Dwight Look College of ENGINEERING
TEXAS A&M UNIVERSITY

Team 30: Ember Bot
Bi-Weekly Update 2

Jonathan Chen, Kevin Rivera,
Nancy Ramirez Castillo, Yuwen Zheng
Sponsor: Kevin Nowka
TA: Roman Venegas

Project Summary

Problem Statement:

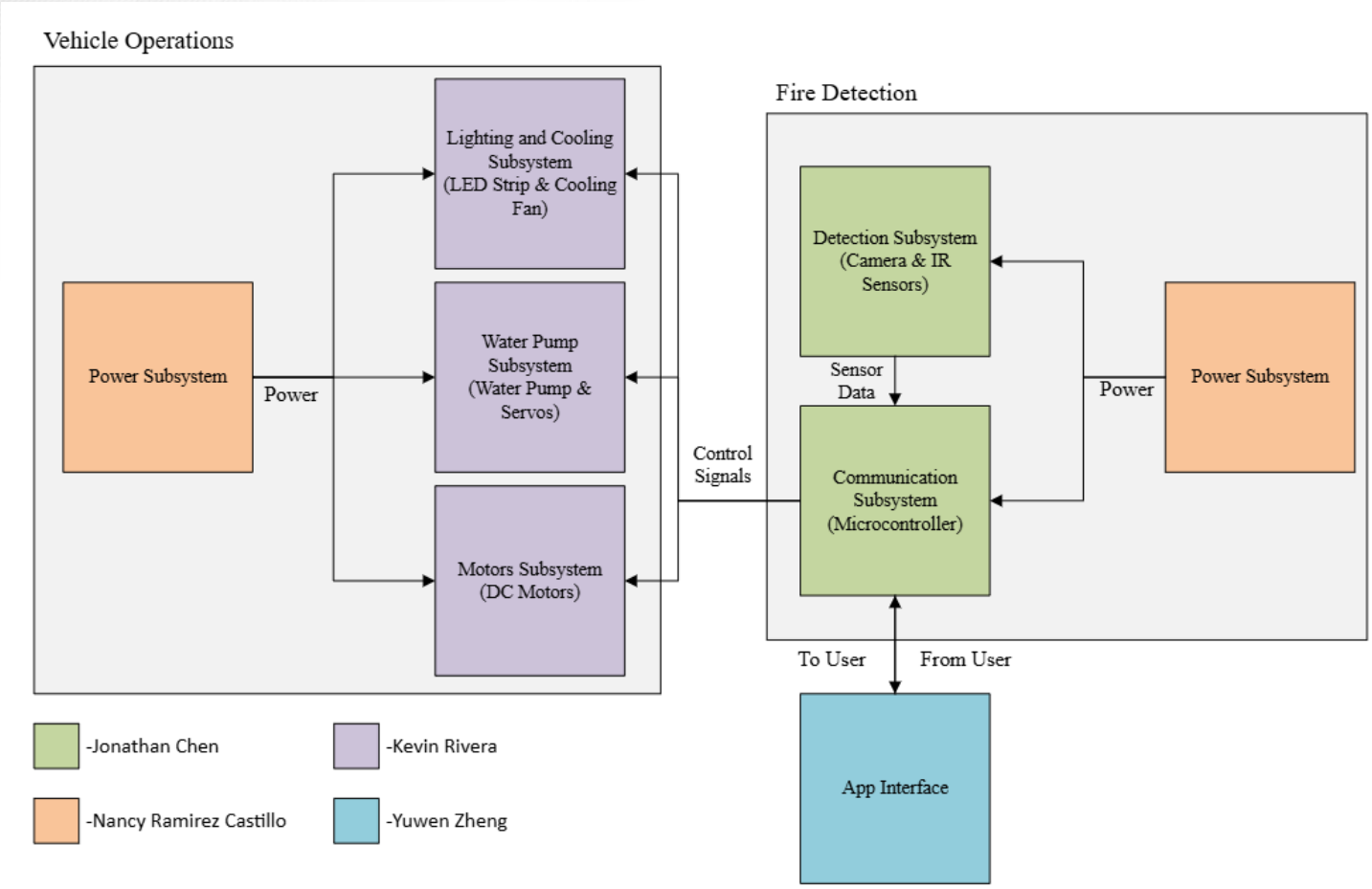
Traditional firefighting methods rely on human intervention, exposing personnel to extreme hazards such as heat, toxic smoke, and structural collapse. These settings pose safety risks, especially in hard-to-reach areas.

