P09027

# Upper Extremity Motion Capture System

2008-1/
2008-2

Biomechatronic Learning Laboratory

## Mission Statement

Design a biomechatronic device that monitors upper extremity motion via physiological and biophysical data to benefit biomedical research in the electrical engineering department at RIT.

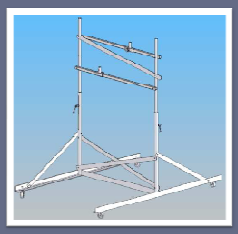
## Core Customer Needs

- Motion of arm in three degrees of freedom (DOF)
  1. Elbow angle
  2. Shoulder angle in sagittal plane
  3. Shoulder rotation in transverse plane
- Measure EMG activity of four muscle groups in arm
- Measure angular position with time
- Wireless data transmission
- Real time display of data (user interface) with data storage

## The Team

Alan Smith (EE)
Jonathan Guerrette (ME)
Daniel Chapman (CE)
Adey Gebregiorgis (EE)
Melissa Gilbert (ME)
Pooja Nanda (EE)

## Concept/Design Methods



### Platform

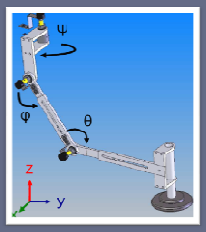
- Supports brace to maintain mobility of system
- Allows for motion capture of subject in sitting or standing position

### Surface Electromyography (sEMG)

- Measurement of electrical potential difference across a muscle fiber
- Surface electrodes are used to collect the data from biceps, triceps, deltoid and brachioradialis muscles

### Brace

- Uniquely designed with aluminum to fit male and female 95th percentile
- Housing for rotary potentiometers




### Rotary Potentiometers

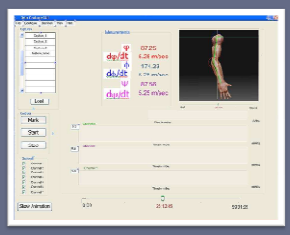
- Shaft of the potentiometer rotates with one adjacent part of the brace while the body remains stationary
- Output voltage is recorded which corresponds linearly to an angle measurement
- Mfd. by P3 America Inc.

### BioRadio®

- Bioinstrumentation device used to transmit EMG and motion data to computer
- Mfd. by CleveMed

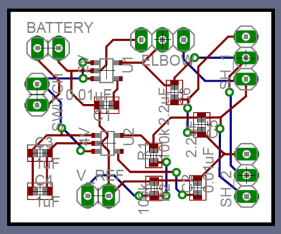
### Software

- Data capture system to display measurements in real time using C++ and Qt
- Data processing includes filters and conversion of potentiometer voltages to joint angles in degrees using linear regression model
- Supports animation which mirrors subject's upper limb motion



### PCB for Power Conditioning

- Layout designed to verify constant 4 Volt supply to potentiometers throughout the use of voltage regulators from 9 Volt battery
- Creates a 2 Volt virtual ground used as reference for the BioRadio
- Includes one output for voltage monitoring




## Testing

### Mechanical

- Mobile
- Durable
- Adjustable for different individuals
- Motion of right or left arm
- Lightweight brace
- Able to add weights to brace

### Electrical

- Proper voltages are verified on PCB
- Voltages provided to the potentiometers are monitored

### Software

- Program loads data correctly and runs with out error
- Data is displayed in real time
- Properly converts voltage measurements from potentiometer to angles
- User friendly GUI

## Conclusion/Future Work

- Project was successfully completed meeting the majority of the customer's needs
- System will be used in the Biomechatronic Learning Lab
- Signal processing algorithms will be created from the collected data
- Algorithms will serve to control robotic arm
- This research will be applied to prosthetics and other assistive devices

## Acknowledgements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