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ENSC 440 – Written Progress Report

November 13, 2012
MotiCon: Motion-Controlled Manipulator System (MCMS)
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Introduction

This report details the progress of our project, with emphasis on recent developments since the oral progress report (Thursday, November 1, 2012).

Subsystems Progress

1. **Software**
   a. **Inverse Kinematics**
      Initially we were having difficulties with getting the inverse kinematics algorithm working, in addition to the angle limitations issue and how the user's joint angles are detected. However, after some adjusting of the 3D frame reference on the robotic arm to the user's arm, we were able to get inverse kinematics working.

   b. **User Interface**
      Currently we are working on the user interface to have it user-friendly and displayable on the laptop during the arm detection. Menu navigation using left hand is currently being developed, in order to provide options such as 'Start', 'Stop', and 'Exit'.

   c. **Detection of hand opening and clenching**
      We are currently trying to detect hand clench motions, with openCV being a library candidate for hand gesture detection, to control the robotic arm's gripper. This is important to allow the robotic arm to grab objects.

2. **Hardware**
   a. **H-Bridge Circuit**
      The H-bridge circuit is built on a breadboard and it functions as expected with an external power supply. However, to better showcase our prototype we are attempting to implement the complete circuit on a perfboard. Ideally, this will happen after we get the servo arm working with our system, which is our current priority.

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b. Servo Circuit

We are planning to build a circuit to interface the Arduino for controlling the servo-motors. The servo-motor circuit might have voltage regulators to maintain a constant DC voltage, but this will be implemented only when we have extra time to do so.

3. Robotic Arm

a. DC-Motor Arm

The DC-motor arm we used is the OWI Edge Robot arm, which we were able to build on the day of the delivery arrival. We installed trimpots at the joint to provide robotic arm angle feedback, since the arm is DC-motor powered. In addition, we have successfully programmed the arm to move accordingly with 3 DOF (i.e. the elbow, shoulder and hip angle) with inverse kinematics.

b. Servo-Motor Arm

The Servo-motor arm we used is the Lynxmotion AL5D, which we only purchased the mechanical parts (i.e. the servo-motors and the mechanical arm components). We plan to integrate our existing system of microcontroller, circuit and software program to the servo-motor arm.

Budget

Due to careful planning of the budget, MotiCon will be able to complete this project on budget under the $700 ESSS funding. Thus far, we have used $650 for our costs, but that includes the Kinect, pre-existing materials, and other provided parts. Out of the $700 ESSEF funding, we have used $400, with $300 remaining for any overhead costs in the future. (Refer to our Design Specification document's Appendix B for the Bill of Materials which includes the materials we purchased and used).

The most expensive items that were purchased so far include the OWI Robotic Arm Edge, the Lynxmotion AL5D Servo-motor Arm and Kinect System (although we were sponsored for this device). Other components such as the microcontroller and electronics were found from each team member's existing electronic inventory. The only unaccounted costs are for the H-bridges and perfboard that we need for building the circuit. MotiCon received $700 funding from ESSEF and we plan to return or use the remaining amount for a "Blackbox" case and other miscellaneous features.

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Human Resources

At MotiCon, our team members work closely with each other. We meet at least once a week in person to discuss deadlines and short goals for the upcoming week to finish. These meetings are primarily used to keep group updated on progress and encountered issues that each pairs working on separate components of the project had. In addition, we also communicate frequently via emails and meet up once a day with our assigned group to work on our parts.

Future Plans

1. **Software**
    a. To apply a rolling filter to provide smoother robotic arm movements
    b. To complete the menu for user interface functionalities.
2. **Degree of Freedoms**
    a. We plan to achieve for the demonstration at least 3 DOF.
3. **Building an Enclosed System (Black Box)**
    a. We plan to spend our remaining resource to build an enclosed system, which we plan to implement with a test bench.
4. **Power supply (Batteries)**
    a. We plan to find power supplies to provide a more portable and customized supply for the enclosed system.

Summary

Despite our progress, there are still some issues and possible improvements that can be made. Regardless, we are comfortable with meeting our final goals.