Project Summary

Solution Proposal:

Ember Bot is a mobile-controlled fire-fighting robotic vehicle equipped with IR sensors and a live camera feed, enabling firefighters to remotely detect and extinguish small fires in hazardous areas where human presence is unsafe.

System Overview



Project Timeline

Subsystem Designs and Testing (completed 9/11)	Integration of motor subsystem and MCU (completed 9/17)	Integration of Wi-Fi and iPhone App (to complete by 9/28)	Individual Subsystem Power Test (to complete by 10/15)	Frame Placement Integration (to complete by 11/2)	Integration Validation (to complete by 11/26)	Demo and Report (to complete by 12/5)

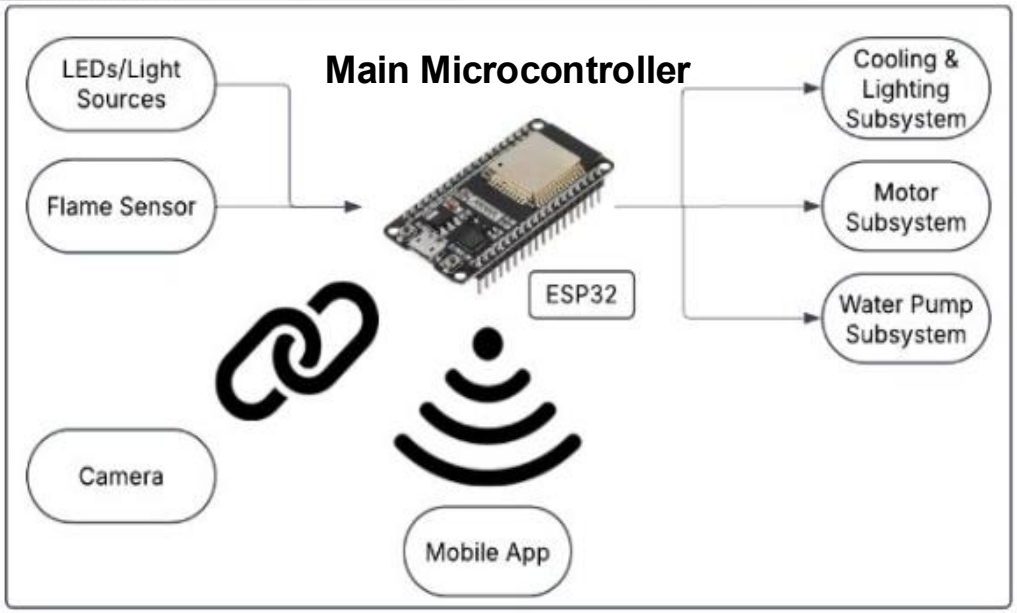
Microcontroller Subsystem

Jonathan Chen

Accomplishments since last update 9 hours of effort	Ongoing progress/problems and plans until the next presentation
• Completed Video Streaming Integration with Mobile App • Tested independent IR Sensors and Camera with real-life situation	• Designing and Testing New Frame for IR Sensor Constraints • Implementing PCBs integration with Power and Motor Subsystems • By next review, will be able to receive information from App Inputs • Optimizing camera output display with mobile app

Microcontroller Subsystem

Jonathan Chen



KY-026 (IR Flame Sensor)

