Dwight Look College of
ENGINEERING
TEXAS A&M UNIVERSITY

Ember Bot:

A Fire Fighting Robotic Vehicle

Team 30:
Jonathan Chen
Kevin Rivera
Nancy Ramirez Castillo
Yuwen Zheng

Executive Summary:

Problem Statement:

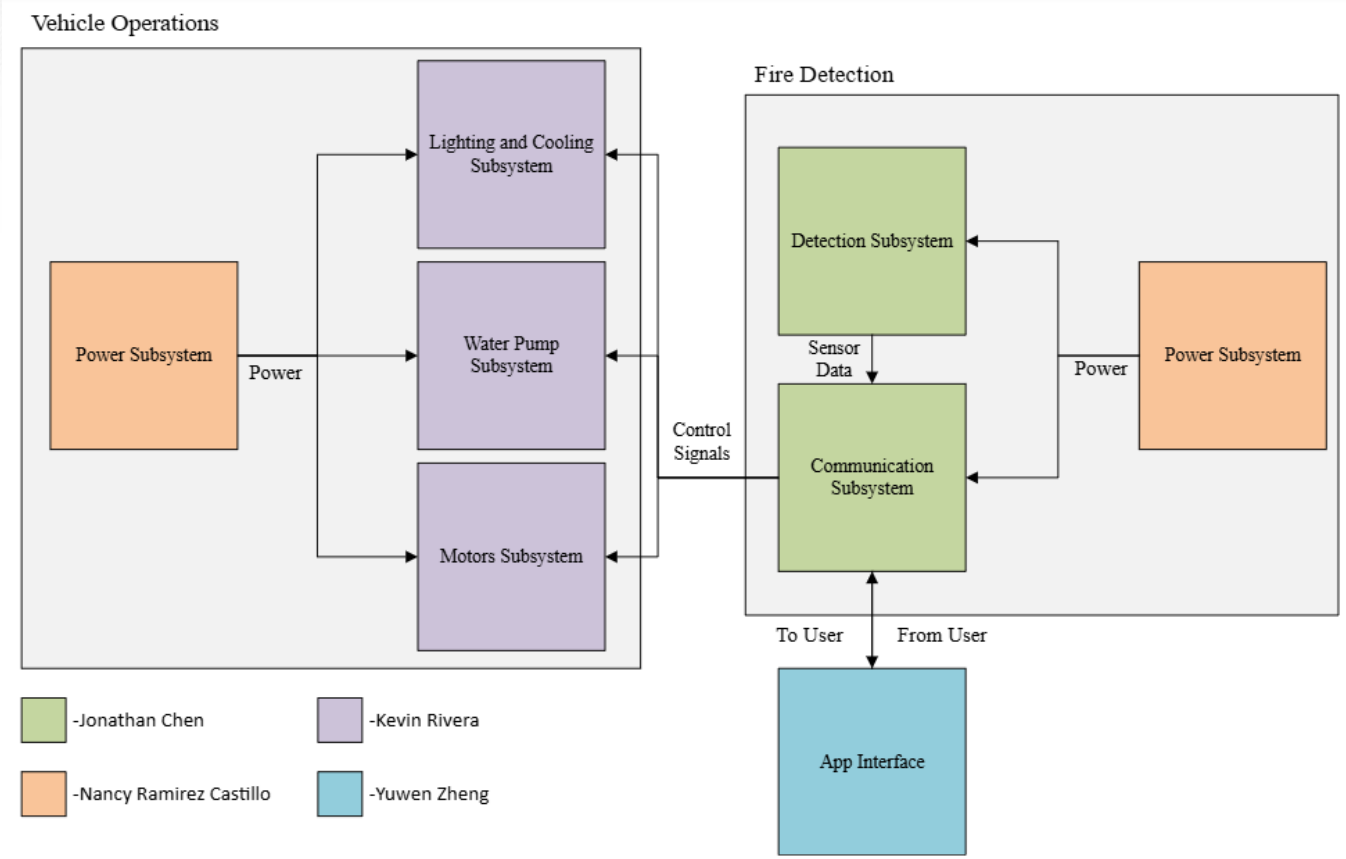
Traditional firefighting methods rely on human intervention, exposing personnel to extreme hazards such as heat, toxic smoke, and structural collapse. These settings can pose safety risks and potential response delays, especially in hard-to-reach areas.

