ECE 445: iBand
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Team 34
INTRODUCTION

A brief description of our project

OBJECTIVES

An explanation of what we hoped to achieve through this project

DESIGN

Supplemental design documentation

OUTPUTS

Videos and graphs of our output values when the iBand is worn

CONCLUSION

The conclusions we found
Introduction
Surface electromyography (sEMG) is a non-invasive computer based technique that utilizes electrodes placed on an user’s forearm to record electrical impulses produced by the nerve’s simulation of the skeletal muscle.

Products that leverage the information provided through sEMG signals for rehabilitation, educational, and recreational purposes already exist in the market today.
However, these devices are unable to withstand continuous use, do not provide the user with an ability to understand the data being collected and are expensive – ranging from thousands of dollars with the cheapest option being discontinued.
Objectives
**IMU Sensor**
Measures the angular and linear acceleration of the object it is placed on.

**sEMG Sensor**
Measures the electrical impulses that muscle groups make when contracted.

**GSR Sensor**
Measures the skin’s conductivity which is directly related to the presence of perspiration.

**Pulse Sensor**
Measures heart rate through the use of infrared light.
Solution

Our solution to increase public accessibility and understanding of sEMG devices is to create an **inexpensive**, **durable**, and **portable** replacement to the now discontinued Myo Armband.

This will be done through:

- **Six** sEMG sensors coupled with medical grade electrodes
- **One** Inertial Measurement Unit (IMU)
- **One** Galvanic Skin Response Sensor (GSR)
- **One** Pulse Sensor
High Level Requirements

Sensing and Size

between 22 cm and 44 cm

have the ability to change circumference without the relative position between sensors changing

Compact Size

new design must be smaller and more compact than the current design (14.8 cm wide x 14.5 cm long x 1 cm tall)

PCB must be less than 10 cm

Data Collection

collect data for at least two hours with minimal to no discomfort put onto the user

raw data from the sensors must be displaced in real-time
Design 03
Design: Visual Aids
**Power Subsystem**

- Output voltage is 5.2V ± 50mV and output current is between 0-1A
- Battery supplies power for 2 hours

**Software Subsystem**

- The input voltage to the bluetooth module is 5 V ± 1V
- Bluetooth connection is enabled and exposed to external devices

**Sensor Subsystem**

- sEMG sensor outputs a filtered signal between |0-1000| units
- IMU sensor correctly reflects changes in spatial position
- Pulse sensor measures values for BPM (Beats Per Minute) of the actual heart rate of the user
sEMG Sensor 1
Flexed
sEMG Sensor 2
Flexed
sEMG Sensor 3
Flexed
sEMG Sensor 4
Flexed
sEMG Sensor 5
Flexed
sEMG Sensor 6
Flexed
GSR
relaxed
GSR
stressed
Unstressed
Stressed
IMU
pitch
IMU
yaw
IMU

roll
Pitch
Yaw
Roll
Pulse
Conclusion
Problems Encountered

1. **USB-to-UART IC** was not properly designed on the PCB
   a. **DTR** and **DSR** are not supposed to be connected together
   b. The **CTS** is an input signal that should be high in order to control data transmission over the **UART** interface.

2. **ADC** had pull-down resistors but needed pull-up resistors for **SCL** and **SDA** for proper serial communication
Summary

1. All sensors gave reliable and accurate data
2. Calibrated all sensors and filtered the data
3. Project met all the high-level requirements
Future Plans

1. Down-size PCB and fix errors
   a. **USB-to-UART IC** as well as **ADC**

2. Move from hardware to software filtering for sEMG sensors

3. More research needs to be done on sensors
   a. Placement may not be ideal for certain use cases

4. Continuous polling in real-time can be improved upon and made instantaneous
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