ESP32-CAM (Independent Camera Module)

```
Camera Initialized Successfully!
WiFi connecting....
WiFi connected
Camera Ready! Use 'http://192.168.4.2' to connect
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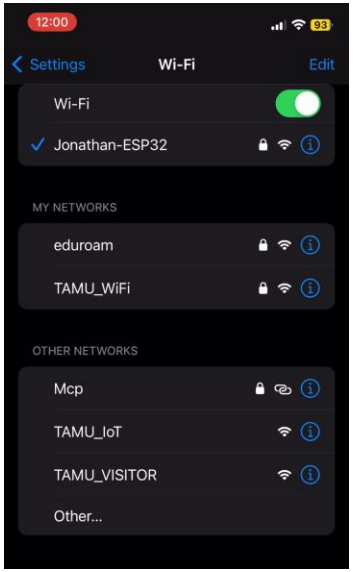
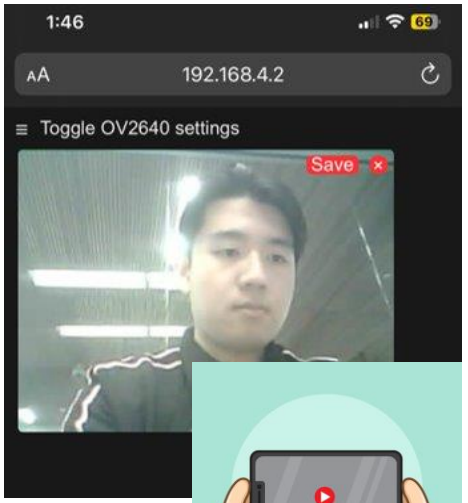




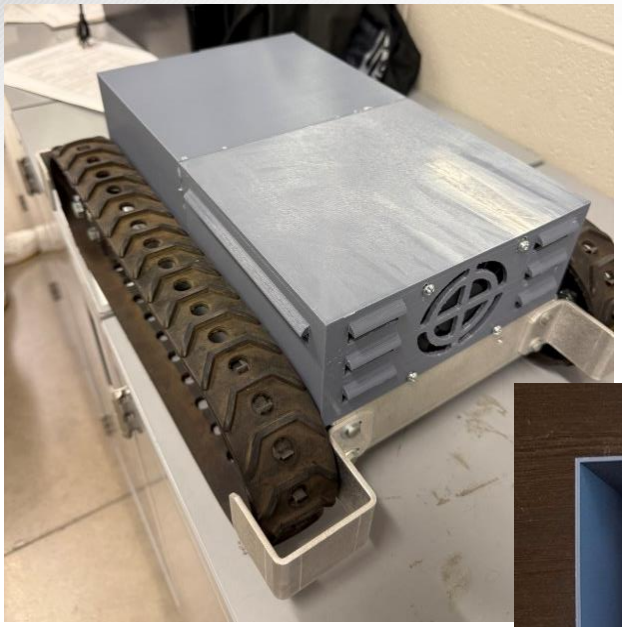
Vehicle Operations & Water Pump Subsystem

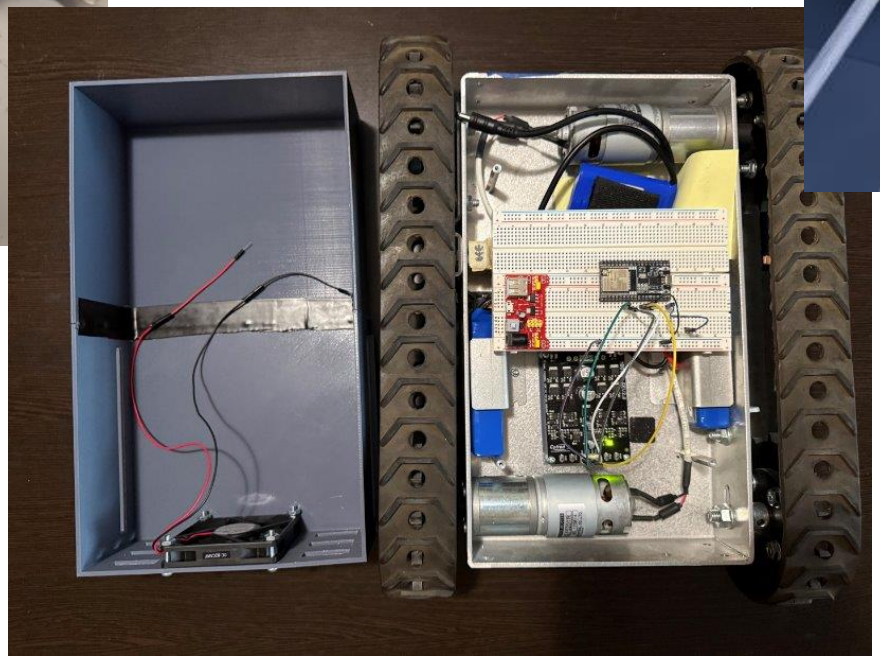
Kevin Rivera

Accomplishments since last update 10 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Separated robot cover frame into 3 sections	• Verify user-input code to integrate with mobile app • Secure cover frame onto metal base to begin placing all boards/sensors

Vehicle Operations & Water Pump

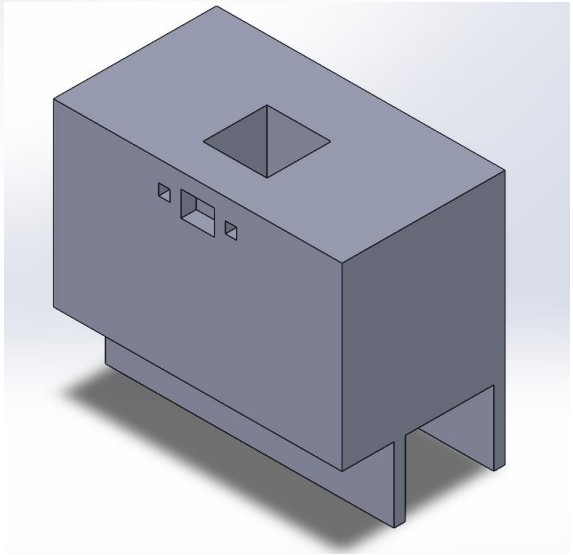
Kevin Rivera





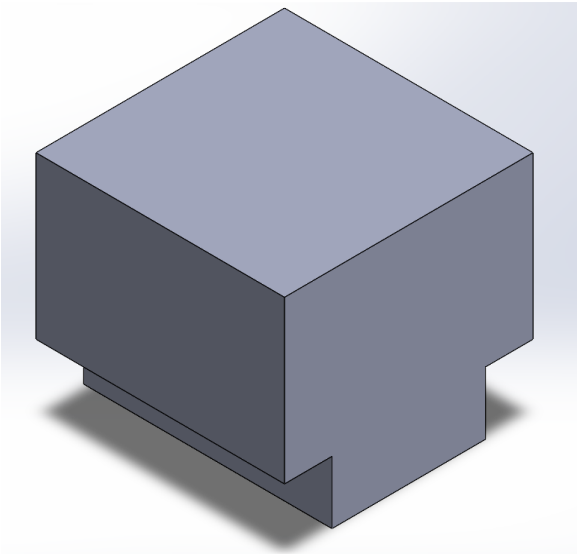
Vehicle Operations & Water Pump

Kevin Rivera

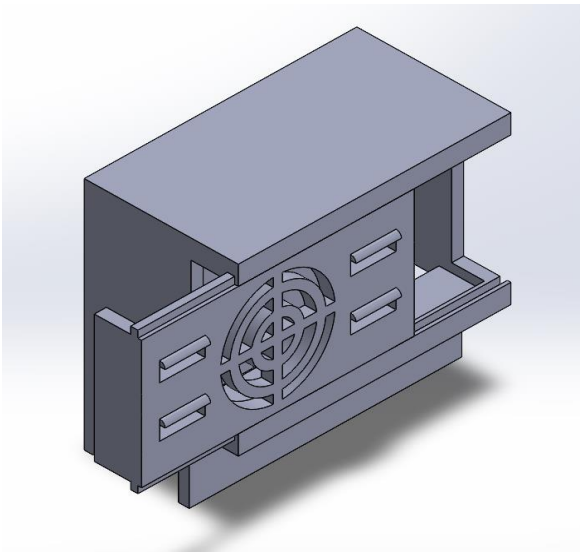


Sensors Section

- Camera
- Infrared Sensors
- Sensors For Water Nozzle



Water Tank



Electronics Section

- PCBs
- Cooling Fan
- Removable Panel

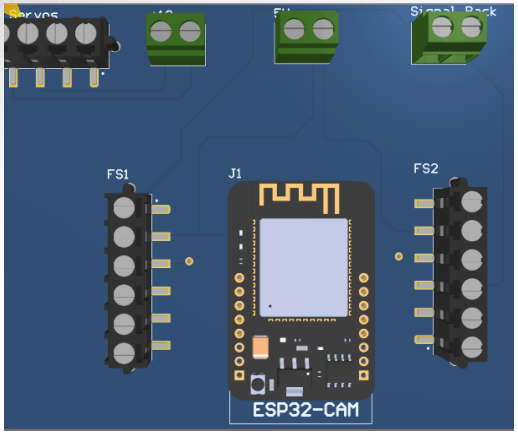
Power & Recharging

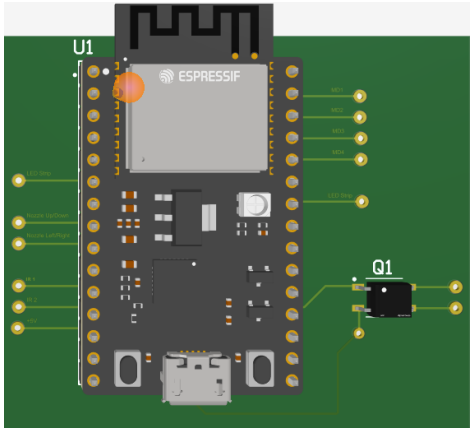
Nancy Ramirez Castillo

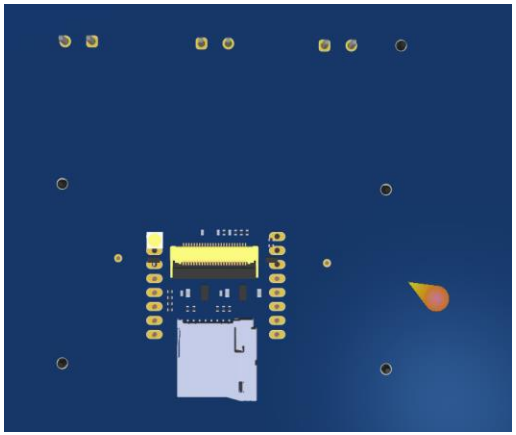
Accomplishments since last update 9 hrs of effort	Ongoing progress/problems and plans until the next presentation