Project Description

Solution proposal:

Ember Bot is a fire-fighting robotic vehicle designed to detect and extinguish small fires in high-risk areas through a mobile app. Equipped with IR sensors and a camera, firefighters will be able to control Ember Bot in areas deemed unsafe for humans.

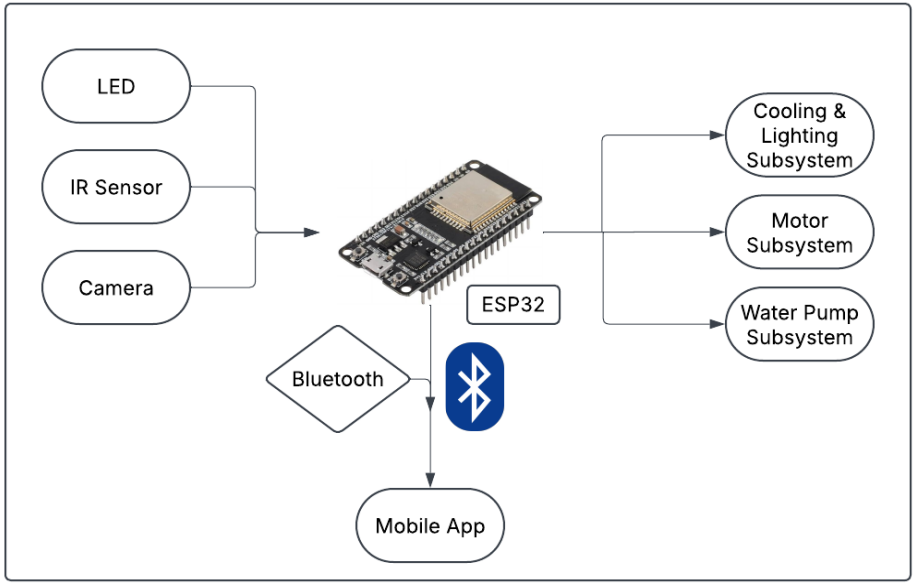
System Overview



Microcontroller and Fire Detection

Fire Detection:

- The subsystem collects infrared and camera data to detect fires via temperature and visual detection
- If a fire hazard is detected, an alert signal is sent to the communication subsystem for further action and manual extinguishment.

