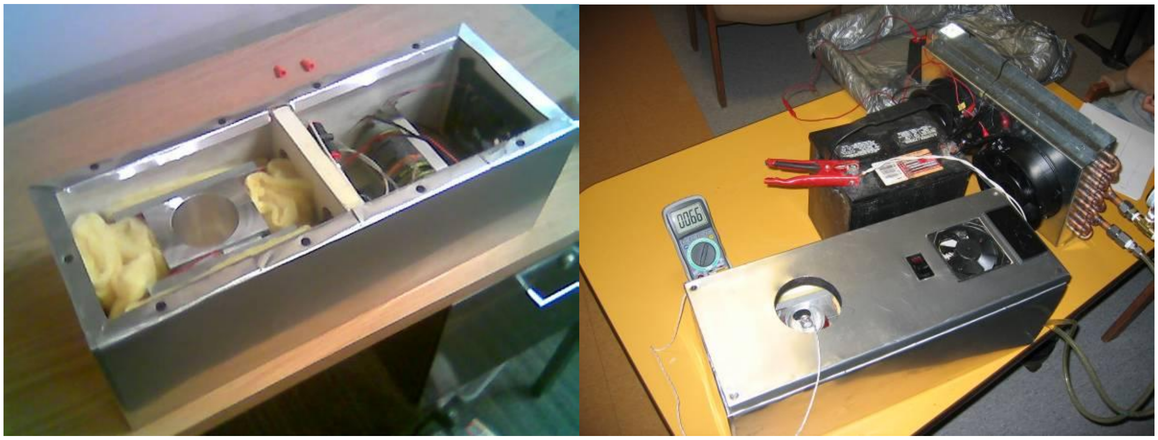

a. b.

Fig. 1 The thermo-electric cooler, a) open b) closed

Introduction:

The goal of this project was to create a portable coolant system that did not rely on the phase changes of its refrigerant to operate. This coolant system could be used in a vehicle, while drawing power off of the vehicle's battery. The system brings the temperature of a beverage to highly acceptable standard (defined as being near 45° F). The designed cooling device must be able to cool this drink from room temperature to the predefined temperature within fifteen minutes time.

Summary of Impact:

The High-powered Thermo-Electric Cooler is designed for commuters. Meaning those that have a lengthy commute to school or employment site, during which a pit-stop at a gas station to procure a cold beverage is undesirable for the waste of time it represents. The device will be placed in the passenger side of the automobile next to the driver for easy accessibility.

Technical Description:

The cooler itself has two chambers within it. The left most, as seen in Fig 1-a. is the location of the core. The core has a cavity within it where a canned beverage can fit very tightly. The reason for the tightness is to maximize contact and thereby maximize heat transfer. The outside of the core is connected to the Peltier devices. It is through these semi-conductor devices that a voltage is applied to create a temperature difference. The side next to the core becomes cold, and the outside, where we have placed heat exchangers, becomes considerably hot. The heat exchangers on the outside are designed to keep the hot side of the Peltiers at room temperature. In the right-most chamber of the cooler, we have a pump that circulates water through the small heat exchangers on the sides of the core, and the large external heat exchanger, as seen in Fig 2b. The large heat exchanger cools the circulating water by exposing it to room-temperature air circulated by 2 fans. A pump was picked that could displace a high volume of water. The reason for this is because we could not accurately predict the head loss from the external heat exchanger. The outer sides of the container were lined with aluminum sheet metal. This sheet metal would help reflect radiation from the container and prevent heat from reaching the core, as seen in Fig. 2b. For ease of operation, a switch was designed that would initiate cooling on the cover of the cooler, next to the pump fan.

a b

Fig. 2 a) The core with heat exchangers b) The external heat exchanger with fans.

Self-Ramping Wheelchair

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Figure 1. Prototype: Right Side

Figure 2. Prototype: Right Side

INTRODUCTION

Height differences in paths are common to everyone who is mobile. However, height differences may not be a hindrance for people who walk as it is a challenge for someone who uses a wheelchair. The user must first find a curb that has an installed ramp or use a portable ramp. To use a portable ramp, the wheelchair user must depend on someone to pick up the ramp after it has been used. The wheelchair must also have some place on it where the portable ramp can be stored. To use a curb installed ramp, the wheelchair user needs to find one on a sidewalk, which can be dangerous if the user is on a busy street with traveling cars. The purpose of our mechanism is to enable wheelchair users to be fully independent. The benefit of our SRWC is that it allows the user to utilize a mechanism to deploy a ramp to climb a four to six inch curb and then restore it on the wheelchair using the same mechanism.

TECHINCAL DESCRIPTION

Our design consists of a bicycle crank set and pulley system that enables the wheelchair occupant to deploy a set of ramps. These ramps are attached to a bicycle chain that is moved using the crank set. When the sprocket is cranked, the ramp moves from its stored position alongside the armrest, to the front of the caster. The rocker brackets attached to the ramps, along with pulleys and tensioner brackets, enable the ramp to pivot to its deployed orientation. After the ramp is fully deployed, the wheelchair occupant can transcend the ramp to get to a higher elevation. When the wheelchair is at the higher elevation, the crank set is utilized again to move the ramp back into its stored position along the armrest.

Figure 4. Prototype: Corner view

Figure 2. Prototype: Rearview

The Automated Board Cleaner

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Figure 1. *Full Assembly*

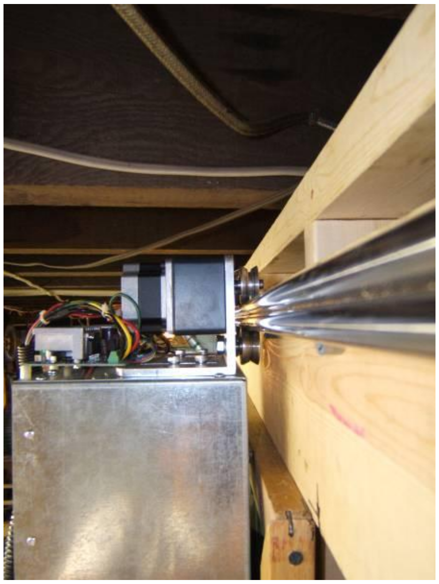

Figure 2. *Mounted Track*

INTRODUCTION

The overall goal of the design project is to create a complete system capable of automatically cleaning a chalkboard and dry erase board through the use of a self-contained system built into a movable mechanical arm. The cleaning process will comprise of both a washing and drying stage, and will utilize a cleaning fluid to accomplish it. The apparatus will be configured to activate at preset time intervals throughout the day, such as between classes, in order to provide a newly cleaned chalkboard or dry erase board for each class throughout the day. It will also include a manual override so the user can activate of deactivate the cleaning system at any time.

SUMMARY OF IMPACT

The Automated Board Cleaning System will be an extremely useful and beneficial product. A dirty chalk board causes pain for both the students and teacher alike. Not only can a dirty chalk board dramatically diminish the learning experience, but washing it can be an awfully painful task for a middle-aged teacher/custodian who often suffer from joint or muscle problems in the arms or back, such as arthritis. Now, with the Automated Board Cleaning System, a flip of a switch will do away with all this pain. In addition, the system will significantly reduce building maintenance costs by eliminating the large amount of employee hours required to provide an entire building with clean boards.

TECHNICAL DESCRIPTION

The Automated Board Cleaner (ABC) is designed to be mounted above any existing chalkboard surface by the use of a linear set of metal rails as seen in Figure 2. Once the track has been installed above the surface the ABC system it is then easily slid onto the rail system and ready for use. The board is cleaned through the use of a cylindrical sponge that is installed inside the board that can be actuation on and off the chalkboard surface.

To remove any access chalk residue left on the board during the scrubbing process, a continuously flowing cleaning solution is pumped into the sponge shaft and collected at the bottom of the device for reuse. As seen in Figure 3, the board moved horizontally from right to left cleaning the board in one simple sweep. Following the sponge is a rubber squeegee to collect excess water on the surface. This helps to collect chalky residue while also decreasing the overall surface drying time. Figure 4 shows how the sponge and squeegee assembly are actuated into and out of the board, while the main body frame travels along the guide rails.

