Dwight Look College of
ENGINEERING
TEXAS A&M UNIVERSITY

Team 14: RF Triangulation
Bi-Weekly Update 3

Josh Broyles, Brandon Stokes,
Jack Parkinson, Kathleen Hutchinson

Sponsor: Max Lesser
TA: Souryendu Das

Project Summary

Biologists have struggled being able to collect data on wildlife's location, habitat use, and breeding patterns without getting directly involved with the animal they're tracking.

Radio Frequency Triangulation allows a user to track a **known frequency** (such as a previously tagged animal) within the **triangulated area of three antennas** by using a motor to successfully **pinpoint the strongest signal.**

Helpful to study both invasive and threatened wildlife, our RF Triangulation system will focus on being able to accurately **track a transmitter within a 150 meter radius with >10% error.**

Project/Subsystem Overview

Josh Broyles - Transmitter

- PCB design for Transmitter
- Programming Transmitter MCU
- Sends out Radio Frequency

Kathleen H. - Receiver - ESP32 Modules

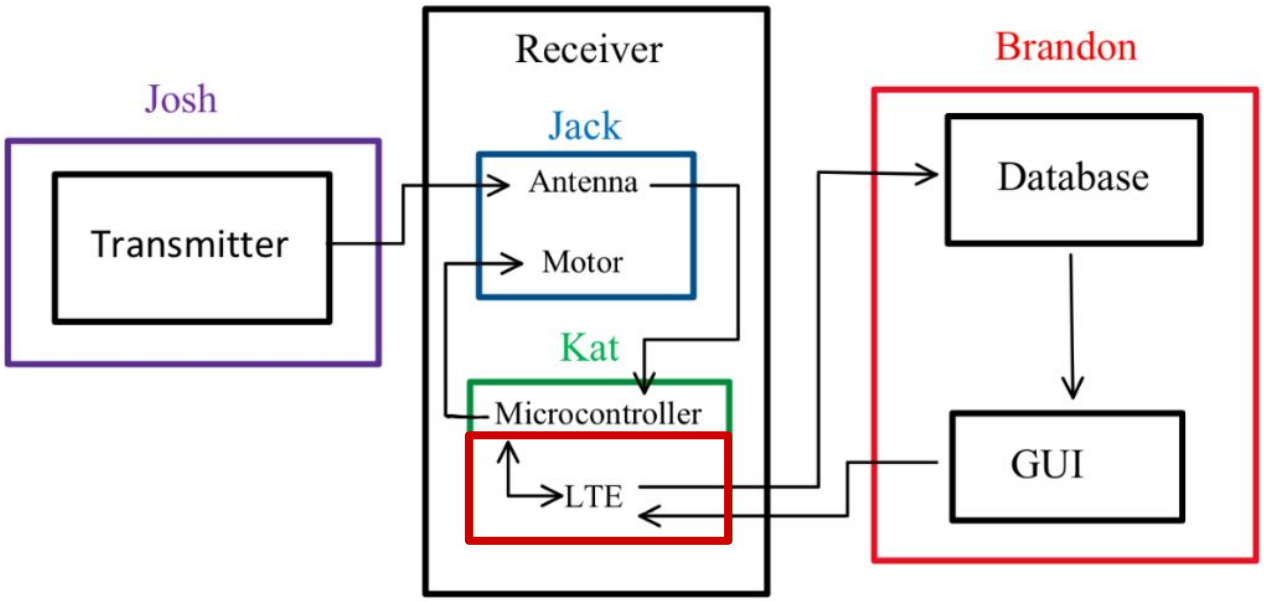
- PCB design for ESP32 and 4 modules
- Programming ESP32 for modules
- Sends signal to Database