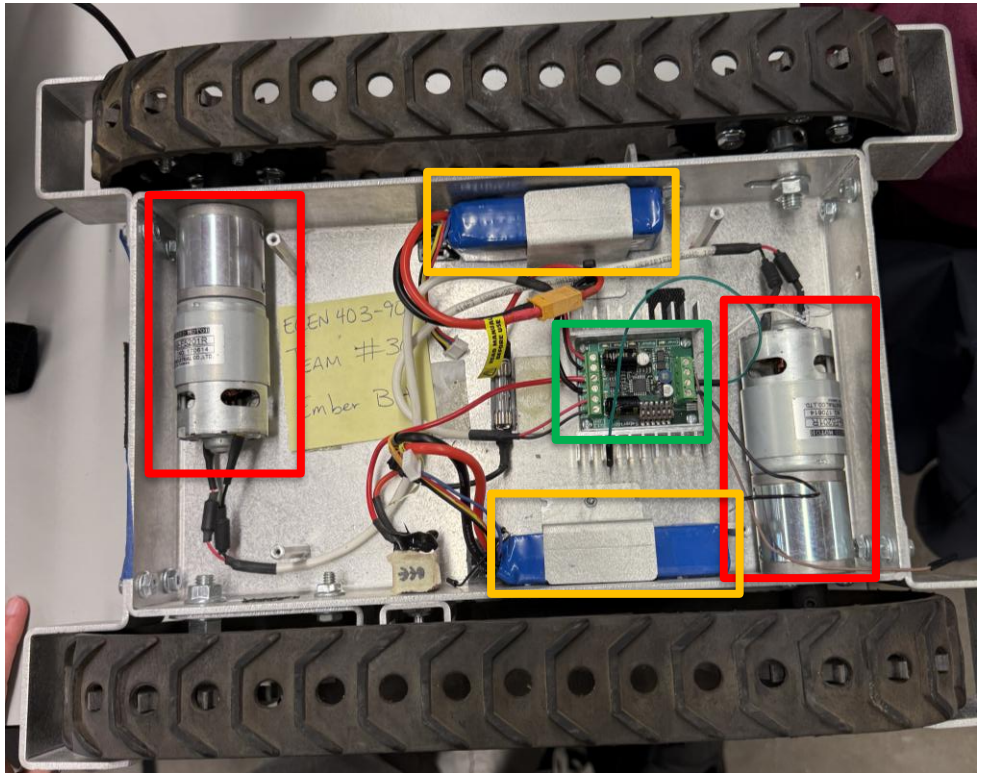


Microcontroller:

- The ESP32 microcontroller processes sensor inputs and manages system operations, including data acquisition, motor & pump control, and communication.
- The microcontroller allows control of Ember Bot via the mobile interface and Bluetooth.

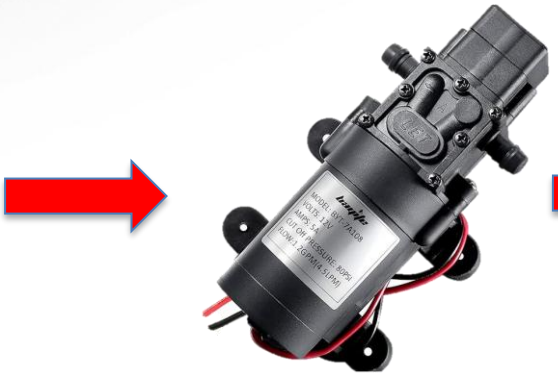
Car Design

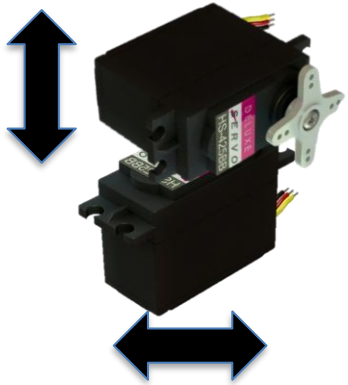
- 2 24V DC Motor
- Dual Channel Motor Control
- 2 11.1V Battery
- To be added:
  - LED Strip
  - Cooling Fan
  - Temperature Sensor
  - ½ Gallon Refillable Water Tank