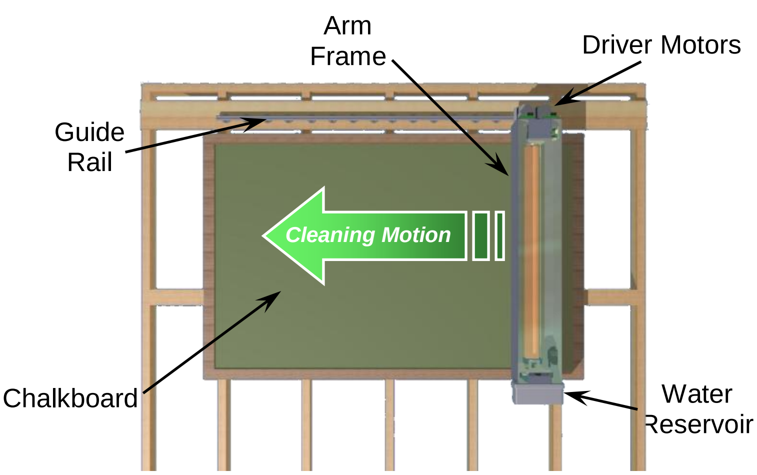

Figure 3. *Cleaning Diagram*

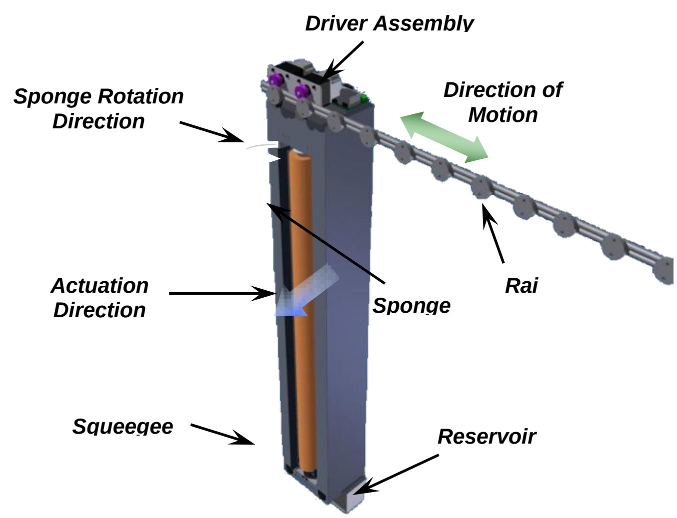

Figure 4. *Full System (Rear)*

Up-N-Ease Chair Lift: Facilitating the Act of Standing from the Seated Position

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Figure 1: *Side Profile View of Prototype*

Figure 2: *3D Model of Up-N-Ease Chair Lift*

I. Introduction

The objective of this design project is to produce a chair that will facilitate the act of standing from a seated position for the elderly individual. In addition, those with muscular weakness and/or knee and hip damage will find this device helpful in reducing the stress and strain on their joints. The user of this device will be assisted to the standing position by means of a physical boost from the chair despite their lack of cognitive abilities. The lifting mechanism will be initiated by a gas spring in conjunction with a hydraulic remote control release button.

II. Technical Description

The Up-N-Ease Chair Lift is a self- powered device requiring no motor or electricity. It utilizes a HON office chair, gas spring, a hydraulic remote control release button, locking wheels, as well as various plates and brackets to perform its function. In order to incorporate the seat lift mechanism, a 60601-T6 aluminum plate was mounted onto the core body frame (which houses recline and height adjustment levers) and another was bolted onto the bottom side of the seat cushion. Four Aluminum Mounted Bronze Sleeve Bearings were used to connect both plates and create a hinge, allowing for pivot rotation.

The chair lift is activated upon initiation of a hydraulic release control button, embedded within the armrest of the chair. The release button then supplies the activation force required for the compressed piston to extend. As the piston extends, the seat lifts to a maximum of 45 degrees. The release button controls the speed of the piston extension and therefore how quickly the seat rises. Depending on the force applied to the release button the user determines the amount physical boost they require to come to the standing position.

The Up-N-Ease apparatus also includes wheels for easy portability. Three out of the five wheels include brakes that are to lock once the chair lift is activated. The locking mechanism may be easily implemented by the use of the user's heel. The chair also comprises of recline, swivel and height adjustment mechanisms.

Figure 3: *Front View of Prototype*

The Automatic Retractable Wheelchair Canopy

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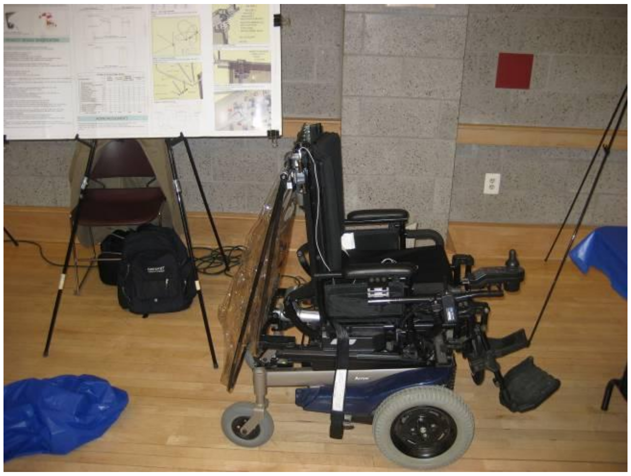

a) ARWC - Retracted Position b) ARWC - Operating Position

Introduction

The Automatic Retractable Wheelchair Canopy (ARWC) provides switch activated rain protection for wheelchair bound handicap people. With the press of a switch located on the armrest a handicap person can activate the assembly of a canopy system above him or herself. When rain protection is no longer needed another press of the switch retracts the canopy into a confined space behind the backrest.

Summary of Impact

The ARWC allows a handicap person with limited abilities to effectively protect themselves from rain. Currently the most popular products are ponchos, manually mounted canopies, and umbrella holders all of which require significant mobility from the handicap person.

Technical Description

The basic operations of the ARWC are best explained with a brief description of the mechanical and electrical process. The ARWC in its retracted position stores the overhead protective component behind the backrest. The process begins with the single press of a switch located on the armrest. An electrical signal activates a motor that consequently drives a mechanical assembly comprised of a motor, worm, worm gear, shaft and three U-tube links attached to a weather resistant clothe. The sequence of events results in the linkage system relocating directly above the handicap person and wheelchair to form the structure for the weather resistant cloth and transform into the protective canopy. When the overhead protection is no longer needed another press of a switch retracts and stores canopy in a confined space behind the backrest.

a) ARWC – Front View

b) ARWC – Rear View

Solar-Powered Desalinator.

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Figure 1: Solar-Powered Desalinator

INTRODUCTION

Our purpose is to design a portable solar-powered desalination device for small-scaled household needs. The device is capable of harnessing solar power and to desalinate seawater. The Solar-Powered "Desalinator" will convert the salt water to freshwater by removing the salt and other harmful materials. The device will be equipped with indicators for the battery's lifetime.

Desalination can be defined as the purification of salt or brackish water by removing the dissolved salt and other impurities. The apparatus works on the principles of distillation that purifies liquids through boiling, so that the steam or gaseous vapors condense to a pure liquid. Pollutants and contaminants may remain in a concentrated residue.

SUMMARY OF IMPACT

This device is utilized to formulate fresh water from polluted or seawater.

TECHNICAL DESCRIPTION

The lift is made up of four major components: The cart, still, the frame, and solar panels. The cart is the main supporter of the entire device. The cart has two compartments. In the bottom shelf, it holds the battery, the winch, and the fresh water reservoir. In the top shelf, it holds the still, the frame, and solar panels.

The still is mounted on the top shelf of the cart. This is where the distillation process occurs to produce fresh water. The still consists of an inlet to pour water in the system, a heater to heat up the polluted water, a float switch to control the water level, a tempered glass for the vapor to condense and also act as a solar "collector," a trough where the vapor is collected, and an outlet where the fresh water exists.

