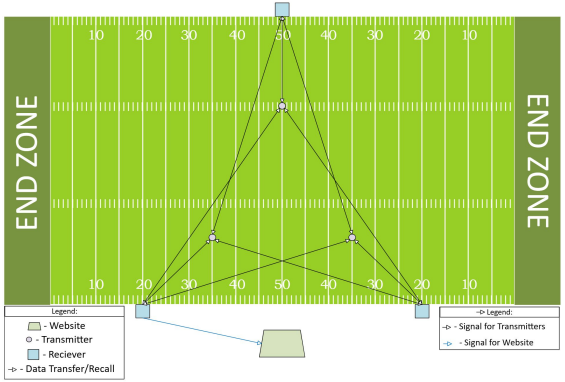
Dwight Look College of
ENGINEERING
TEXAS A&M UNIVERSITY

# ECEN 404 Final Presentation
# Team 08: Marching Band LPS

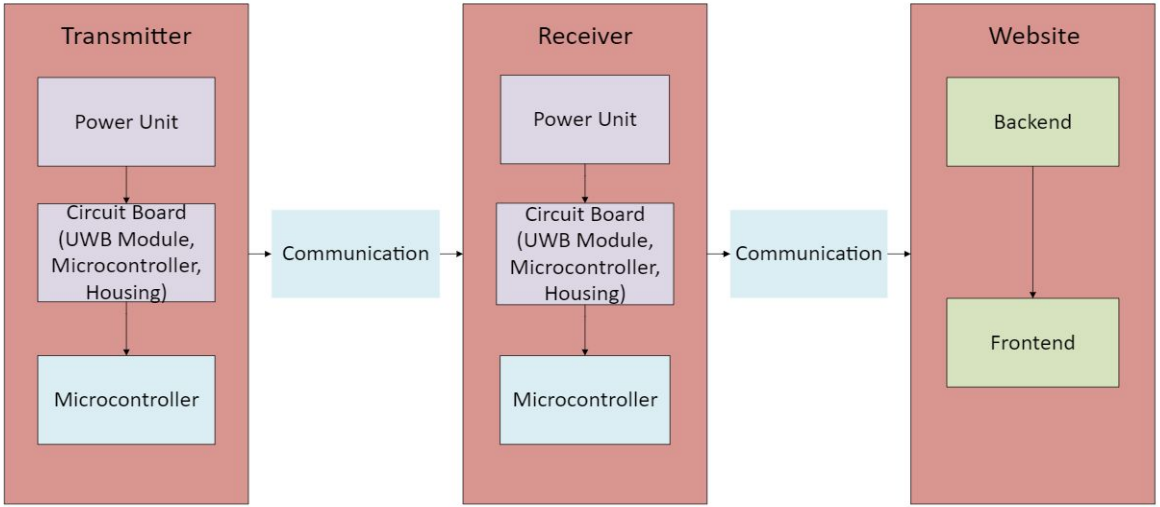
Alex Flores, Vlad Lebedev
Sponsor: Troy Morris, Andrew Morris
TA: Vishwam Raval

# Problem Overview

- **Problem:** Marching bands require very precise positioning for their shows. Currently, the only method of review for marcher positions is a band tower, which is only accessible to the band directors.
- **Solution Proposal:** We are developing a system of wearable transmitters that send signals to stationary receivers for location calculation. This data is then sent to a web application that is accessible to both marchers and the director for a true bird's eye view.