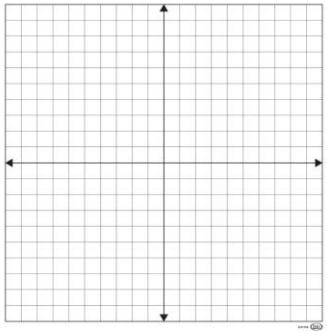


Pump System

Water Tank





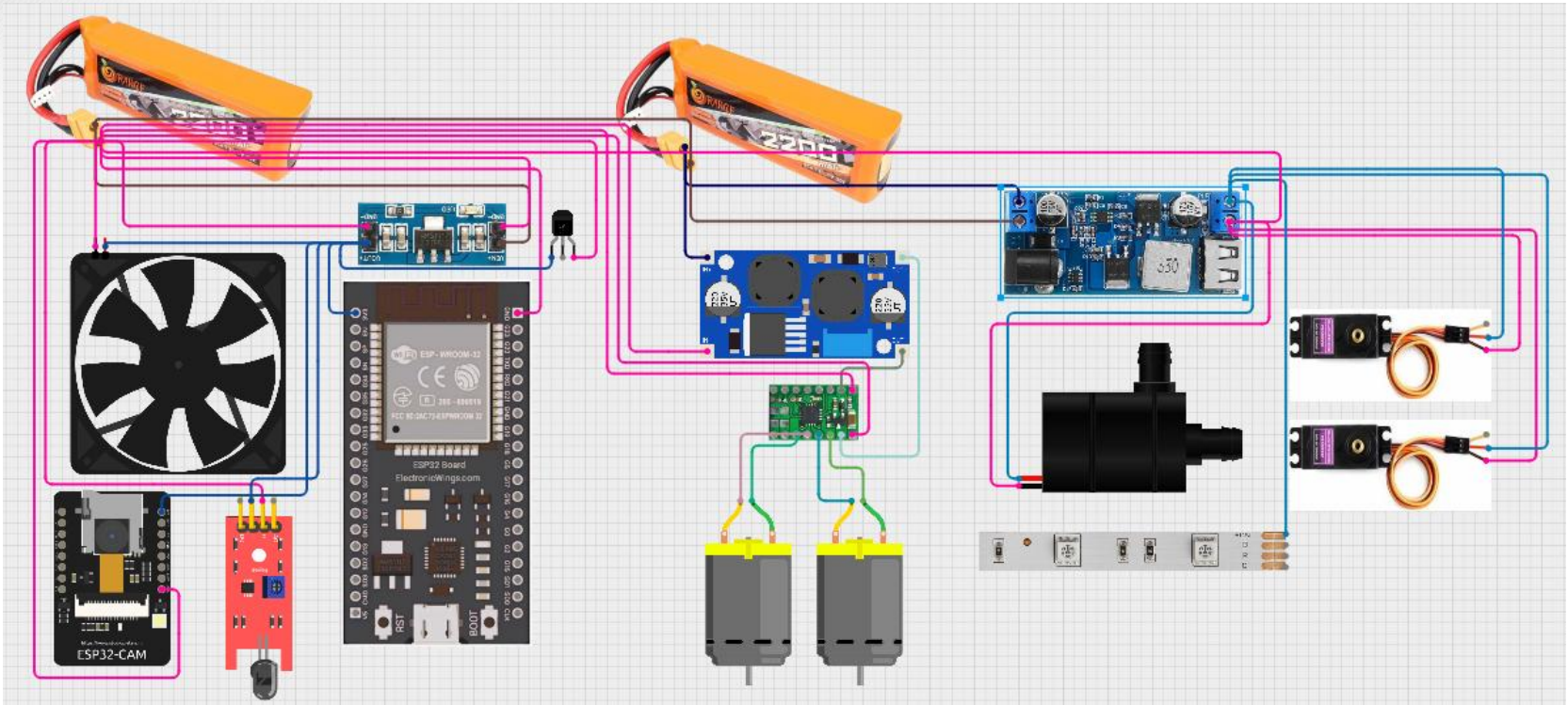


- Water transfer pump pressurizes the water to shoot it out
- Two stacked servos to move the water nozzle
  - One servo moves in the x direction, the other in the y

Power System

- Power Source & Distribution:
  - 2 – 11.1V/2200mAh Batteries
  - Regulators:
    - Buck Converter (11.1V to 3.3V)
    - Boost Converter (22.2V to 24V)
    - Buck Converter (22.2V to 12V)