The frame is mounted around the still on plywood used for support. The frame material utilized is aluminum. The frame holds the solar panels in place at a certain angle. The angle can be adjusted to position the solar panels according to the sun by running the winch. A guided rail is used to angle the solar panels. A slider is used on the frame to extend the solar panels.

Solar panels are essential in this design. The panels are supported on the aluminum frame. The solar panels accept solar energy to then convert it to electrical energy. This electrical energy is stored in the battery. The battery is then used to power the heater, which boils the water. There are two 50-Watt solar panels utilized in this device.

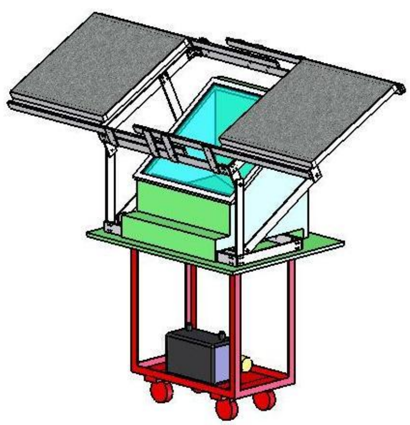

FIGURE 2: Panels Extended

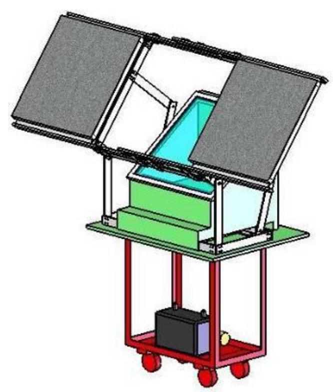

Figure 3: Panels Extended Angled

The procedure of the device is as follows: The device is placed out in the sun for the solar panels to store energy in the battery. Then water is poured in the still from an inlet up to the water level mark. The switch for the heater is turned on to boil the water. The water vapors condense on the glass and drip down into the trough. The trough is angled so the condensed water slides down the trough and exists through an outlet. The water goes through an external purifier to finally produce fresh drinkable water.

Torque Sensor for MEMS Devices

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Project Involvement: Yu Zhou, Jim Quinn
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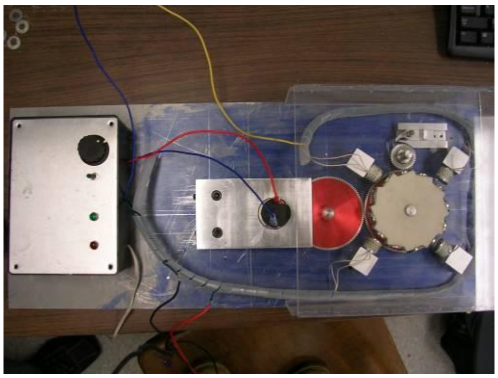

Figure 1a: Torque Sensor

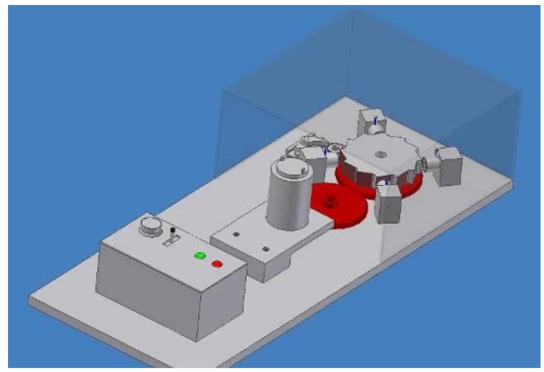

Figure 1b: Torque Sensor in 3-D

Introduction

The purpose of this project is to design a sensor which measures the torque and provides a reasonable estimation of reliability and lifetime of electric micro-motor without causing any significant impedance to the system. Because of the scale of the sensor, the fabrication process is often proven to be difficult and rather expensive. Therefore, the fabrication of large scale prototype has been done to mimic the conditions found in the micro-motor.

Basically, the concept that has been used in this design is the natural attraction forces in magnets. This attractive force will act as the resistance in the prototype that will assist in measuring the torque. The sensor's measurements will be acquired and converted from analog-to-digital signal through the use of a system of variable resistors that will detect the magnitude of the current and sends a signal to a virtual instrumentation program LabVIEW.

Summary of Impact

This project develops a torque sensor that can measure the maximum torque without causing the damage to the system.

Technical Description

In the complete design, all the components are mounted to the base plate. The motion of the gear system (or the stoppage of motion) will be counteracted by the controller sending current through the electromagnets and once the resistive force overpowers the motion, the pawl switch will trigger from the ratchet. Once the system stops, we measure the current and that corresponds to the force that the maximum torque of the motor reaches.

The figure 2 shows the CAD drawing with dimensions of our torque sensor mounted on the base plate. The figure 3 shows the top view of the torque sensor and isometric and real image are indicated in the figure 1a and 1b, respectively.

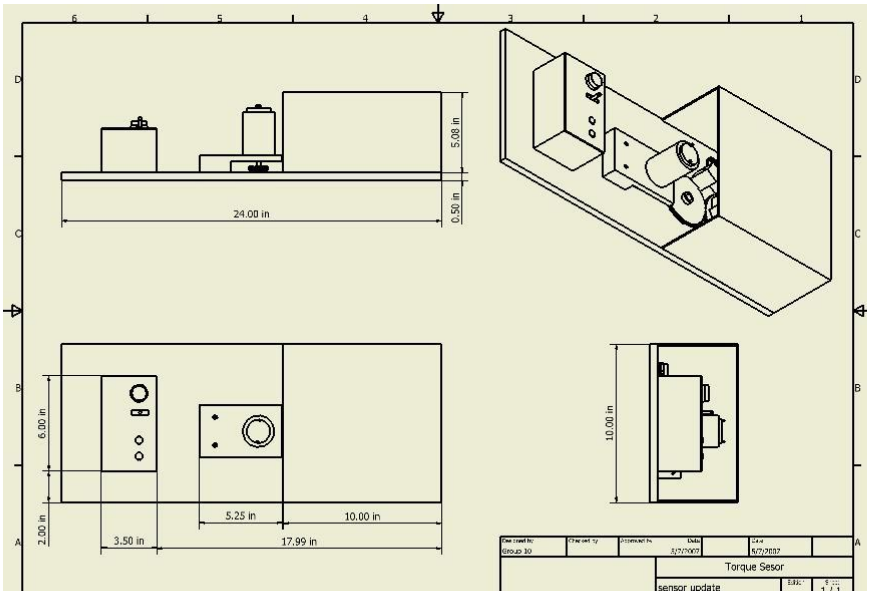

Figure 2: Assembled Drawing w/ dimensions

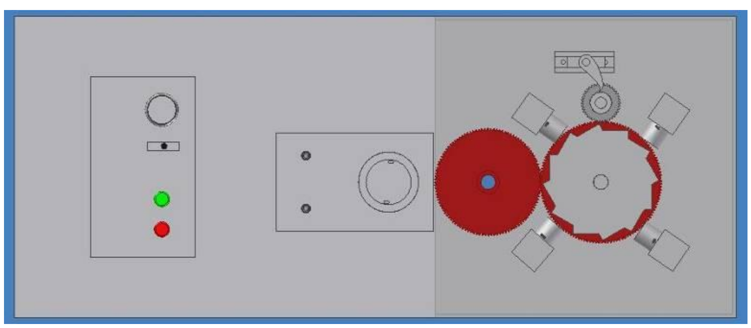

Figure 3: Top View

Restoration of A Solar Powered Boat

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Supervising Professor : Yu Zhou
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Figure 1 The Boat Hull

Introduction

The Solar Splash solar powered boat is used to compete in the annual ASME Solar Splash competition. The goal is to restore the boat, as well as the Stony Brook Solar Splash team. This team would provide an alternative to the Stony Brook Motor Sports team, and allow for more participation by team members, due to its small size. The boat itself can be used for the ASME Solar Splash competitions, once it is restored.