Jack P. - Receiver - Antenna/Motor

- PCB design for motor driver
- Programming ESP32 for motor
- Receives signal

Brandon Stokes - Database & GUI

- Database creation
- LTE and GUI connection
- Error calculation through GPS



Project Timeline

The team will finalize and order parts/PCB

Finalize realistic goals with sponsor

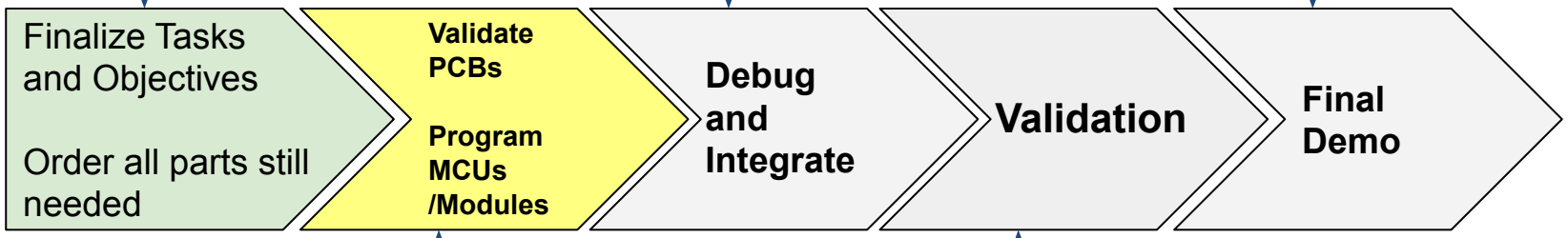
[Complete before February]

The team will debug any problems with code, power, etc. and begin integration

[March]

Once validation is complete with a working project, the team will complete a final demonstration

[Late April]



The team will finalize individual subsystems

[February]

Once fully integrated with all parts working, the team will begin validation testing.

[Late March through Mid April]

