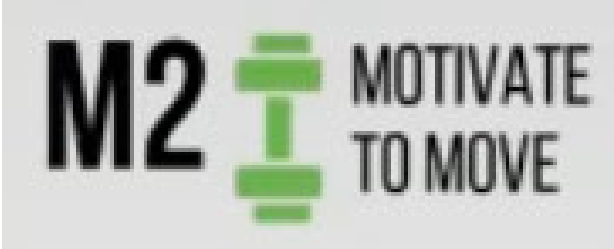
Greenies - Motivate to Move (M2) Band

A fitness band for children with intellectual disabilities that helps keep track of their basic vitals along with their location in case of an emergency. The band will use a heart rate monitor, thermometer, pedometer/accelerometer, and GPS to monitor vitals and location. The band will also use GeoFencing to provide safe areas for the child, and when the band leaves the safe area an alert will be sent out. A companion app will also be used alongside with the band to be able to display the information read from the band's sensors.



Team

App Design & Communication
App Design & Communication
App Design & Communication
PCB Design & Actuaries
PCB Design & Actuaries

Objectives

The M2 Band would be created for younger kids with intellectual disabilities. The band would be made to be comfortable and non-intrusive while still being able to function properly. The primary functions of the band include a heart rate monitor, GPS to be used with GeoFencing, thermometer, pedometer/accelerometer, a strong enough battery life, and have a user friendly interface. The band will keep track of basic vitals of the user, to help the user keep track of daily activity and to provide them with information about how active they are. It will also incorporate GPS in case the child goes missing or wanders off and their location is needed to be found. The GPS will also factor into GeoFencing so if a child is at day camp, the GPS will send an alert when the child leaves the building when they aren't supposed to. The band will also have a companion app with it.

The companion app will be iOS based and display the information from the band. There will be a dedicated server that will collect the information from the band and send it to the app where it will be displayed in a user friendly GUI. The app will show the

location of the band via the GPS, basic vitals taken, and have push notifications for if the GeoFencing is tripped. The app will have to display this data accurately and quickly retrieve information from the server in a reliable fashion.

Success would be measured by the band accurately reading various sensor values and displaying them on the app. The values for GPS, heart rate, and accelerometer should all match the expected values. Another indication of success would be that the band stays comfortably on the wearer for a full day without running out of battery. Our geofencing will be successful if it can accurately detect the boundaries and be able to tell if the band is inside or outside of them, and indicate this on the app. Additionally, the user interface should be simple yet friendly, and allow for anyone to understand/operate it.

Design Constraints

- Product must be non intrusive and lightweight to the user and must have a very friendly UI.
- Possibly linked to an article of clothing; shirt, pants, etc.
- Small footprint for electronics and PCB.
    - SMD parts
    - Microcontroller
    - GPS technology
    - Sensors & actuators
- Battery must retain charge for at least a full day of use.

Fall Goals

- First iteration prototype using the M5 Stack with main functionality working along with a working version of the app. Look into compact designs from there and have successful connections with the server and app.

Spring Goals

- Second iteration prototype with custom PCB, must be smaller in size to be more wearable but still incorporate all core functionality. Have a fully working app and dedicated server. Use most of the time for testing and debugging to get it functioning as best as it can.