Summary of Impact

The Solar Splash team has already recruited several students wishing to participate in Solar Splash. The restoration of the boat has allowed these prospective members to see the process by which a Solar Splash boat is built and fitted. Thus, through hands on demonstrations, we have gained the interest of these students.

Technical Description

The solar powered boat uses mechanical and electrical systems. Its mechanical systems include the steering and the shaft and motor assemblies. The electrical system consists of the dead mans switch, the pulse width modulator and the batteries that power the motor.

The motor used is an LEM-13 from Lynch Motors. It is connected in ,a direct drive configuration, to the shaft. The shaft extends through the hull and into the rear of the boat, where it is mounted to the outside hull. The motor is connected to the PWM system as well as the speed control box. The batteries connect to the PWM, and all the equipment is connected to the dead mans switch.

The steering system for the boat is a steering wheel with an exposed drum with a cable wrapped around it. The cable passes through a set of pulleys which leads it to the rudder quadrant. The rudder quadrant is directly connected to the rudder, and thus the steering wheel controls the rudder directly via cable.

Figure 2 : Steering column

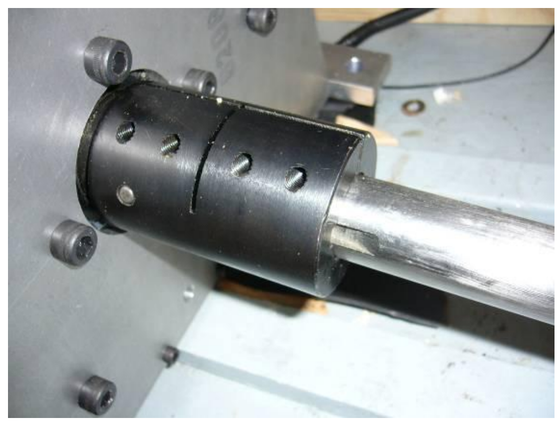

Figure 3 : Motor Couple

Solar Powered Personal Computer

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Figure 1: Assembled Working Prototype

Introduction

The aim for this design is to reduce electricity cost, and reduce green house gas emissions by utilizing solar energy to power a personal computer. The design allows the user to power their personal computer from a kit which is self-installed and considered "off-the-grid." The term "off-the-grid" refers to the fact that the system is completely separate from the power grid which supplies electricity to the rest of the user's home.

Some influences for our design were that efficiency must be kept high, and cost reduced. The reduced cost is important to keep the investors return on investment short. Many people are passionate about being environmentally sensitive, but will only do so when there is some kind of monetary advantage. High efficiency helps keep cost down as well as being an engineering challenge. An overall efficiency of 78% was predicted, this number neglects power lost from the sun to the panel.

Summary of Impact

The solar powered pc allows the user to power a computer for free using the energy supplied from natural sun light. The design benefits the user because they will see a decrease in their electricity bill as well as decreasing green house gas emissions. The growing awareness of environmental issues and the growing desire of society to correct centuries of environmental abuse; makes this product highly desirable.

Technical Description

The advantage this design offers when compared to similar products on the market is that this design utilizes 100% DC current. Keeping the current in DC form allows efficiency to remain high, while reducing an expensive part that is typically required to convert a DC signal into an AC signal. Solar panels absorb energy from the sun and convert it into a DC current electric source. Computer hardware also utilizes a low voltage DC current. The combination of both these technologies is almost obvious.

The design incorporates many off the shelf components. Solar panels, glass-matt sealed batteries, a solar controller, a computer, and a DC input power supply were all combined to create a system that can power a computer with a storage capacity of over 10 usage hours. The solar panels chosen based on there high efficiency, and high power output. The high power output of the panels allowed our design to only require two panels, compared to most other models which would require at least one possibly two more panels. The batteries were selected because they incorporate a deep cycle discharge, and large storage capacity. The solar controller regulates the voltage from the solar panels, controls the charging of the batteries, prevents over-charging of the batteries, and regulates power distribution to the computer. The DC input power supply allows the computer to accept the DC current.

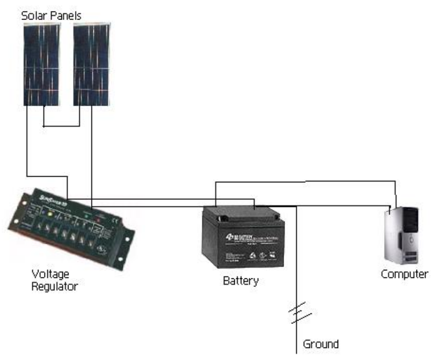

Figure 2: Wiring Schematic of System

The entire system is designed around the 24 volt input DC power supply. A 12 volt or 48 volt system could have been designed, but 24 seemed optimal. Therefore, many components had to have compatibility with 24 volt systems. Most components this was not problematic, but since 12 volt batteries are common this was an issue. It was decided to utilize two, 12 volt batteries combined and wired to form a 24 volt battery system. This was accomplished by simply wiring a positive terminal and a negative terminal together. Now the potential difference between the two remaining positive and negative terminals is 24 volts. A single 24 volt battery could have been used, but cost was much higher, and availability is not nearly as good as 12 volt batteries.

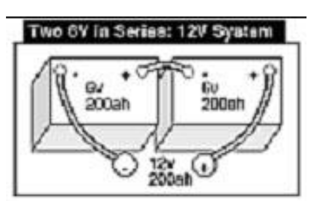

Figure 3: Principle used to wire batteries

Non-Contact Socially Interactive Robot

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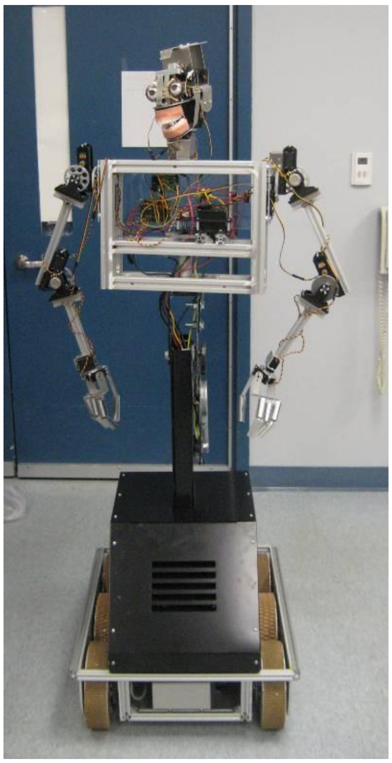

Fig. 1 **– "Jeff" fully assembled**

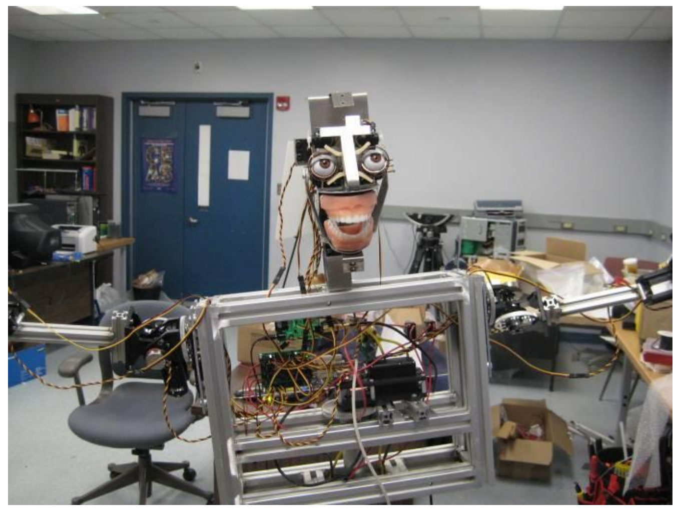

Fig. 2 **– "Jeff" expressing itself**

Introduction

The goal of this design team was to develop a non-contact socially interactive robot. This socially interactive robot can be used for a variety of different human/robot interactions, applications, educational, rehabilitation and entertainment purposes. In order to design such a human-like body, this robotic platform has an upper torso, moving waist, and two arms. The mobility of the upper body goes hand in hand with the structure. There are 4-degrees of freedom for each arm and 2-degrees of freedom for the waist. The objective of the arms is to provide non-verbal communication such as gestures and expressions. The waist provides additional degrees of freedom to allow the robot to attract the attention of the human, i.e. for face to face interaction and also to provide additional degrees of freedom for expressions via non-verbal communications.