# Diagram of Integrated System

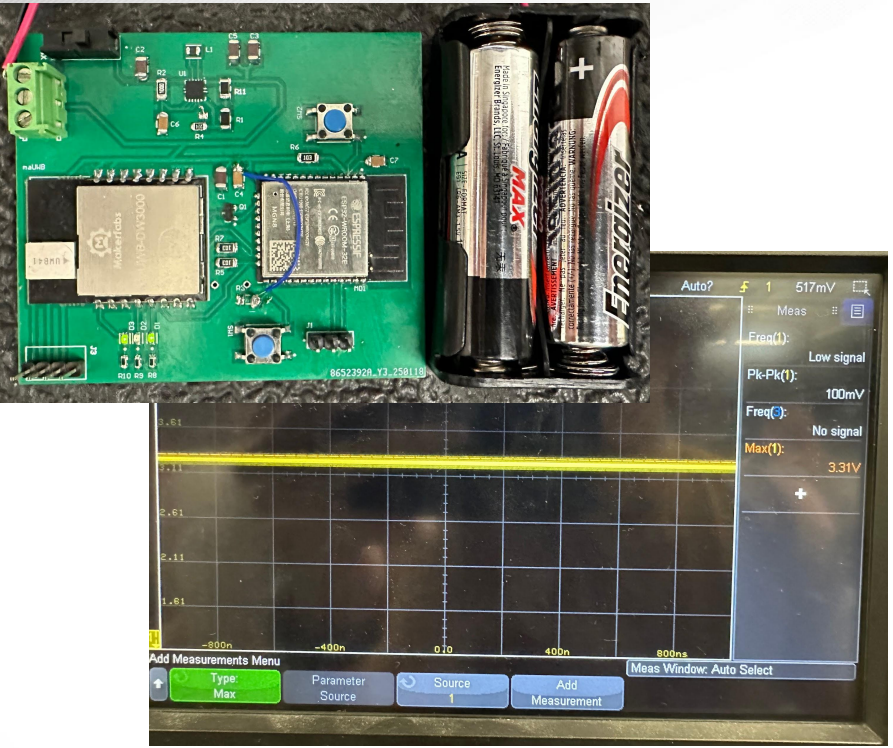



- Alex

- Both

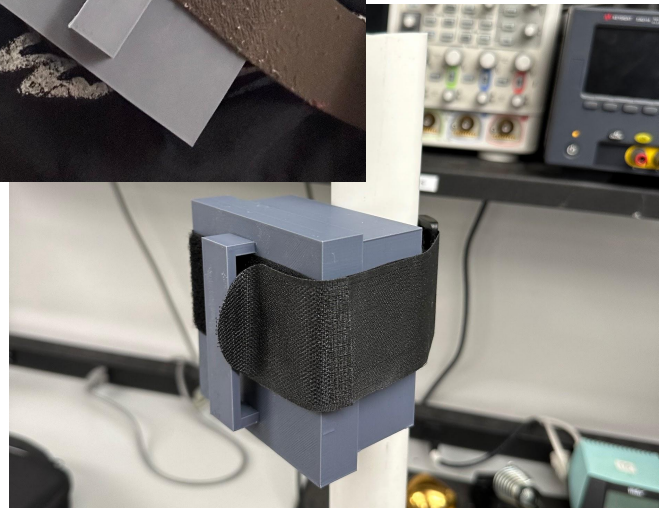
- Vlad

# Hardware Design Accomplishment




- Subsystem was designed to provide accurate location data using Ultra Wideband time of flight data
- Designed and constructed 5 boards to test full system (3 anchors and 2 tags)
- Provides steady 3.3 V supply to the microcontroller and the UWB module
- System can run for up to 5 hours off of 2 AA batteries
- Accuracy at full scale found to be within 5% error
- Range is within functional limits of 100 m x 50 m (American Football Field)

# Hardware Design Accomplishments



- Fits within volume and mass requirements (80 mm x 40 mm x 80 mm, 0.0635 kg)
- Fits comfortable and stable when worn by a person or mounted to a pole

# Firmware Design Accomplishments

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```

- Firmware enables the hardware to connect to the website through WiFi, sending tag data through a JSON string
- Code sends a new position update in less than a second (50 data points in 47 seconds)

# Firmware Design Challenges

***Hardware to Firmware:***

Challenges -

- Issues with ESP32 randomly resetting in the middle of setup function

Solutions -

- WiFi cannot be initialized without proper power, so battery life testing was implemented before operation
- Serial communication between ESP32 and UWB can be sunset if the serial line is “busy”, so changes to system set up were made

***Firmware to Website:***

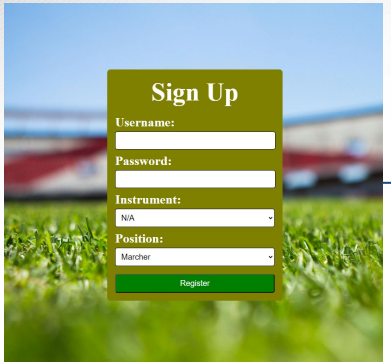
Challenges -

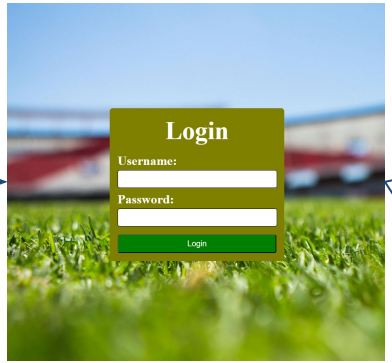
- In testing this design, lack of reliable WiFi connection for testing on full scale made testing difficult (ie, iPhone hotspot is not very strong/fast)