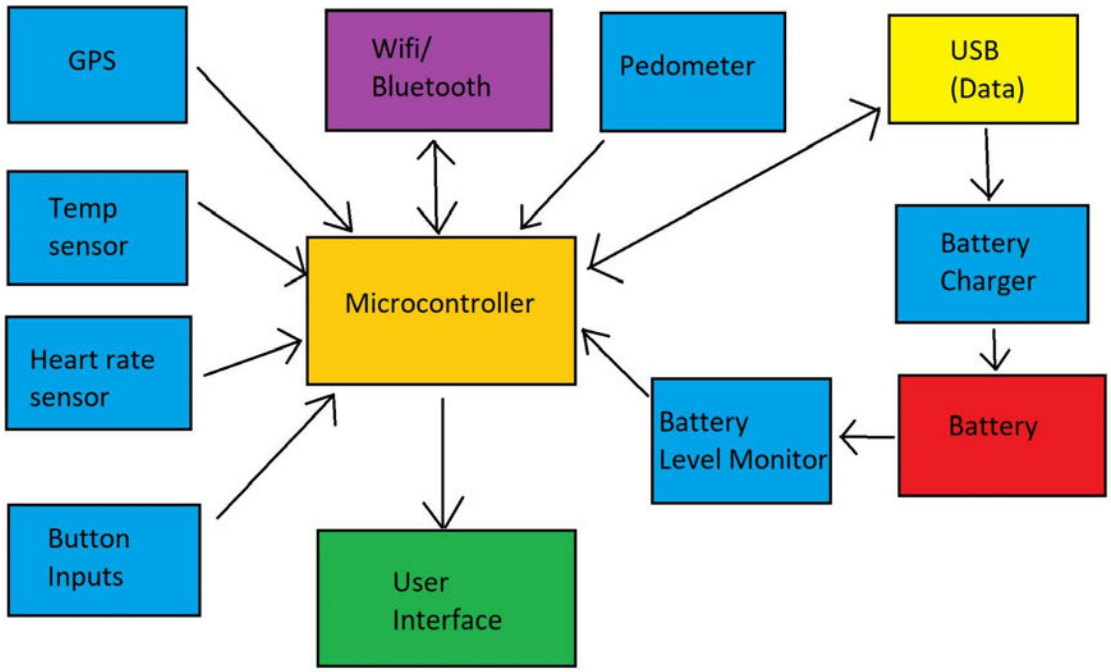
Prototype

- Functioning band that uses all sensors and GPS to provide useful information to the user, has easy UI, has a dedicated server and application, and is non-intrusive to the user.

Approach

- Use the M5 Stack to build a base prototype that is easy to assemble and use that to program code and test functionality.
- Design a custom PCB with the microcontroller embedded to create a more compact and wearable design that is still functional to the user.
- Use PCB and other design techniques to keep the device as small and wearable as possible.
- Have a dedicated server to receive data from the band and send it to a companion app.
- Code a companion app that will receive data from the server and display it with an easy to read user interface.
- Test this by using it ourselves and having a selected target group test it too.

Block Diagram



This diagram shows all the different components that the M2 Band consists of and how they interact with the microcontroller. All of the data will be sent over the Wifi/Bluetooth module and then sent to a server to be displayed clearly and neatly on the application.

Equipment Needed

Hardware:

- M5Stack Core2 ESP32 IoT Development Kit for AWS IoT EduKit ($49.90)
- Battery Module for ESP32 Core Development Kit ($7.95)
- GPS Module with Internal & External Antenna (u-blox NEO-M8N) ($36.90)
- NCIR Non-Contact Infrared Thermometer Sensor Unit ($19.95)
- ECG Module13.2 (AD8232) with cables and pads ($45.90)
- Mini Dual Button Unit ($2.95)
- ESP32C

Software:

- Microcontroller program that reads in all sensor data and incorporates GeoFencing.
- Server related stuff (Raspberry Pi or AWS)
- 1 year license for iOS app (~$100)

Budget

We have $5000 from Martha Hall & her team, and $250 from the senior design budget if needed. So far we have spent $190 of our $250 senior design budget.

Schedule

Fall Semester

Week	**Task**
9/27/2021	- Meet with Martha and discussed audiences for the product
10/4/2021	- Meet with Martha (in person) to look at old prototype - Proposal
10/11/2021	- Finish proposal - Order Parts
10/18/2021	- Look into setting up server - Commit to IOS app - Meet with target market group to iron out design specifications + their preferences for location/size of the device

10/25/2021	- Start building prototype (app and band)
11/1/2021	- Split into 2 groups: hardware & software
11/8/2021	- App development + prototype development
11/15/2021	- Order parts for Final prototype, polish app/server
11/22/2021	- Thanksgiving break
11/29/2021	- Finish/test working prototype, ideally have functional app
12/6/2021	- Final Presentation Preparation
12/13/2021	- Final Presentation

Spring semester

Week	**Task**
2/7/2022	- Begin building final prototype, order any additional parts
2/14/2022	- PCB design and ordering
2/21/2022	- Geofencing
2/28/2022	- Have successful exchange between prototype and server
3/7/2022	- Get code functionality for all sensors working properly
3/14/2022	- Start testing final prototype in private setting
3/21/2022	- Resolve issues found from testing
3/28/2022	- Spring Break
4/4/2022	- Test final prototype on target audience

4/11/2022	- Work out any kinks found from testing
4/18/2022	- Finalize prototype & app
4/25/2022	- Contingency time
5/2/2022	- Final presentation preparation
5/9/2022	- Final Presentation preparation
5/16/2022	- Final Presentation

Challenges

- Compact size
- Comfortability
- Practicality
- Accuracy
- App development
- Making a prototype that is able to get accurate readings from sensors while being comfortable for user to wear
- Sever construction & maintenance
- Privacy
- Using geofencing as part of our final prototype

Equipment Not Fully Understood

- M5Stack/ESP32C
- Using Swift for designing iOS apps
- Embedded microcontrollers

Skills

- Object based programming ability
- Schematic/circuit design
- Programming microcontroller
- PCB design

References

- Previous prototype
- Other designs by Dr. Martha Hall (mlucinda@udel.edu) & her team
- Lab Coordinator Kai Louie (kailouie@udel.edu)
- Dr. Martin, Dr. Cotton & our TA's
- Dr. Hall's reference groups for the target audience