- Ordered ESP32 PCB, Flame Detection PCB - 12V Buck Converter Running	- Minor fixes on the 5V Buck - Integrate with Vehicle Operations and Microcontroller to mount on frame

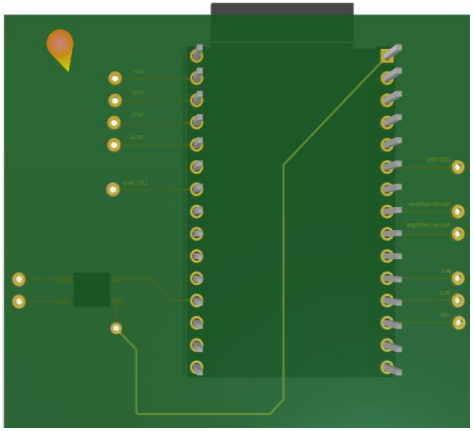
Power & Recharging

Nancy Ramirez Castillo









Front Sensors PCB

Isolated ESP32 PCB

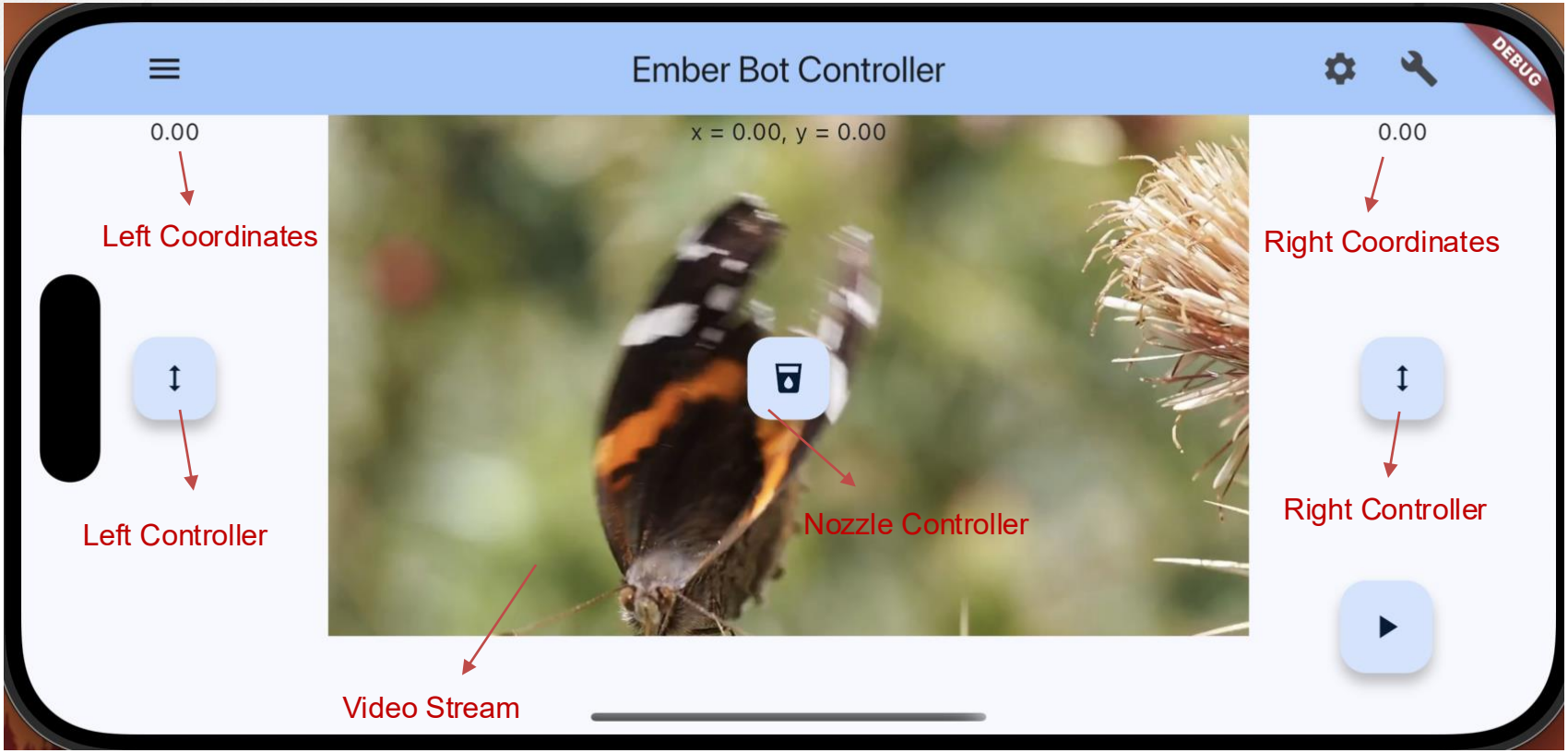
Mobile App Subsystem

Yuwen Zheng

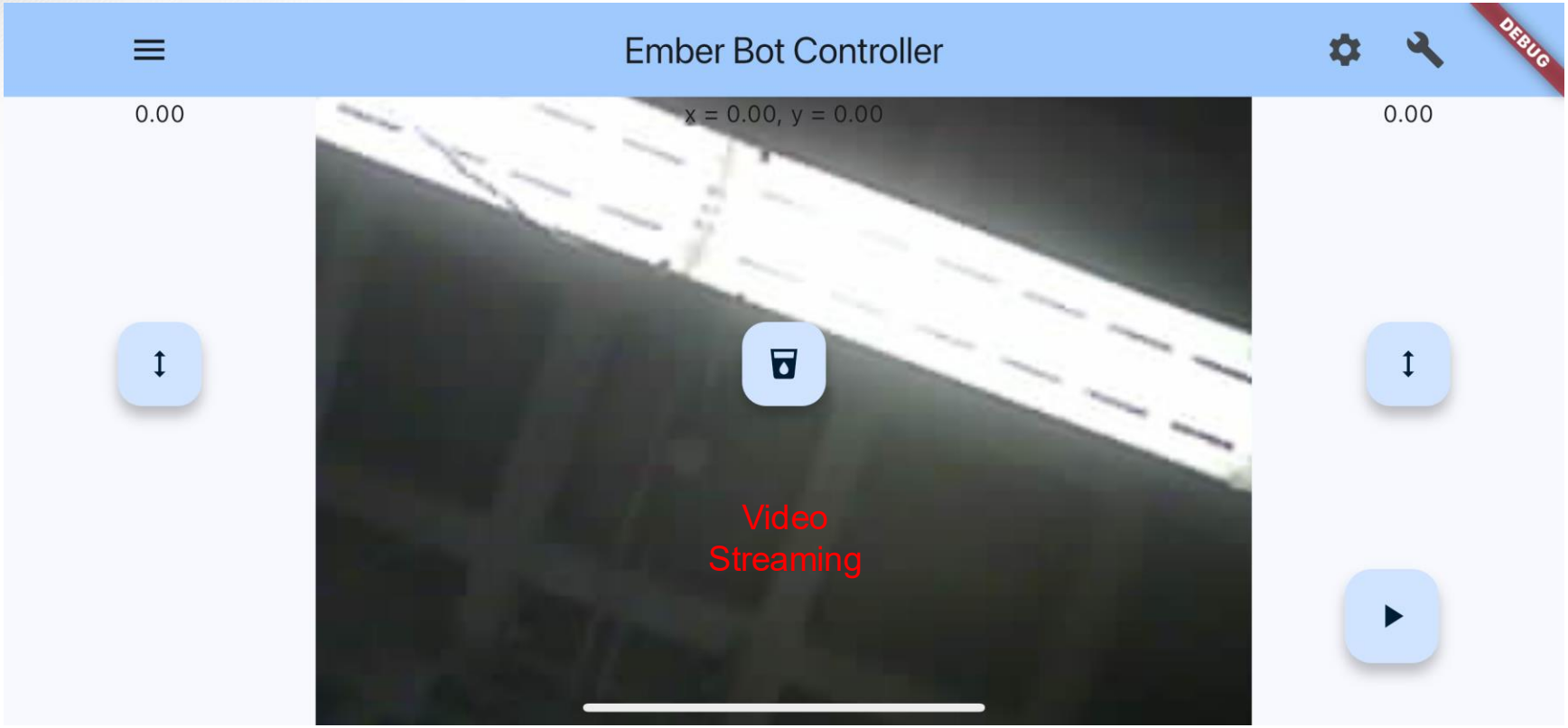
Accomplishments since last update 8 hrs of effort	Ongoing progress/problems and plans until the next presentation
- Completed real-time video streaming integration with microcontroller subsystem - Tested video streaming functionality on mobile app by connecting to ESP32 and displaying video streaming while camera is moving	- Create fixed size video display in Mobile App - Add LED Button & Nozzle Button - Test user control coordinates functionality with microcontroller and water pump subsystem

App Interface

Yuwen Zheng



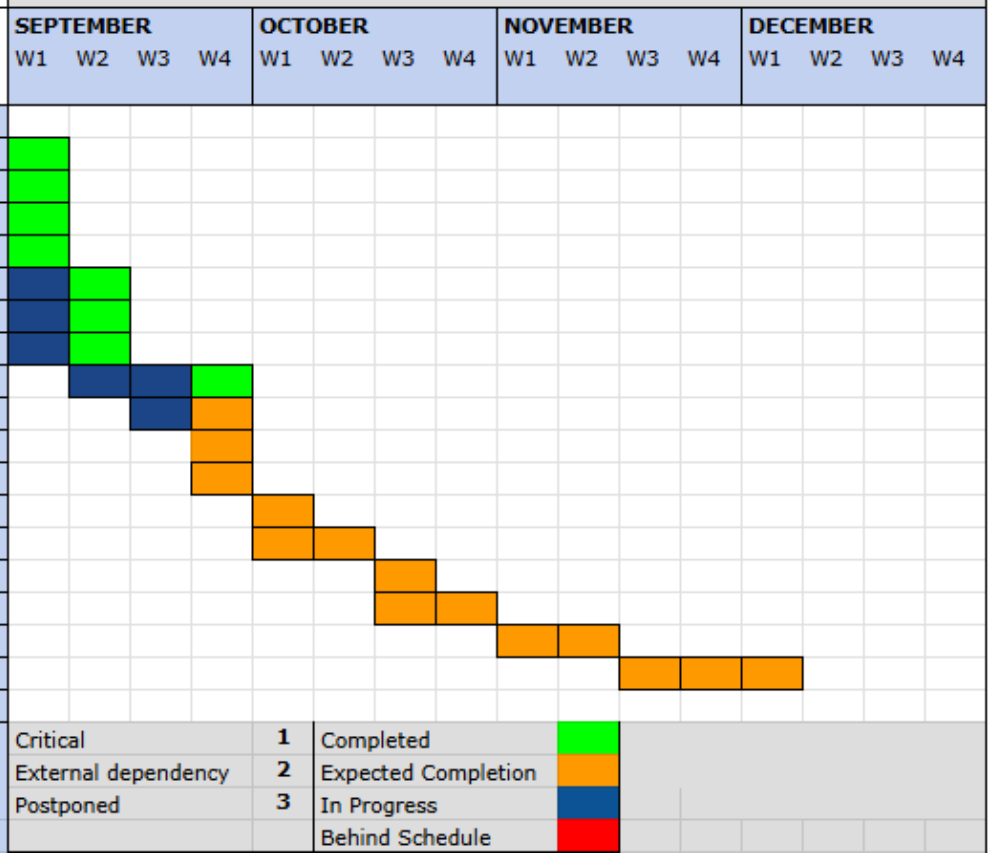
Mobile App Subsystem
Yuwen Zheng



Execution Plan

Ember Bot Project Schedule

Deliverable/Task	Owner	Duration
Engineering Milestones		
Add IP Address Page	Jonathan	1 Week
Implement Video Streaming code	Yuwen	1 Week
Real Flame Testing	Jonathan	1 Week
Buck Converters Re-design	Nancy	1 Week
Integrate Video Streaming with ESP32	Yuwen/Jonathan	2 Weeks
Frame Re-design	Kevin	2 Weeks
