ENSC 440 – Written Progress Report

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Team 3: V-Cycle
Daniel Edmond
Michael Henrey
Jack Qiao
Lukas-Karim Merhi

Introduction:

Since the Oral Progress Report (Thursday March 4, 2010), V-Cycle has made substantial progress on the development of the V-Cycle Pro Virtual Reality Bicycle Trainer. The following progress report showcases the progress on individual subsystems and integration of our product.

Subsystems:

1. *Mechanical*
   The mechanical portion of the device consists of a rear trainer unit, front lifting platform and mechanism for adjusting the resistance of the trainer. The rear trainer is designed to allow tilting side to side. Since our last progress report, the spring force has been adjusted by incorporating additional elastic members and has a much more stable, realistic feel. The platform has been proven to rise up and down on the ball screw, and we are happy with the performance of the shaft coupler, brackets and mounting hardware that we have been designing and machining over the last couple weeks. At the time of our last progress report we were leaning towards a simple mechanical solution for adjusting the resistance of the trainer, however discussions with professors, examination of current exercise equipment and our own research has lead us to an electronic solution instead. We are incorporating an electric motor running in generator mode with an electronically controlled load to provide a variable resistance to the user's cycling action.

2. *Electronics Hardware*
   The electronics portion consists of various sensors, actuators and power modules. Since our last progress report, the accelerometer circuit (based around an instrumentation amplifier) has been built and tested. The motor has been connected to the power supply, microcontroller and stepper driver and the system was successfully tested.

3. *Software and User Interface*
   The software provides visual feedback to the user who is cycling on our device. The software now incorporates a physics model and engine, and the code has been optimized to run on a laptop with lower processing power. Two scenes have been created for the user to cycle around and explore.

4. *Microcontroller Code*
   The microcontroller code generates motor steps, collects and processes sensory input, and provides a method of communication with the computer. Significant debugging of the stepper code has occurred recently, since the start of our testing and integration.

Budget:

Currently our project is on track for spending; however projections will put us about $200 over budget as we have decided to implement a generator and electronic load for controlling the resistance of the trainer as opposed to a simple mechanical system.

Human Resources:

Our group still gets along well. We meet between 2 and 3 times a week to work on the project, and still find time to have fun, taking time off ENSC 440 (and other courses) to go to parties and watch Olympic events together.

Next Steps:

1. *Mechanical*
   The next steps include incorporating a flanged bearing to the front lifting platform so that the user can turn their wheel side to side. Also, the addition of an anti-gravity shock cord to the platform will assist the platform in rising and falling at similar rates. Various structural fine-tuning is still required, including the addition of cross members on the base structure to prevent twisting under non-centered loads. Mounting hardware for the motor controlling the variable resistance load will need to be designed and machined, however this should be less difficult as we have experience from mounting the first motor. The final step will involve construction of boxes and sheet-metal enclosures where safety precautions are required.

2. *Electrical*
   Looking ahead, we see the incorporation of limit switches as a next step. Also construction and testing of the circuit to provide the electronic load for the variable resistance unit will be completed over the next week as the parts arrive. Moving all the circuitry from breadboards onto an Arduino Proto-Shield will be undertaken once all the circuits have been finalized (including the new variable resistance circuit).

3. *Software and User Interface*
   The computer software is essentially complete, however full integration (basic communications have already been tested) with the microcontroller and testing the complete system will be done as this becomes appropriate.

4. *Microcontroller Code*

   The individual aspects of the control system have been tested, however further integration is necessary to create a complete control system. Significant amounts of new code will be required to operate our variable resistance load as a motor, in order to reduce the resistance further while the user travels down steep hills. Finally, complete integration with the computer software will be necessary for testing of the final system.