Power System

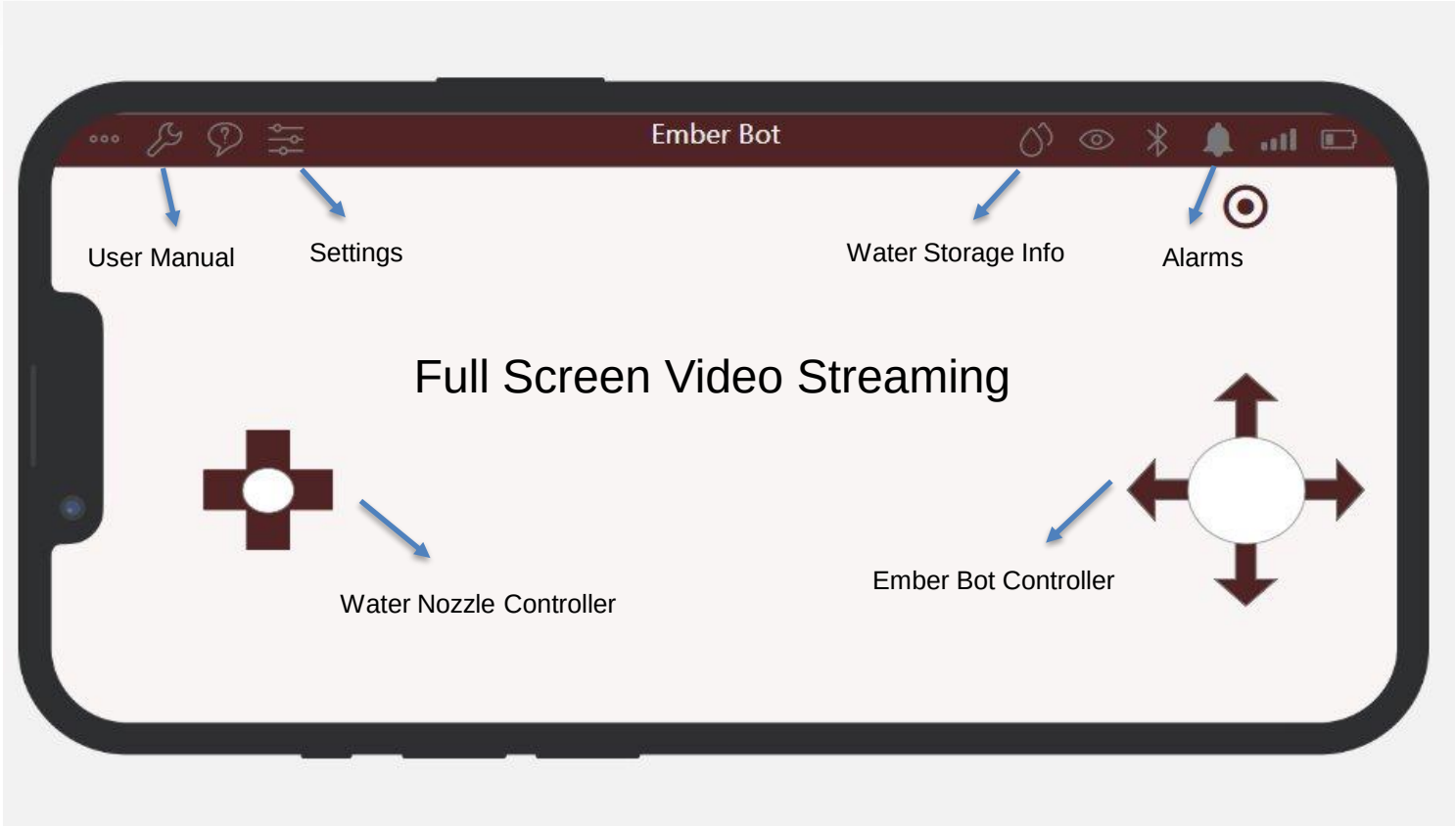


Mobile App Design

- Build with Flutter, a cross-platform framework
- Support iOS / Android
- Code written in Dart
- Communicate with Ember Bot via Bluetooth

