REVO STATIONARY BIKE

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OUTLINE

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RATIONALE FOR STUDY

Rehabilitation
- Conventional stationary bikes are inaccessible for elderly due to lifting leg over seat
- Exercise after knee or hip injuries
- Muscular integrity

Power Generation
- Many stationary bikes currently power user interface with power generated by workout, but no further use is implemented
- Possible use in outer space, maintains muscular integrity and allows for generation of power in space
TARGET MARKETS

- Rehabilitation Services
  - Nursing homes
  - Physical therapy

- Recreational use
  - Physical Training Establishments
  - Private Home Use

- Space Applications (NASA)
CURRENT MARKET

- Rehabilitation – no user interface
  - Stationary bike peddle assembly – $26.23- $63.45
  - Restorator Clinical Model - $439.00
CURRENT MARKET

- Rehabilitation – with user interface
  - Deluxe Resistive Pedal Exerciser - $132.03
  - Magneciser – $165.24
  - Monark Rehab Trainer - $1,495.00
CURRENT MARKET

Generating power

- **Green Revolution Inc.**
  - making stationary bikes into mini-power plants
  - Claim one year’s worth of workouts could produce enough energy to power lights in 72 homes for one month
  - No further explanation as to how long a workout is or how many people are needed

- **Windstream ©**
  - Supply all necessary equipment to make human generators with stationary bike
  - Have their own bike generator system with many attachments
No specific patents about rehabilitation stationary bikes or power generation system implemented into stationary bikes

General frames and pedal assemblies for stationary bikes have been patented along with all of the parts used in each
Stamina 5325 Upright Stationary Bike

- Stationary bike chosen to be modified
  Frame, seat, console, handrails, and drive train will be used
Stamina Frame Representation

- Real Stock Frame Photo
Stamina Frame Representation

• CAD model of stock frame
Modified Frame for Revo

- Tilt Actuator Anchor
- Cut Down Seat and Console Tubes
- Rear Stabilizer
- Main Pivot for Seat Mechanism
- Extended Rear Section
- Point of Attachment for Console Stand
- Extended Forward Section
- Forward Stabilizer
Seat Mechanism: Track

- Modified I-Beam with actuator brackets
Seat Mechanism: Track
Seat Mechanism: Trolley

- Six guide wheels connect the trolley to the track
Seat Mechanism: Trolley
Assembled Seat Mechanism
Console Support Column: Swivel Base

- Connects Support Column to Frame
Console Support Column: Swivel Base
Console Support Column: Tilt Bracket

- Pivot Point for Tilt Function of Column
- Rotates in Swivel Base
Console Support Column: Tilt Bracket
Console Support Column: Outer Column

- Lower Section of Console Support Pivots in Tilt Bracket
Console Support Column: Outer Column
Console Support Column: Internal Column

- Telescopes from Outer Column Connects to Console Base
Console Support Column: Internal Column
Console Support Column: Stopper

- Keeps Internal Track from Being Pulled Out of Outer Track
Console Support Column: Stopper
Assembled Console Support Column
Console: Display Base

• Houses and Anchors all Console Features
Console: Display Base
Total Frame Design

- Rear Mounting Platform
- Seat Mechanism
- Generator Mounting Platform
- Console Support Column
POWER GENERATION SYSTEM

Overview

- User’s kinetic energy rotates generator shaft sending electrical energy to battery which powers an inverter, head console, 3 actuators, Philips LCD DVD player, and the mini-track.
**POWER GENERATION**

- The user’s kinetic energy turns the pedal assembly, which turns the fly wheel.
- As the fly wheel rotates it spins the generator shaft.
- With an estimated generator shaft roller diameter of 3 inches the relationship between the user’s RPM and the generator’s RPM is 1:24 found by calculating the circumferences of the assembly, flywheel gear, flywheel, and estimated 3 inch roller for the generator.
- Using the generator’s operating manual RPM vs Voltage relationship and an estimated patient’s 50 RPM, the output voltage produced by the generator is roughly 6 Volts.
POWER GENERATION

- Following the generator is a diode full wave bridge kit rated for 35 Amps to prevent backflow of current into the generator.
- Because the voltage produced is much less than 12 volts required for the battery, a transformer may be required, however it is more likely that the ‘gearing’ ratio will be changed to have higher RPMs from the generator to create more voltage.
- After the transformer, or bridge circuit, is a voltage regulator to control the voltage to the battery at a constant 12 volts.
Power Control

- The 12 volt deep cycle battery will have a battery monitor that will constantly be reading the battery life left.

- The battery powers several different parts of the bike each requiring a different voltage and different current demands.

- The voltage will be controlled by several different voltage regulators, depending on the need for each part of the bike.