Completed

In Progress

Not Started

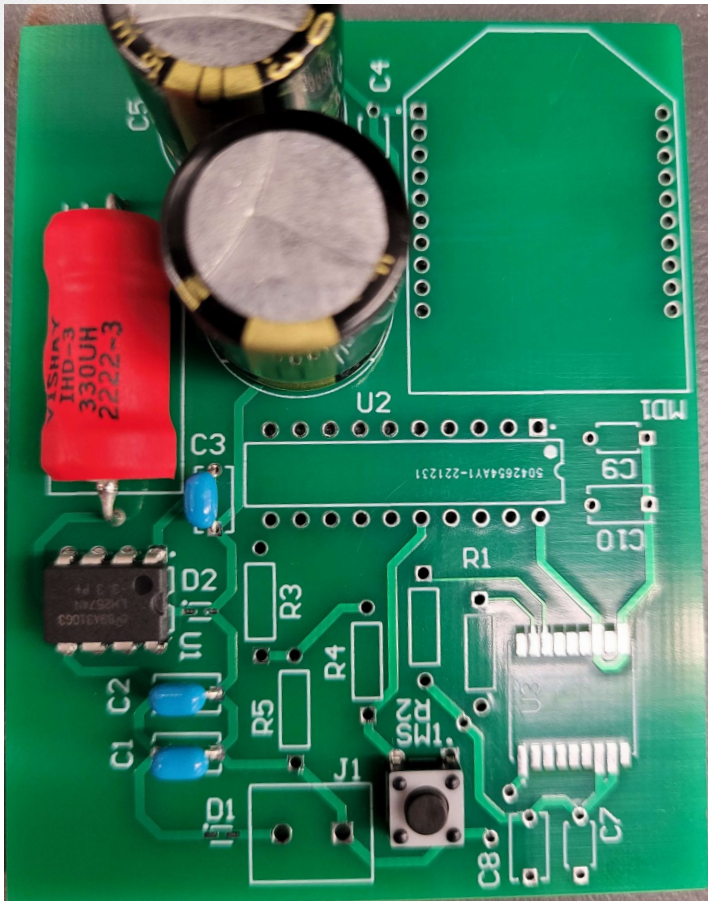
Transmitter

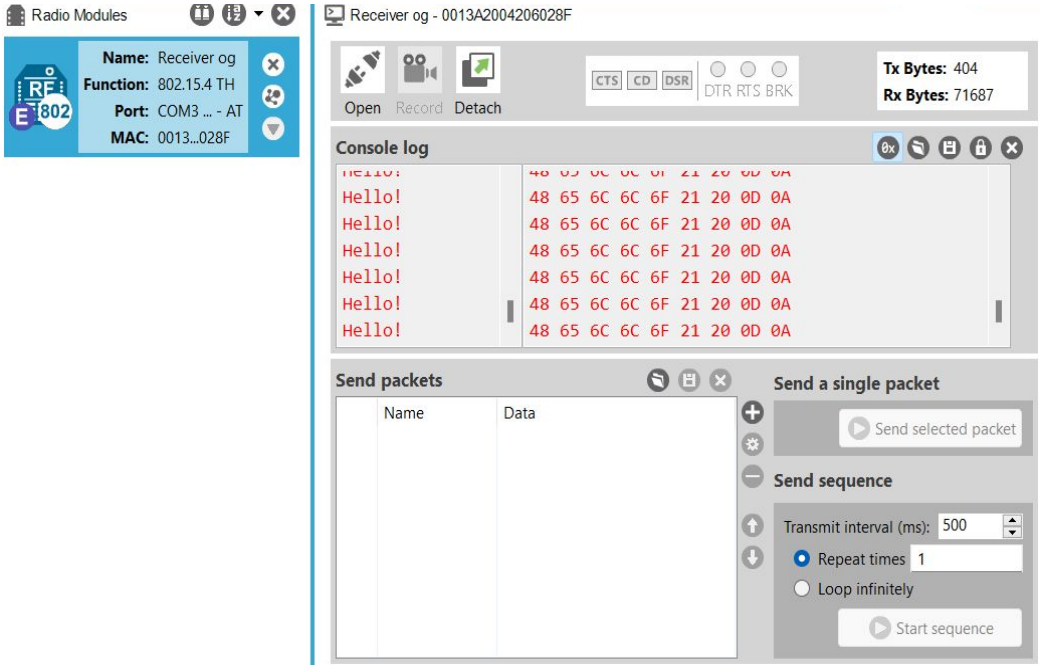
Josh Broyles

Accomplishments since last update 14 hrs of effort	Ongoing progress/problems and plans until the next presentation
Finished MCU code	On-going PCB Assembly Begin Validating Transmitter Begin working with GPS on Receiver side 3D Print Final Radio Housing design

Transmitter

Josh Broyles





Receiver: Antenna & Motor

Jack Parkinson

Accomplishments since last update 16 hrs of effort	Ongoing progress/problems and plans until the next presentation
Simulated Yagi Antenna Finalized Antenna dimensions	Finalize antenna design (how I am going to build it) Buy parts for antenna Help Kat Assemble PCB Finalize code for stepper motor driver