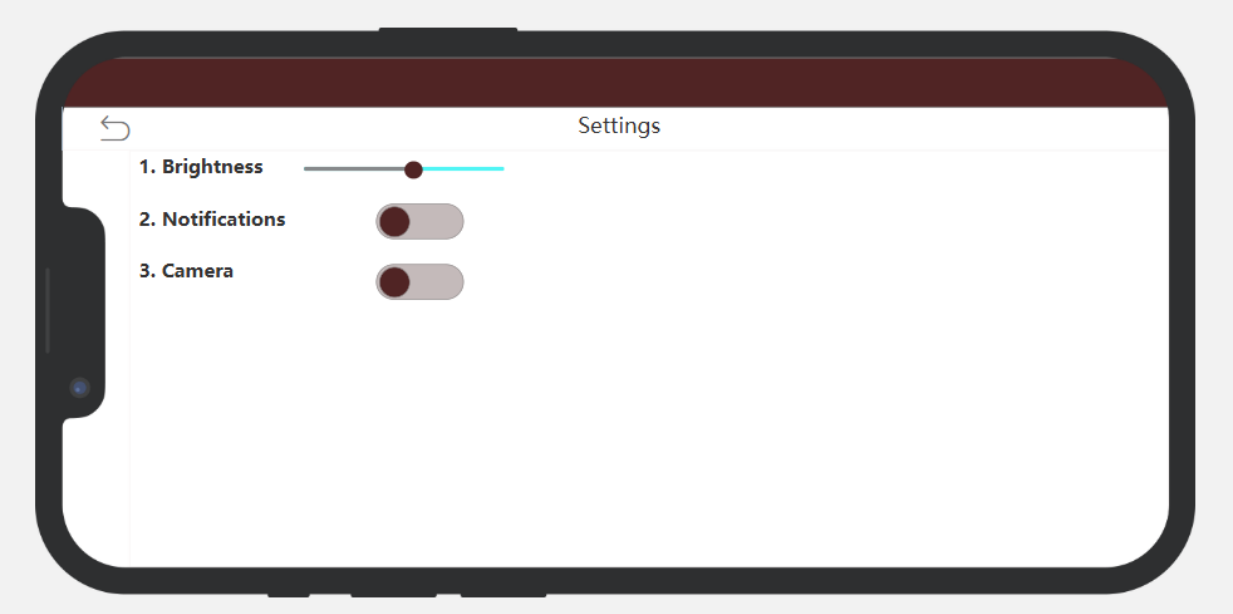
UI Demonstration

- App demonstration on iPhone 14 Pro Max



Features

- User Manual
- Settings & Help Page
- Warnings & Alarms



Future Possibilities

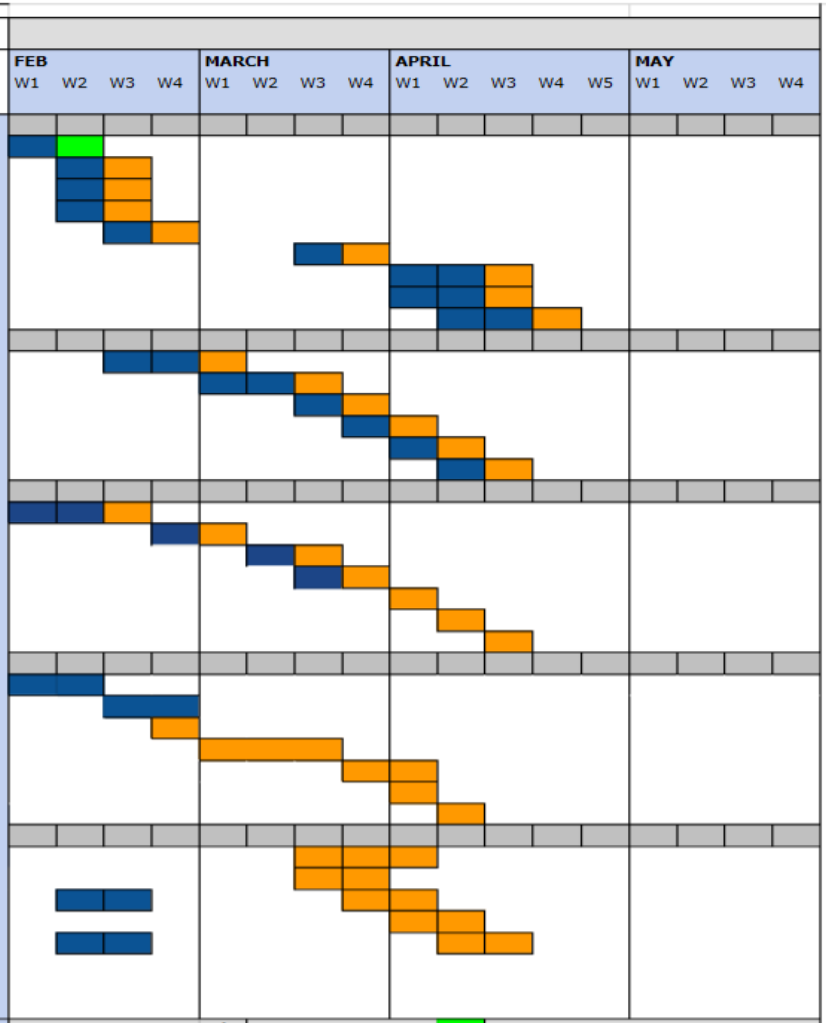
Some Possible Future Additions:

1. Tap to Extinguish
2. Automatic Land Traversal
3. Extended Communication Range
4. Even More Possibilities!

Execution Plan

Ember Bot Project Schedule

Deliverable/Task	Owner	Duration	Note
Overall Deliverables			
ConOps	All	2w	Due 2/5
FSR + ICD	All	2w	Due 2/20
Validation Plan	All	2w	Due 2/20
Milestone Plane	All	2w	Due 2/20
Midterm Presentation	All	2w	Due 2/24
Status Update Presentation	All	2w	Due 4/2
Final Presentation	All	3w	Due 4/16
Final Demo	All	3w	Due 4/21
Final Report	All	3w	Due 4/27
Microcontroller & Fire Detection			
ESP32 Installation + Start-Up	Jonathan	3w	
ESP32 Framework	Jonathan	3w	
Camera Module	Jonathan	2w	
IR Sensor Detector	Jonathan	2w	
Light Source	Jonathan	2w	
Microcontroller Connection w/ Subsystems	Jonathan	2w	
App Development			
Create wireframe and overall structure	Yuwen	3w	
Create clickable prototype	Yuwen	2w	
Create User Interface Design	Yuwen	2w	
Test the app	Yuwen	2w	
Create User Mannual within app	Yuwen	1w	
Create User Help page within app	Yuwen	1w	
Finalize App Design	Yuwen	1w	
Power System			
Design circuit schematic	Nancy	2w	
Breadboard Assemble and Testing	Nancy	2w	
Power Efficiency and Load Testing	Nancy	1w	
PCB Design	Nancy	2w	
PCB Testing	Nancy	3w	
Thermal and Safety Analysis	Nancy	1w	
Validate Recharging	Nancy	1w	
Pump System + Car			
Verify Vehicle Movement	Kevin	2w	
Set up Lighting and Cooling	Kevin	2w	
Movable Nozzle	Kevin	2w	
Water Pump System	Kevin	3w	
Creating Vehicle Frame	Kevin	2w	



Annotations:

Critical	1	Completed
External dependency	2	Expected Completion
Postponed	3	In Progress
		Behind Schedule

Validation Plan

Status Indicators	
Completed	
In Progress	
Behind Schedule	

Task	Deadline	Current Status	Color Code
Understand & Research	1/30/2025	Completed	
ConOPS Completed	2/5/2025	Completed	
Components Ordered	2/18/2025	Completed	
FSR, ICD, Milestones, and Validation Plan Completed	2/20/2025	Completed	
Midterm Presentation	2/24/2025	In Progress	
Parts Received	TBD	In Progress	
Breadboard Testing	2/28/2025	In Progress	
Vehicle Movement	3/18/2025	In Progress	
PCB Designed + Ordered	3/19/2025	In Progress	
ESP32 Framework Completed	3/25/2025	In Progress	

Validation Plan

Task	Deadline	Current Status	Color Code
Pump System Completion	3/25/2025	In Progress	
Primary App Design Completed	4/1/2025	In Progress	
PCB Testing Complete	4/2/2025	In Progress	
Microcontroller System Set-up	4/8/2025	In Progress	
Power System Tested w/ Car	4/8/2025	In Progress	
Final Presentation	4/16/2025	In Progress	
Final Demo	4/21/2025	In Progress	
Final Report	4/27/2025	In Progress	