- A fuse will also follow most of the regulators to prevent an overflow of current from reaching a circuit and creating a potential harmful situation.
ACTUATORS

- The three linear actuators require 12 volts therefore no voltage regulator is required.
- The larger of the three, 5ZC33, has a max load of 22 Amps and thus will have a 25 Amp fuse while the smaller two actuators, 5ZC47 and 5ZC44, both have a max load of 6 Amps so they will each have a 10 Amp fuse.
- All three actuators have a two way switch to either elongate or contract the motor when needed. When not in use the switch is in an idle ‘neutral’ where no motion takes place.
**Console, Mini-track, and Philips LCD DVD Player Set Up**

- All three of these systems have a 10 Amp fuse to prevent an overflow of current and damaging the system.
- The console required a voltage regulator of 12V down to 3V to replace the AA batteries in series.
- The mini-track system requires a voltage regulator of 12V down to 5V to power the microcontroller system.
- The Philips LCD DVD player is best powered using a car cigarette outlet adapter, which required 12V so no regulator is necessary after the fuse going to the adapter.
POWER INVERTER

- In the case where the user has an additional external device requiring power there is the 1500W power inverter.
- The inverter converts the 12Vdc to 120Vac and makes it accessible via two outlets.
- There is a 75 Amp fuse in between the battery and the inverter.
MINI-TRACK SYSTEM

- The purpose of the mini-track is to act as a simulated 200 m track and show the user’s progress.
- This system was built using a microcontroller and twenty LEDs.
- The microcontroller will be programmed with C code that will tell the LEDs when to turn on
MINI-TRACK SYSTEM

- The code for the microcontroller can be found on the team website and in the appendix of the final report.
- When the Multisim file was to Ultiboard ‘27 virtual’ pieces weren’t transferred leaving just the microcontroller and the voltage regulator and has been left out of the presentation.
CONSTRAINTS

- Economic constraints
  - Little money for personal spending
  - Personal fitness not priority

- Production costs
  - Product Estimate: ~$950.

- Sustainability
  - Regular maintenance, part replacement
CONSTRAINTS

- Health and safety
  - One primary purpose is rehabilitation, safety must be assured
- Manufacturing
  - Making the main unit with interchangeable seats
  - Must be very customizable with settings for each user
- Knowledge base
POSITIVES

- **Environmental**
  - Compact design, “green” capabilities of producing energy
  - Can be made of recyclable materials

- **Marketing**
  - Positive influence on personal health
  - Fits “green” revolution trend
  - NASA use possibilities
**SAFETY**

- Safety is main concern in a rehabilitation unit
  - Extra care in electrical systems with voltage regulators and fuses
  - Limited moving parts, more room for user, less chance of mechanical failure
  - Emergency cart stop
  - Reinforcement of frame
  - Foot straps
IMPACT OF ENGINEERING SOLUTIONS

Rehabilitation

- Being the first rehabilitation device of its kind the Revo could open a new market.
- The ability to help patients recover faster and stronger creates an overall healthier society.

Power Generation

- ‘Going green’ is the current trend.
- The Revo can be made entirely of recyclable materials, other than the battery and be recycled itself.
- Completely independent of outside power, potential to start new gym product line of self sufficient equipment.
LONG-TERM EFFECT

- Globally if the idea of harnessing kinetic energies ‘wasted’ or ‘lost’ power were to be captured it could generate enough power to solve the energy crisis currently taking place.
- From the simple motion of walking kinetic energy could be eventually be captured and if this happened to everyone world-wide a lot of power could be generated.
LIFE-LONG LEARNING

- Exposure to many different computer programs
  - MPLAB IDE
  - CAD
  - Visual C Code
  - Multisim
  - Ultiboard
  - Visio
- All these programs are valuable in school, but more importantly in the job market.
- Being treated like an actual business with a project of this magnitude teaches how to plan ahead of time and hope for the best but prepare for the worst.
- Being held accountable for deadlines gives real world applications more meaning.
**Budget**

- Total budget allotted $5,000
- Total spent thus far on parts $1,756.54
- Predicted spending on stock steel and wires = $1,029.36
- Estimated total with current parts and stock = $2,785.90
- Over $2,000 still available for parts and to handle any future complications
BUDGET

- Parts still to be specified and ordered:
  - Voltage Regulators
  - Generator attachment for belt
  - Belt for turning generator
  - AC car adapter for LCD DVD player
  - Fuses
  - Mini-track board and components
  - Plastic for display cover
  - Wires, fasteners
  - Stock aluminum and steel
  - Actuator switches
  - 20 red LEDs
  - PIC18F877
  - Crystal oscillator
## Timeline

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<thead>
<tr>
<th>ID</th>
<th>Task Name</th>
<th>Duration</th>
<th>Start</th>
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### Timeline Continued

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TEAM MEMBER CONTRIBUTIONS

Drew Seils

- Drew is in charge physical design of the bike and developing all CAD diagrams and some Visio Diagrams.
- Drew researched and outlined the necessary parts that suited the physical design and requirements of the device.
- Drew wrote up the necessary purchase orders for parts.
- Drew assembled the stock frame of the bike and developed a 3D model in CAD.
- Drew developed CAD models for the modified frame, seat mechanism, console, and console support column.

Shane Tornifoglio

- Shane is in charge of all electrical components such as the power generation system and making the electrical map in Visio.
- Shane has done the C code, Multisim and Ultiboard/PCB diagrams, and programming the microcontroller.
- Shane has done a lot of research in the market looking up competitors and their successful features.
- Shane also assisted in keeping track of the budget and parts.
- Shane also researched constraints and safety issues as well as the engineering solutions.
CONCLUSION

- **Needs met**
  - Rehabilitation, power supply, space use
- **Target markets**
  - Rehabilitation facilities, gyms, private use, NASA
- **Two design units**
  - Head unit and main unit with two interchangeable seats
- **Budget**
  - Prototype Estimate: ~$3000.00
  - Product Estimate: ~$950.00
ACKNOWLEDGEMENTS

- Dr. Enderle
- Dr. Bennett
- Dr. Peterson
- James Paolino
- Eric Leknes
- Eric Knight
- Jennifer Desrosiers
- Kerrie Wenzler
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