Solutions -

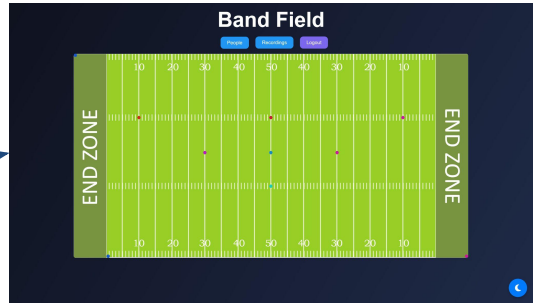
- WiFi was proven to work perfectly while testing connection on more reliable WiFi sources

# Website Design Accomplishments

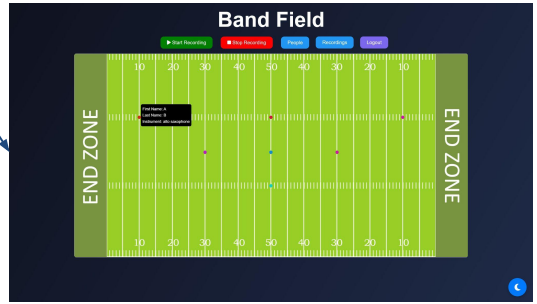



Marcher:

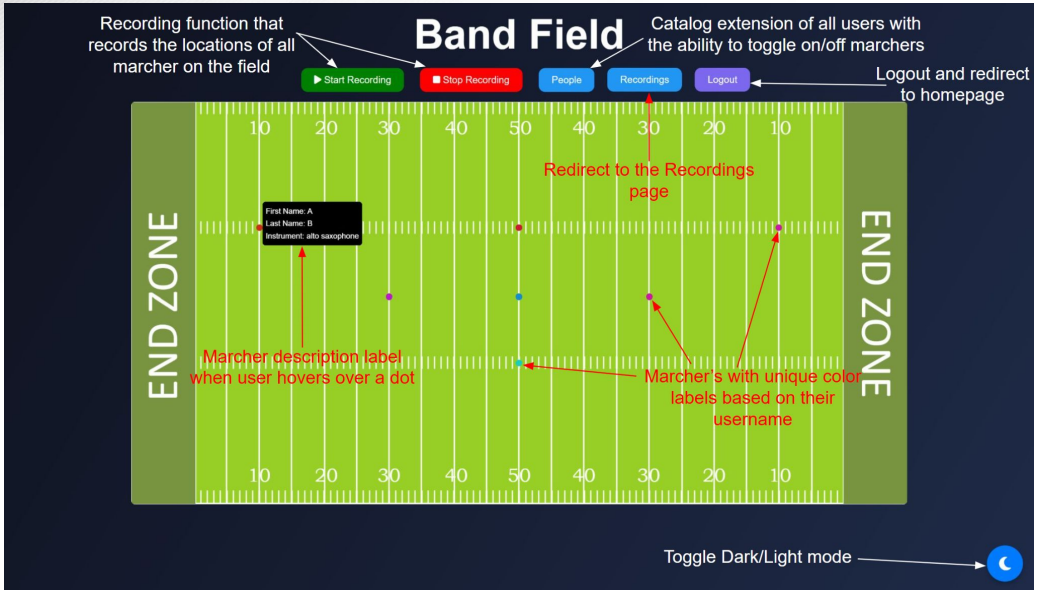



Director:



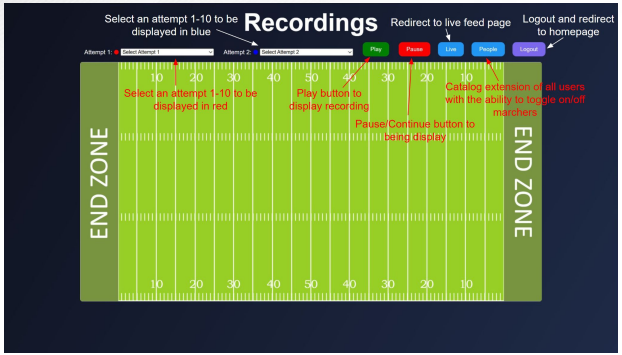

- Designed a sign up and login page that redirects users based on their defined “Position” (Marcher or Director)
- Tested functionality by signing up multiple users of different username, password, instrument, and position
- Validated functionality by being redirected to the correct page based off position and the backend adding the new user the to authenticated users database