Nozzle Calibration	Kevin	2 Weeks
ESP32 PCB Design	Jonathan/Nancy	2 Weeks
Motor Control via App	Yuwen/Kevin	2 Weeks
Order PCBs	All	2 Weeks
Implement App User Guide	Yuwen	1 Week
Implement LED Button	Jonathan/Kevin	1 Week
Fine Tune Buttons of UI	Yuwen	2 Weeks
Frame Installation with Water Tank Filled	Kevin	1 Week
Bind Mobile App with ESP32	Yuwen/Jonathan	2 Weeks
Test Mobile App on Different Devices	Yuwen	2 Weeks
Final Integration and Testing	All	3 Weeks
Annotations:		



Validation Plan

Test Name	Success Criteria	Methodology	Status
Real Flame Testing	Able to detect Flame 5 to 10 Feet at Distance	Use the IR sensor on a at a small controlled flame source (lighter) and record baseline data before lighting the flame. Conduct multiple trials at each distance and logging analog sensor output	Tested
Optimizing WiFi Connection	Connect via Wi-Fi Access Point 50-100 Feet Away	Attempt connecting to the ESP-32 Wi-Fi access point at varying distances and with/without obstacles inbetween.	Tested
Frame Installation	Minimal frame vibration during operation	Once installed, the robot will be moved via the motors and the vibration magnitude will be recorded	Untested
Water Holding	Water Tank Does Not Leak	With the designed and printed water tank, it will be filled with water away from all electronics and be observed for any areas of leaks	Untested