Receiver: Antenna & Motor

Jack Parkinson

Yagi_antenna_final.nec - 4nec2 Edit

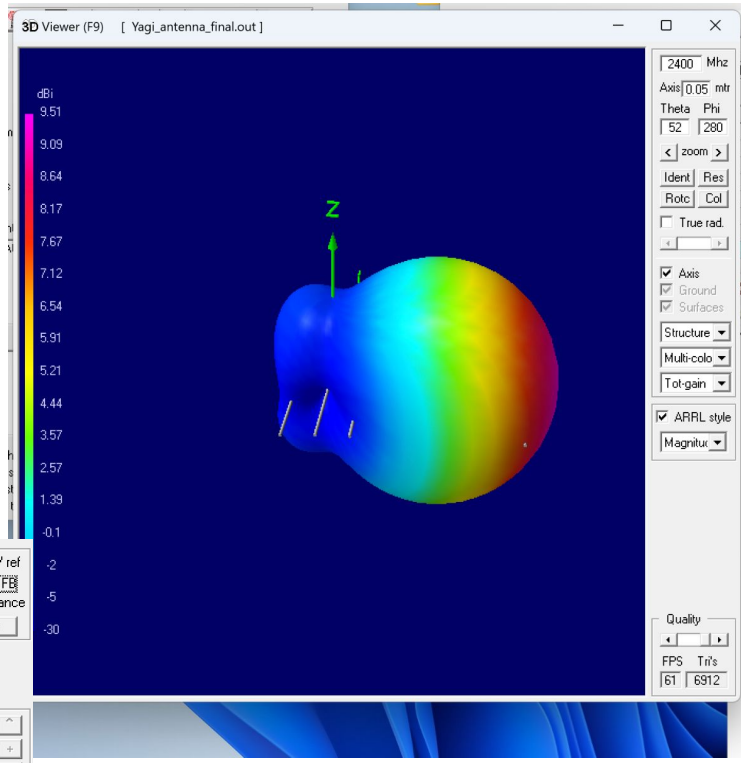
File Cell Rows Selection Options

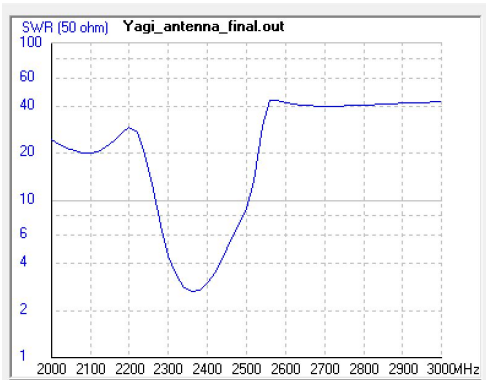
Wire/element radius (diameter/2) Upd Ins. Del.

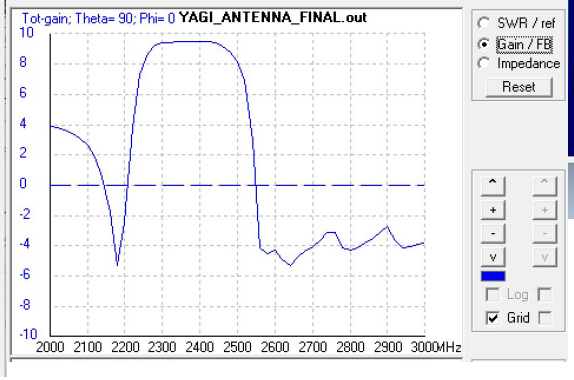
Symbols | Geometry | Source/Load | Freq./Ground | Others | Comment

Geometry (Scaling=Meters) Use wire tapering

Nr	Type	Tag	Segs	X1	Y1	Z1	X2	Y2	Z2	Radius
1	Wire	1	9	0	-0.030	0	0	0.030	0	0.00015
2	Wire	2	9	-0.01	-0.032	0	-0.01	0.032	0	0.00015
3	Wire	3	9	0.01	-0.029	0	0.01	0.029	0	0.00015
4	Wire	4	9	0.02	-0.028	0	0.02	0.028	0	0.00015
5	Wire	5	9	0.03	-0.027	0	0.03	0.027	0	0.00015
6	Wire	6	9	0.04	-0.026	0	0.04	0.026	0	0.00015
7	Wire	7	9	0.05	-0.025	0	0.05	0.025	0	0.00015
8	Wire	8	9	0.06	-0.024	0	0.06	0.024	0	0.00015
9										