Summary of Impact

This project will assist those or provide entertainment for anyone who wants to interact by this non-contact socially interactive robot.

Technical Description

The preliminary design of this robot will consist of a human-like demeanor having similar functionalities to a human from the waist up. However below the waist is the support structure which is mounted on top of the wheeled base. The support structure is comprised entirely of powder-coated cold-rolled steel (11 and 16 gauge). The upper structure and the support structure meet at the waist where there is a ball bearing track and a pivot. The frame for the torso of "Jeff" is comprised entirely of extruded aluminum bar stock. The majority of the motion that "Jeff" does is provided by the 10 servo motors scattered throughout its body: 4 for each arm and 2 waist motors. This robot will provide visual and tonal entertainment by moving its arms while talking and it even sings.

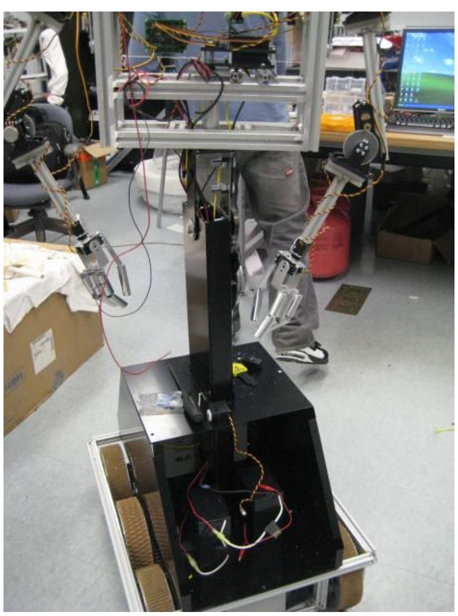

Fig. 3 **– Support structure**

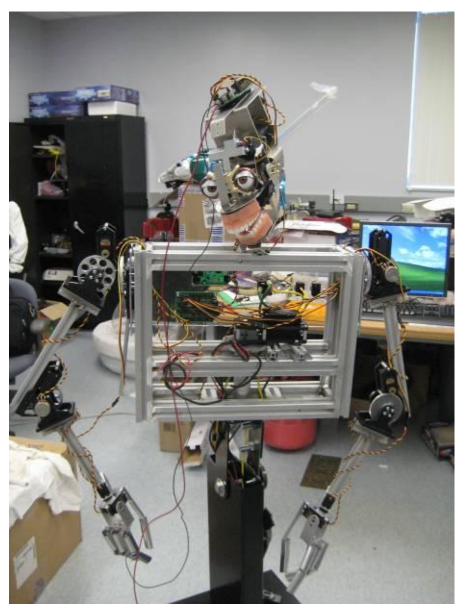

Fig 4 **– Upper frame w/ head**

THE ENERGY EFFICIENT REFRIGERATION SYSTEM

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INTRODUCTION

This design involves modifications of a refrigerator that will utilize existing temperature differences for both cooling of the inner refrigerator and of the condenser coils. The primary modification is the addition of dual heat exchangers extending from the inside of the refrigerator to the outdoors in order to passively remove the heat, thus eliminating the need for the compressor during sub forty degree Fahrenheit weather. The second modification works by attaching an array of heat pipes to the condenser coils thus lowering the coefficient of performance. The temperature gradient will be provided by cold water which would run into the household water heater or into an outdoor geothermal piping system. Both modifications will lower the energy needed to run the refrigerator thus reducing the annual cost. The Energy Efficient Refrigeration System is suitable for both existing homes and new homes due to the minimally invasive modification required for the refrigerator and hose structure.

SUMMARY OF IMPACT

Refrigerators exist in every household in America. Even with minor adjustments on individual appliances to conserve energy, the energy saved collectively would be significant. The heat exchanger addition will alleviate the electricity consumption of the compressor, and the heat pipe attachment will lower the electricity consumption of the compressor.

TECHNICAL DESCRIPTION

Heat pipes are highly conductive pipes that passively transfer heat. The heat pipe heat exchanger was constructed and mounted to the fridge. Cold water is run past the baffles on the condenser section of the heat pipes, while the evaporator section of the heat pipes is in direct contact with the condenser coils. Conductive grease was used to fill in the gaps between the fins on the heat exchanger. The refrigerator consumed 0.04 kilowatt hours when run under normal conditions (without the use of the heat exchanger). The heat exchanger was then filled with water at 12 degrees Celsius and maintained approximately at this temperature to simulate constant flow conditions. With the functioning heat exchanger, the refrigerator performed at 0.03 kilowatt hours. The system was shown to run with approximately 25 percent less energy consumption.

The outside heat exchanger expels heat to the outside environment by natural convection, forced convection, and radiation. The most prevalent out of all the methods is forced convection. The average wind speed in NYC is 10mph during the winter with a temperature of 30 °F. Using these numbers, a heat exchanging rate of 182 W is optimally generated. The heat exchanger that is inside the refrigerator is operated by forced convection, radiation and conduction with forced convection being the most dominant. A heat exchanging rate of 170 W is possible, alleviating the use of the compressor to maintain the temperature inside the refrigerator. The refrigerator compartment will peak at about 10^{o}F more than the outside temperature due to the heat added from the pump and the input lines. The pumping power in our test uses about half the energy of the fridge which would result in half the operating cost.

Figure 1 Interior of refrigerator with heat exchanger coils

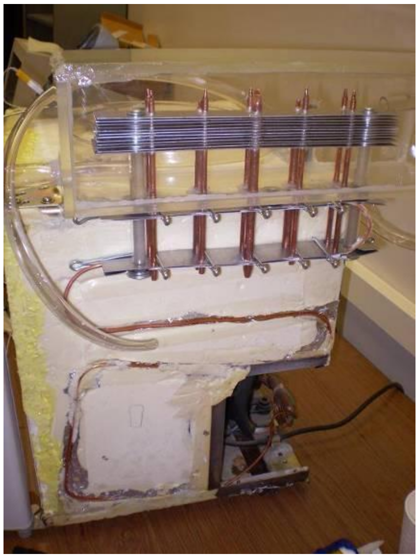

Figure 2 Exterior of refrigerator with heat pipe attachment

Hydro-Mobile- Hydrogen powered cell phone charger

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Figure A- Hydro-Mobile Housing

Figure B- Hydrogen Fuel Cell
(courtesy of Fuel Cell Store)

INTRODUCTION

Hydro-Mobile is a hydrogen fuel cell powered portable electronic device charger. The use of alternative energy sources is a pressing issue in today's world due to a recent global awareness of more efficient energy sources. That is why the main goal of this project is to develop a portable device charger that runs solely on hydrogen and oxygen. Essentially, the product will eliminate the need for any other energy source, such as electricity to charge a portable electronic device. In addition, individuals can keep the product on-hand in case a portable electronic device to be charged where an electric outlet is inaccessible.

SUMMARY OF IMPACT

The device is durable and uses hydrogen fuel cells to provide energy to a cell phone or other portable device. The device can be used by any electronic device user and is easy to use.

TECHNICAL DESCRIPTION

As shown in Figure 2, Hydro-Mobile includes three 1.7 volt producing fuel cells, a Horizon PEM Electrolyzer, a solar panel, tubing, wiring, and a Plexiglas housing. The system was designed to eliminate potential hazards from the use of hydrogen. The Horizon PEM electrolyzer, which is powered by a solar panel, produces a safe amount of hydrogen, which is then connected directly to the fuel cells. The fuel cells, connected in series, then draw in the hydrogen and oxygen from ambient air and produce approximately 3.7 volts, which will power a device, such as a cellular phone. The system is entirely selfsustaining as long as solar energy is provided to the solar panel. The housing is assembled using Plexiglas, which gives the device protection while maintaining a modern appearance.