Thermal Management	All electronics do not exceed their operating temperature conditions	Place all electronics in the frame and have them run at nominal operating states with the fan on. Temperature of each board will be tracked and recorded every 30 seconds for a total of 5 minutes.	Untested
Movement Speed With Weight	Ember Bot is able to move at 4mph with the estimated full weight of system	The equivalent of the total weight of all electronics/components will be placed on the robot. Verify that the motors are capable of moving the weighted robot at our desired speed by recording the total displacement in 10 seconds.	Untested
Water Nozzle Aim Calibration	Water Nozzle points to +-10 degrees of user input	Sketching a x-y plane at the recommended distance of 6ft and measuring the accuracy of this distance.	Untested
Video Streaming	Mobile app can receive and display video signals from ESP32	The mobile app will able to display video streaming from the camera on Ember Bot	Tested
Video Distance & Frame Test	Video Stream doesn't lose frames or quality as distance increase	Test the independent mobile integration with the camera at varying distances, aiming for 5 feet intervals until 50 feet or the distance of entire room	Tested
LED Button	Mobile app can turn LED On/Off	The LED on Ember Bot should turn on/off when user press the LED button in the app	Untested
App User Guide	App user page can be viewed on the mobile app	Let other group members walk through the user guide to check if it provides a clear instructions to users	Untested
Mobile App on Different Devices	The mobile app can be loaded on to at least 3 other devices	Load mobile app on other group member's devices to test if the app can function as expected on different devices	Tested
Power Boards Testing	Able to supply power under max load	Using different combinations of loads, two buck converters should keep a consistent output for all components needed	Untested
Battery Endurance Testing	Ember Bot can operate for an hour under continuous use and indicate when battery is low	Starting with full batteries, Ember Bot will run all different components for an hour and then will log how much battery power was used.	Untested
Motor and nozzle user test	Control the motors and nozzle movements with no more than a 2 second delay via the mobile app	After connection between the ESP32 and our mobile app is made, have a user send inputs from the app to control the motors and servo motors. Track how long it takes for these actions to take place.	Untested
Electonics Isolation	There is no risk of water damaging the PCB, motors, and other electronics in the bottom layer of the robot	Connect the pieces of the frame and pour 1 gallon of water over it for a short time and once done check below the frame to see if water leaked	Tested
Servo Movements	Servos can successfuly move and point to a certain point	Attatch a laser on the end of the servo configuration to point to a x-y grid. Input x and y coordinates and verify that the laser is pointing to the correct point	Tested
Water Nozzle Movement	Water pump system successfully attatched to the servo system	Connect the servos with the water nozzle and verify that the range fits with the coordinate system verified in the servos movement test	Tested
Vehicle Movement	Both motors can be controlled independetly via the motor driver	Input control signals can control each motor independetly to go forward, backwards, turn left, turn right, and turn 180 degrees.	Tested
12V Buck Simulation	Steady state waveform and outputing a max of 12.6V	Using LTSpice/Altium to select components and verify power rail. Using a higher voltage to compensate for real world applications which will decrease the output voltage	Tested
5V Buck Simulation	Steady state waveform and outputing a max of 5.5V	Using LTSpice/Altium to select components and verify power rail. Using a higher voltage to compensate for real world applications which will decrease the output voltage	Tested

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Questions?

Thank You!
Ember Bot

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