# Website Design Accomplishments

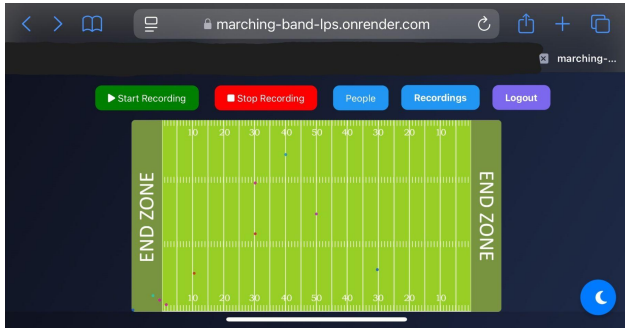



- Designed a live feed page that tracks positions of marchers in real-time
- Designed a recording feature that records up to 60 seconds per attempt out of 10 attempts
- Tested and validated by creating a recording and letting it run until it stops, going into the database and counting the number of positions of x-coordinates and y-coordinates to be 60 (as I have the recording set to store positions every second)
- Designed a toggle switch on each marcher
- Tested and validated by toggling off a marcher and comparing it with the dot removed from the band field

# Website Design Accomplishments




- Designed a recordings page that allows 2 attempts to be overlaid at one time
- Tested and validated by displaying different attempt combinations




- Globalized the website on the hosting service “Render”
- Tested and validated by opening the site on different devices and testing that functionalities were still working

# Integrated System Results

## Full Scale Operation Video:

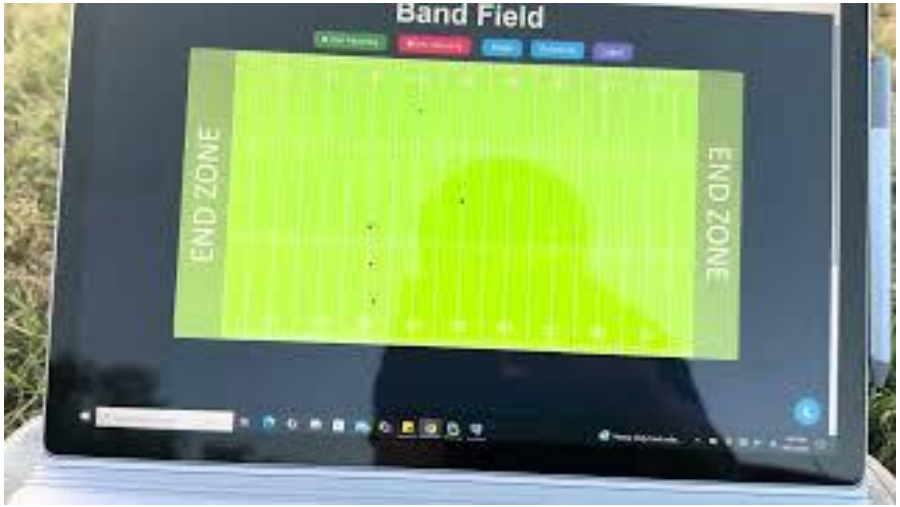
Video Link

| | X Value | Y Value | | | Percent Error X | Percent Error Y |
|---|---|---|---|---|---|---|
| Position 1 Physical | 3657.6 | 131.55 | (30 yd, 1.5 yd) | Position 1 | 3.63653762 | 4.561003421 |
| Position 1 LPS | 3790.61 | 137.55 | | Position 2 | 2.380952381 | 4.160591037 |
| | | | | | | |
| Position 2 Physical | 3840.48 | 2057.4 | 42 yd, 22.5 yd) | | | |
| Position 2 LPS | 3931.92 | 1971.8 | | | | |

# Integrated System Results

Full Scale Operation Video:

Video Link



# Conclusions

- Largest change to project from last semester was the move from 3 project members to 2 and using Arduino for firmware development
- Additionally, 3rd anchor was added to system for trilateration
- Current status: Fully integrated and collecting data for demo, final report, and Engineering Project Showcase