The total cost of the project is approximately $450.00 including all of the necessary parts.

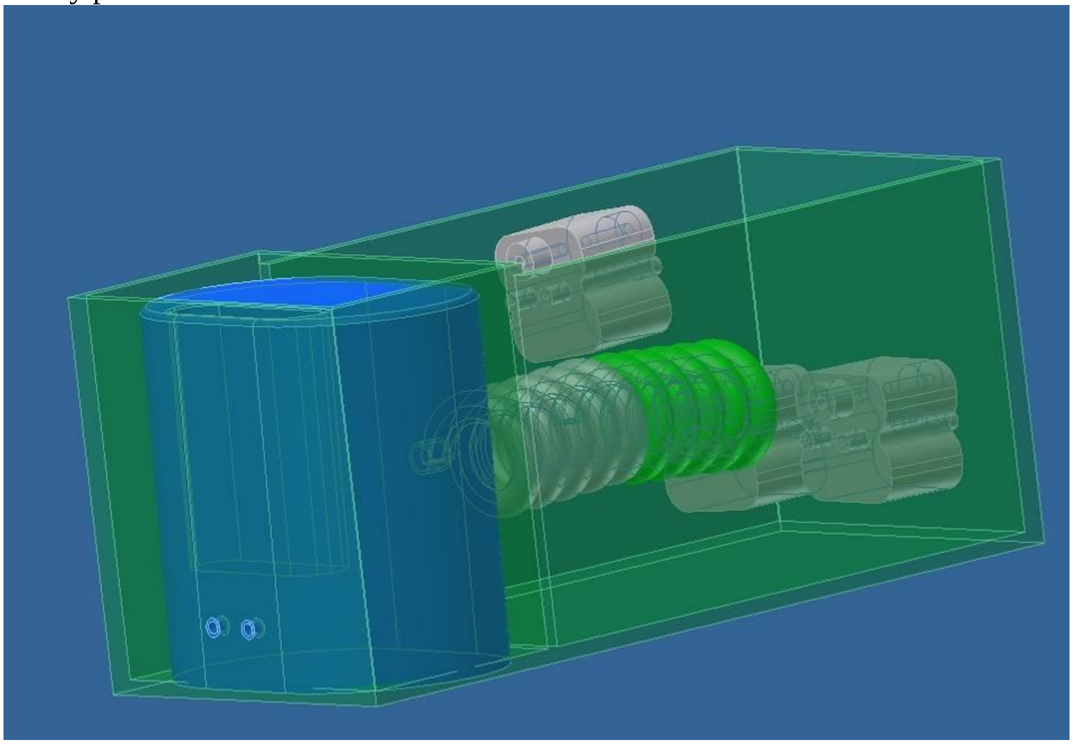

Figure C- Total Assembly of Hydro-Mobile without lid

The Human Power Water Distiller

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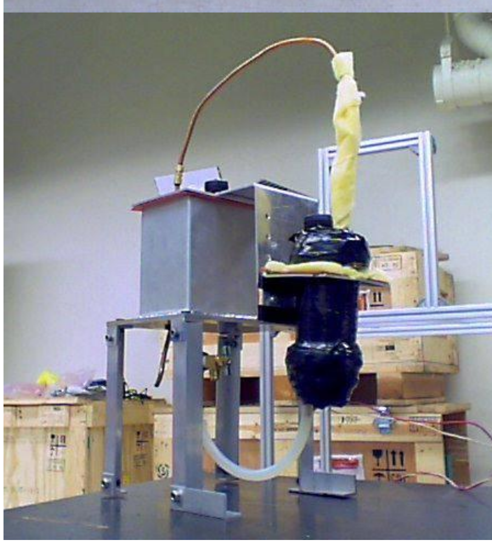


Power Transfer Mechanism Water Distiller thermal system

INTRODUCTION

The purpose of the human powered water distiller (HPWD) project is to create a self-contained device that can produce clean water from polluted water by means of human mechanical motion. The HPWD can be used in areas that have undrinkable water and no other means of power generation except for people. Examples of areas that the HPWD can be used are disaster sites and poverty-stricken areas.

SUMMARY OF IMPACT

This project provides purified water using human power to areas affected by major disasters. Disasters can cause disruption in the supply of potable water as well as temporarily eliminate all sources of power such as electrical lines and flammable sources of heat. This design depends entirely on human power to distill polluted water and provide survivors with potable water.

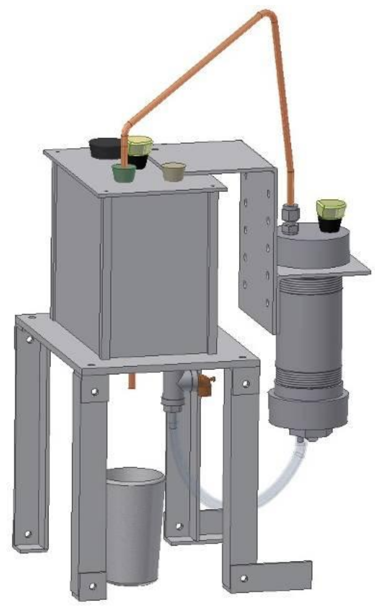
TECHNICAL DESCRIPTION

The human powered water still is made up of two main systems: a stationary power input bike and a thermal water distiller system. The two systems are connected together by wires from the generator to a safety wiring box to the distiller's resistive heating element. This device converts mechanical energy into heat via a production of electrical power as intermediary. The stationary bike utilizes rectangular stock and angle stock for legs to give it stability. There are also sprockets and chains that connect to and rotate the generator shaft. The generator is powered when the rider pedals the bike with their legs which then drives a three stage set of sprockets and chains to maximize the speed of the generator shaft.

The generator is connected to the heating element of the thermal system which provides power to the heating element to heat up the water in the boiler. The thermal water distiller system consists of an aluminum dirty water storage tank, a stainless steel boiler with aluminum caps, and a copper pipe heat exchanger that coils back in through the dirty water storage tank. The dirty water goes from the storage tank through a rubber tube to the boiler, like a manometer. The water is then heated eventually reaching boiling at which point steam is produced. The steam then rises into the copper tubing heat exchanger which passes through the dirty water tank returning some heat back to the system as a preheat of the dirty water and condensing the steam back to liquid water which flows via gravity out of the heat exchanger and into the clean water storage tank or cup.

The total cost of building the prototype was $728.56 which doesn't include cost of materials from the Engineering machine shop or the labor for custom fabrication of parts and system assembly. This price is retail and can be significantly reduced if parts were purchased in bulk at wholesale prices.

3-D Model of Power Transfer Mechanism System



3-D Model of Water Distiller Thermal

The CSPN Gripper

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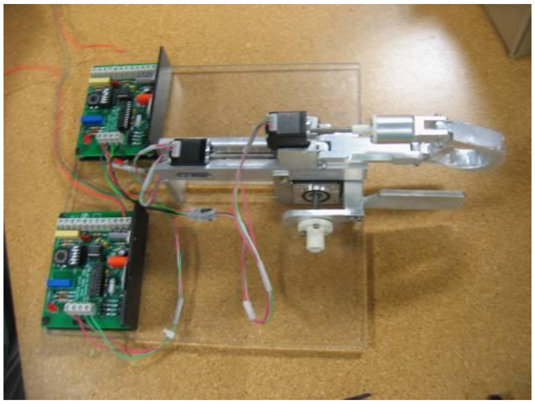

Fig. 1-A: CSPN Gripper View

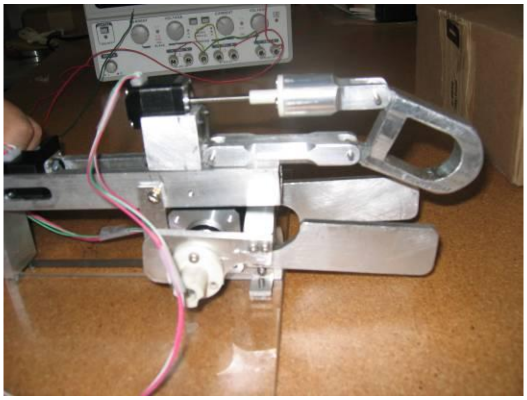

Fig. 1-B: CSPN Gripper Side View

INTRODUCTION

The main goal of this project is to design a robotic gripper that can grab reading materials out of a library bookshelf for the disabled and elderly people with limited mobility in a library, home or office environment. The gripper will be attached to a robotic arm to provide a complete mobile gripping system. Many book shelves are higher than eye level and it would be impossible to reach certain books without standing up. With this gripper, users can retrieve books from unreachable spots on the bookshelf without needing to stand up or receive outside help.