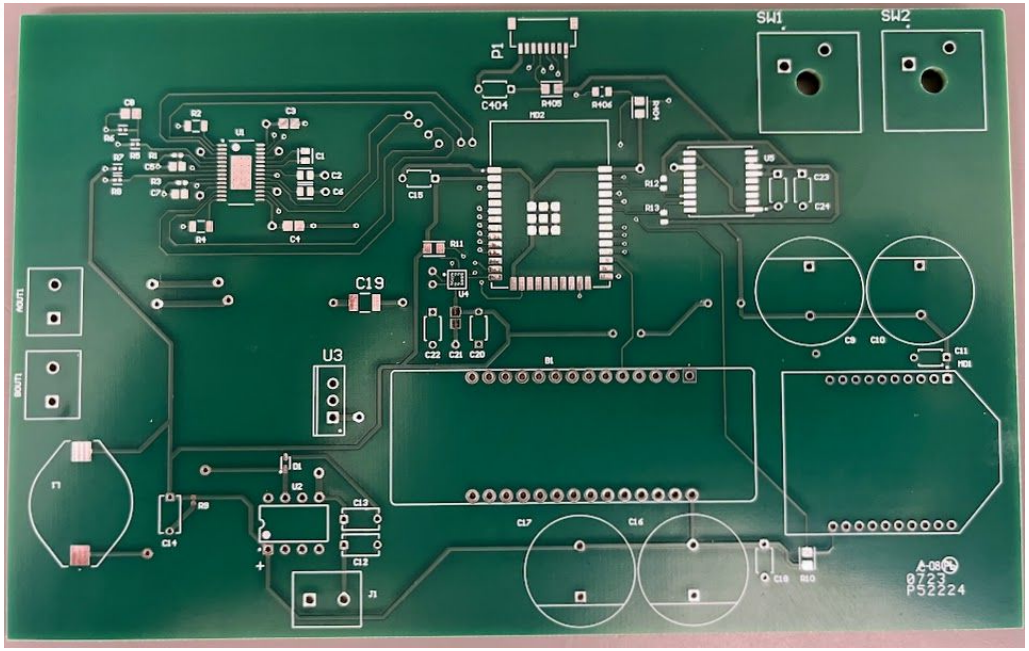
Receiver: ESP32 & Modules

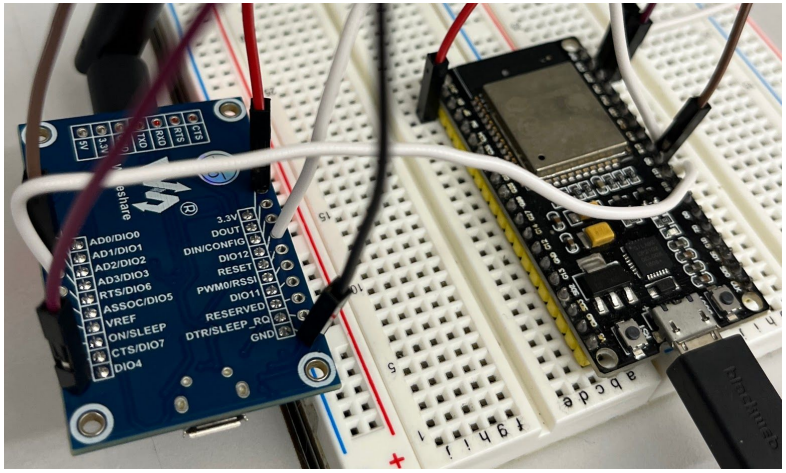
Kathleen Hutchinson

Accomplishments since last update 17 hrs of effort	Ongoing progress/problems and plans until the next presentation
PCB has arrived	Solder PCB (today 6-9pm) On-going testing of XBee Create housing for PCB that can be mounted on tripod

Receiver: ESP32 & Modules

Kathleen Hutchinson





Database & GUI

Brandon Stokes

Accomplishments since last update 20 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Completed integration of database and Pycom over WiFi with ability to read and update data	• Transition Pycom to LTE instead of WiFi

Database & GUI

Brandon Stokes

```
WiFi connection established
Connected to MQTT mqtt.pybytes.pycom.io
Pybytes connected successfully (using the built-in pybytes library)
Configuration successfully converted to pybytes_config.json
(1, 30.61946, -96.27269, 30.61875, -96.27055, 339.5, '2023-02-06 02:33:37.7')
(2, 30.62068, -96.26993, 30.61875, -96.27055, 254.8, '2023-02-06 02:33:37.7')
(3, 30.61731, -96.26922, 30.61875, -96.27055, 129.9, '2023-02-06 02:33:37.7')
Executing update
(1, 30.61946, -96.27269, 30.61875, -96.27055, 339.5, '2023-02-19 10:21:45.3')
(2, 30.62068, -96.26993, 30.61875, -96.27055, 254.8, '2023-02-19 10:21:45.3')
(3, 30.61731, -96.26922, 30.61875, -96.27055, 129.9, '2023-02-19 10:21:45.3')
```

	recname smallint	rec_lat double precision	rec_long double precision	trans_lat double precision	trans_long double precision	sig_angle double precision	time_last_updated text
1	1	30.61946	-96.27269	30.61875	-96.27055	339.5	2023-02-19 10:21:45.3
2	2	30.62068	-96.26993	30.61875	-96.27055	254.8	2023-02-19 10:21:45.3
3	3	30.61731	-96.26921	30.61875	-96.27055	129.9	2023-02-19 10:21:45.3