TECHNICAL DESCRIPTION

The gripping process consists of two motions; tipping and a grabbing motion. Imagine a person that is tipping a book out, as soon as the finger lands on the book and the tipping motion begins. The finger will be positioned at the top of the book and curl to tips the book out. After this process is complete, the book must be tipped out to have enough contact area on the sides to allow the gripping motion. The four-bar linkage explained above have provided the tipping motion yet no linear motion to actually pull the book out. Therefore, a slider is needed to complete the linear motion. Lastly, two fingers at the sides are needed to complete the book grabbing motion. Therefore final design consists of three main parts. Finger to top the book, slider to pull the book out, and two fingers to grab the book. A simple four-bar linkage mechanism is used to emulate the tipping motion of a finger. As seen in figure 1-B, top motor and its base serve as the ground link, two links on top and bottom, and lastly the finger as the fourth link. As the motor pushes the top linkage forward, it will make the finger link to move. This will give rise to a simple tipping motion that resembles the tipping motion of a human finger. A high friction material (in our case, it is hot glue) is attached to the end of this linkage. High frictional material is required to prevent the book from sliding in the next step of the gripping motion. Both, the motor that is attached to the top linkage and the bottom linkage itself are attached to the slider. The slider is allowed to move linearly on the guide rail. The linear motion of the slider is provided by another motor (Hayden 21000) that is attached at the end of the guide rail itself.

Next, the two bottom finger, which consists of a motor (Hayden 35000), motor mount and the gripper, is attached to the bottom of the slider. The motor itself has a screw that goes through the motor from one side to the other and the grippers are attached to each side of this screw. As the motor turns the screw clockwise or counter-clockwise, the gripper will close in to grab the book or it will move away and releases the book. The motor (Hayden 35000) is attached to the bottom of the guide rail as seen in Figure 1-B. With this, the whole assembly of the mechanical part is complete.

The circuitry and programming is crucial in the motion of the gripper. Circuitry and programming makes it possible to create the sequence of the gripping motion. At start, the controller turns on the top motor. When the top finger is tipped so that there is a decent amount of pressure between the finger and the gripper, a sensor attached to the bottom of the finger will signal the program to turn the top motor off and start the motor for the slider. When the slider has pulled the book out, second sensor will signal the program to stop the second motor and start the third motor and move the two bottom fingers. When there is enough pressure on the sensors attached to the two bottom fingers, the whole process will stop.