Execution & Plan

	1/24/23	1/31/23	2/7/23	2/14/23	2/21/23	2/28/23	3/7/23	3/14/23	3/21/23	3/28/23	4/4/23	4/11/23	4/18/23	4/23/23	4/29/23
Ring out PCB															
Test Radio Distance															
Finish Programing MCU															
Assemble PCB															
Validate PCB															
Validate Messages to Receivers															
Finalize Schematic/PCB Design															
Order/Print PCB															
Program Modules															
Validate PCB															
Finish ESP32															
Connect Antenna															
Finalize Antenna Design															
Order/ Build Antenna															
Test Antenna															
Test Motor Controller															
Database to Single Table															
Rework out of bounds situation															
Finish Pycom															
Add Error checking to data															
Integrate Reciever Modules															
Test Inter-Communication															
Complete System Validation															
Final Demo															
Final Report															

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Validation Plan

Paragraph	Test Name	Success Criteria	Methodology	Status	Responsible Engineer
3.2.1.1	LTE Stability	The LTE does not drop more than 1 time per 5 minutes and shall reconnect within 20s.	System is put into default operational state (tracking transmitter) and left to run for 30 minutes while Pycom tracks LTE connection	UNTESTED	Brandon Stokes Kathleen Hutchinson
3.2.1.2	Antenna Characterization	Physical antenna has a gain of at least 7 in the direction of the antenna.	Physical antenna will be made and tested inside a characterization chamber with the help of Professor Nowka.	UNTESTED	Jack Parkinson
3.2.1.3	Motor accuracy	The motor can turn with speed and precision while the carrying the weight of the reciever PCB and antenna.	After connecting the system to the motor, it will spin with vairying speeds and steps and be stopped to check accuracy and time.	UNTESTED	Jack Parkinson
3.2.1.4	System Connection	The time it takes to connect and transmit data between the GUI, transmitter, and receiver shall be 30s.	System runs start signal from application to receivers and back to application with data and timed using timer function into code.	UNTESTED	Brandon Stokes Kathleen Hutchinson
3.2.1.5	Operation Time	System operates continuously on battery power for 30 minutes.	System transmitter and receivers are put into default operational state and left to run for 30 minutes.	UNTESTED	Full Team
3.2.1.6	Detection Range	The detection range shall be an 150m radius from transmitter to a single receiver.	Receiver antenna will be place 150 meters from transmitter and be able to detect and step towards the signal transmitted.	UNTESTED	Josh Broyles Jack Parkinson Kathleen Hutchinson
3.2.2.1	Mass	The weight of the system shall be at max 27lbs.	Measure receiver unit with digital scale.	UNTESTED	Jack Parkinson
3.2.3.1.1	Input Voltage	The input voltage level for the ESP32 and MSP430 shall be 3.3V	Use multimeter to validate input voltage levels	UNTESTED	Josh Broyles Kathleen Hutchinson
3.2.3.1.2	Input Voltage (Motor)	The input voltage level for the DRV811PWPR (motor driver) shall be 12V.	Use multimeter to validate input voltage levels	UNTESTED	Jack Parkinson
N/A	Full System Demo	A user of system is able to accurately track the transmitter in an open space with a positional error of less than <10%.	System runs start signal to receivers which tracktransmitter's strongest signal with the motor, both stationary and moving, which sends data to GUI that outputs an accurate map with an error of <10% calculated through GPS points.	UNTESTED	Full Team

Thank you for your attention!

Feel free to ask us questions