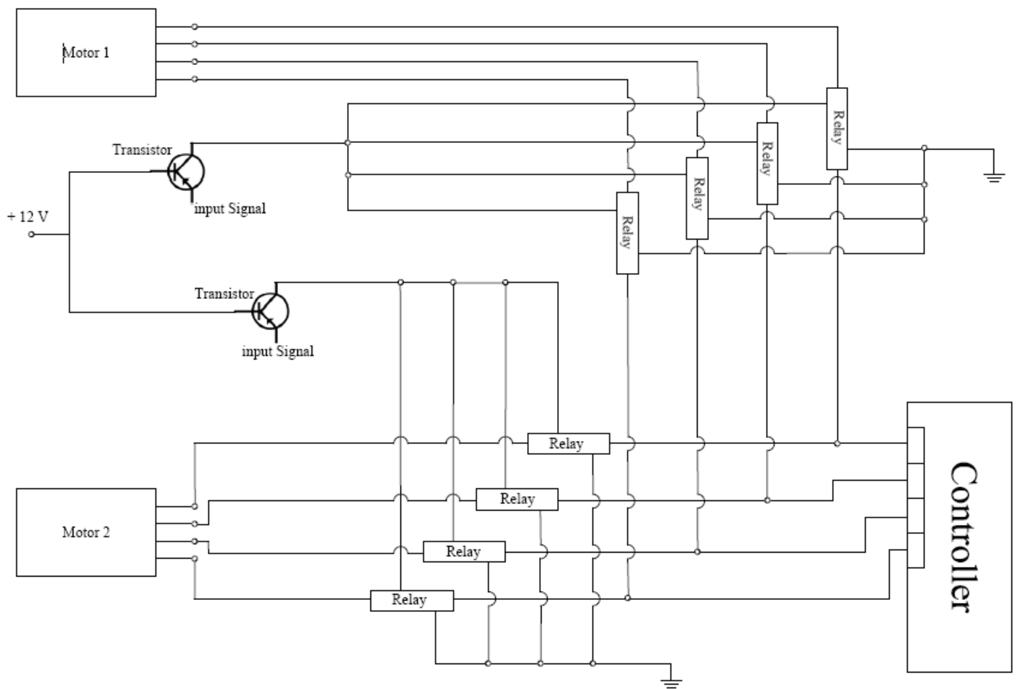

Fig 2-A: Motor and Controller

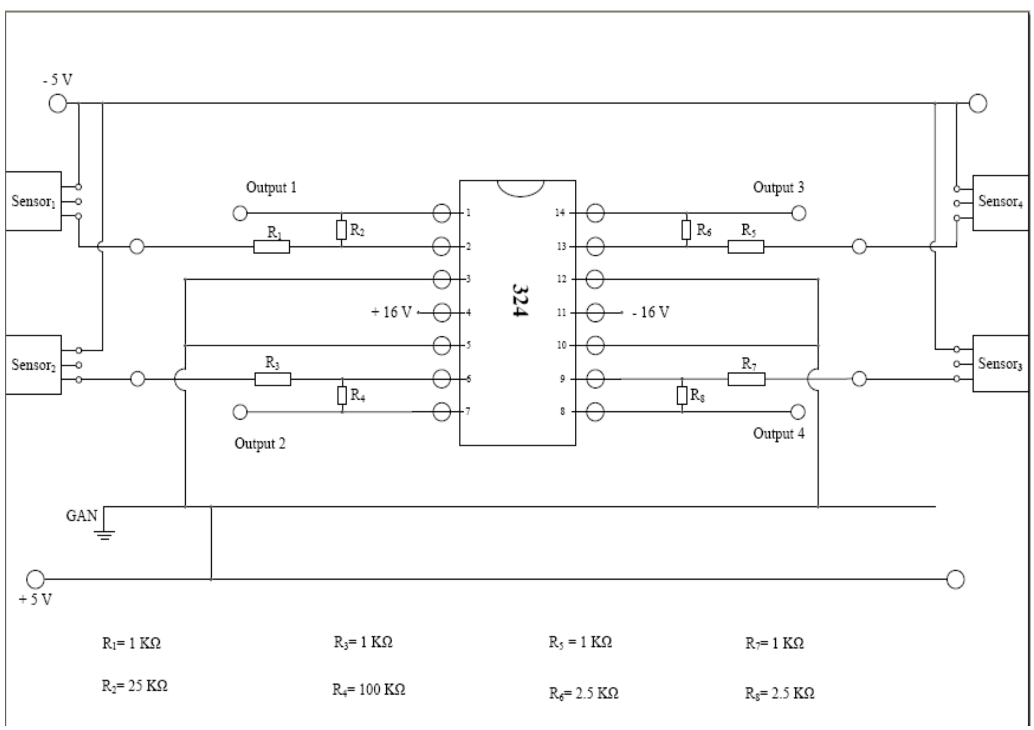

Fig 2-B: Amplifier and Relays

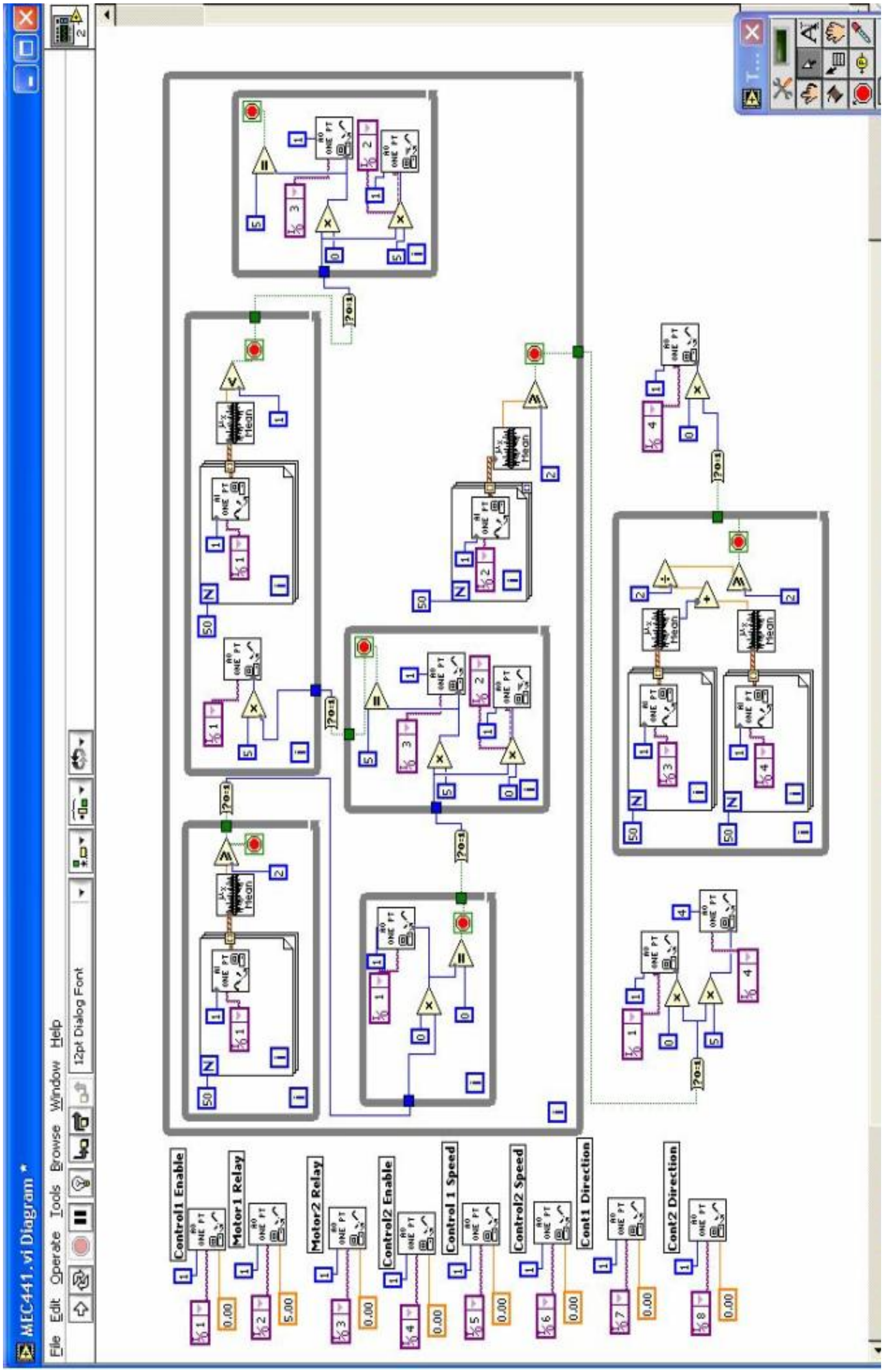

Fig 2-C: Programming

Ankle Force and Angular Parameter Measurement Devices

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Introduction:
Children with cerebral palsy show signs of one or more impairments that affect motion control and walking. Range of motion and the ability to generate force about an ankle joint are limited due to a combination of factors that affect muscle control and other tissues surrounding the joint. Hence, their ankle movement and force are small. There are no current methods that measure such joint forces and angular parameter.

Summary of Impact:
The goal is to develop two electronic devices to measure ankle force and angular motion respectively for children with cerebral palsy between the ages of 6 to 13 years old.

Technical Description:

Figures 1&2 – Ankle Force Measurement Device

Ankle Force Measurement Device

The device is used to measure the tapping force of the foot. The upward and downward forces of the movement are generated from the ankle. First we developed a mechanical device that could mimic the movement of the foot tapping motion. We would have a pedal that is supported by two supports and that pedal is rotating on an axis. At the end of the pedal there are two pushing beams, one on top and the other on the bottom of the pedal. The pushing beam would exert a force on the bending beam located on an outside casing, and that force is measured. In order to measure the minimal force that the child with cerebral palsy would apply, a very sensitive sensor is needed. A strain gauge is a sensitive sensor which converts information about the strain placed upon an object into a change of resistance. With the change in resistance, a program is developed in Labview and the forces would be the readout.

Ankle Angular Parameter Measurement Device

Figure 3 - Ankle Angular Parameter Measurement Device

This device is used to measure angular motion of ankle. The major characteristic of this design is a pedal connected by two pins to either two opposite supports. The pins are removable. It can be put in along either x-axis or y-axis. The pedal can rotate along either x-axis or y-axis at a time after the pins are installed. There are eight major components in this design, which are pedal, shielded ball bearings, supports, pins, base, gyro, evaluation board, and software. The pedal provides a platform for foot to step on it and insert pins. Also it is the platform of the evaluation board where it secured. The shield ball bearing is used to reduce friction between pins and supports. It reduces the uncertainty during the measurement caused by friction. The supports provide housing for the bearings and raise the pedal to give it range of rotation. The pins are connecting the pedal and support and give the pedal ability to rotate along the pin axis. The gyro is complete angular rate measurement system in a single microchip. It is used to detect and measure angular rate along both x-axis and y-axis. The evaluation board is a PC-based evaluation system designed for integrating into existing design platform, eliminates the need for “prototype” soldering and simplifies interface design for gyro. The base provides a strong and stable platform to four supports. The software provides options for evaluating the gyro. Also it is used to displace, control and calibrate the output of gyro.

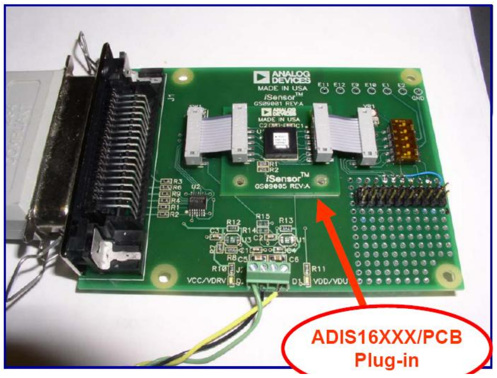

Figure 4 - The evaluation board of gyro

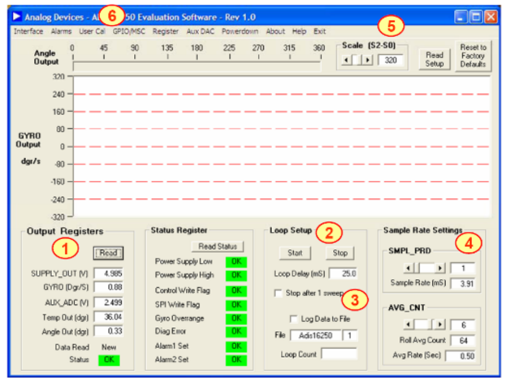

Figure 5 - The software of evaluation board