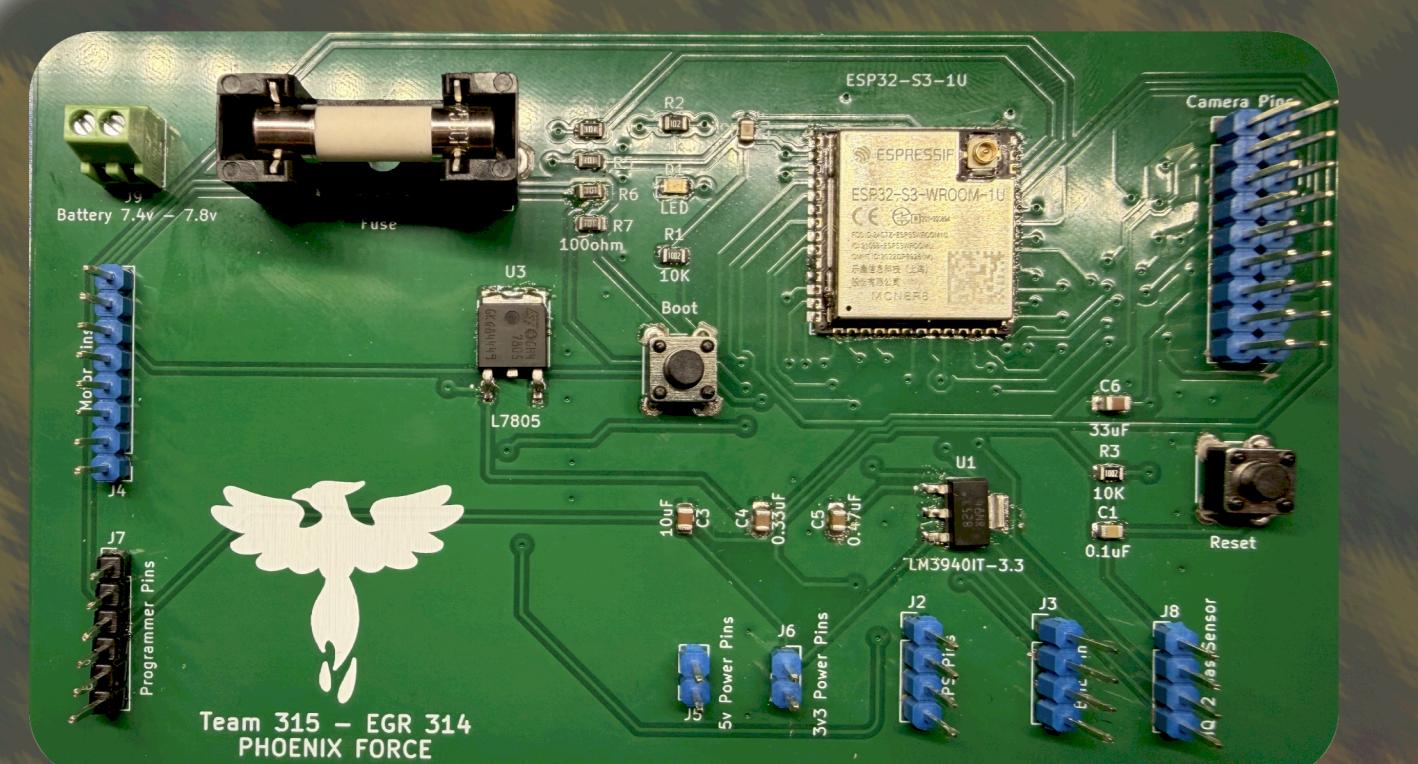
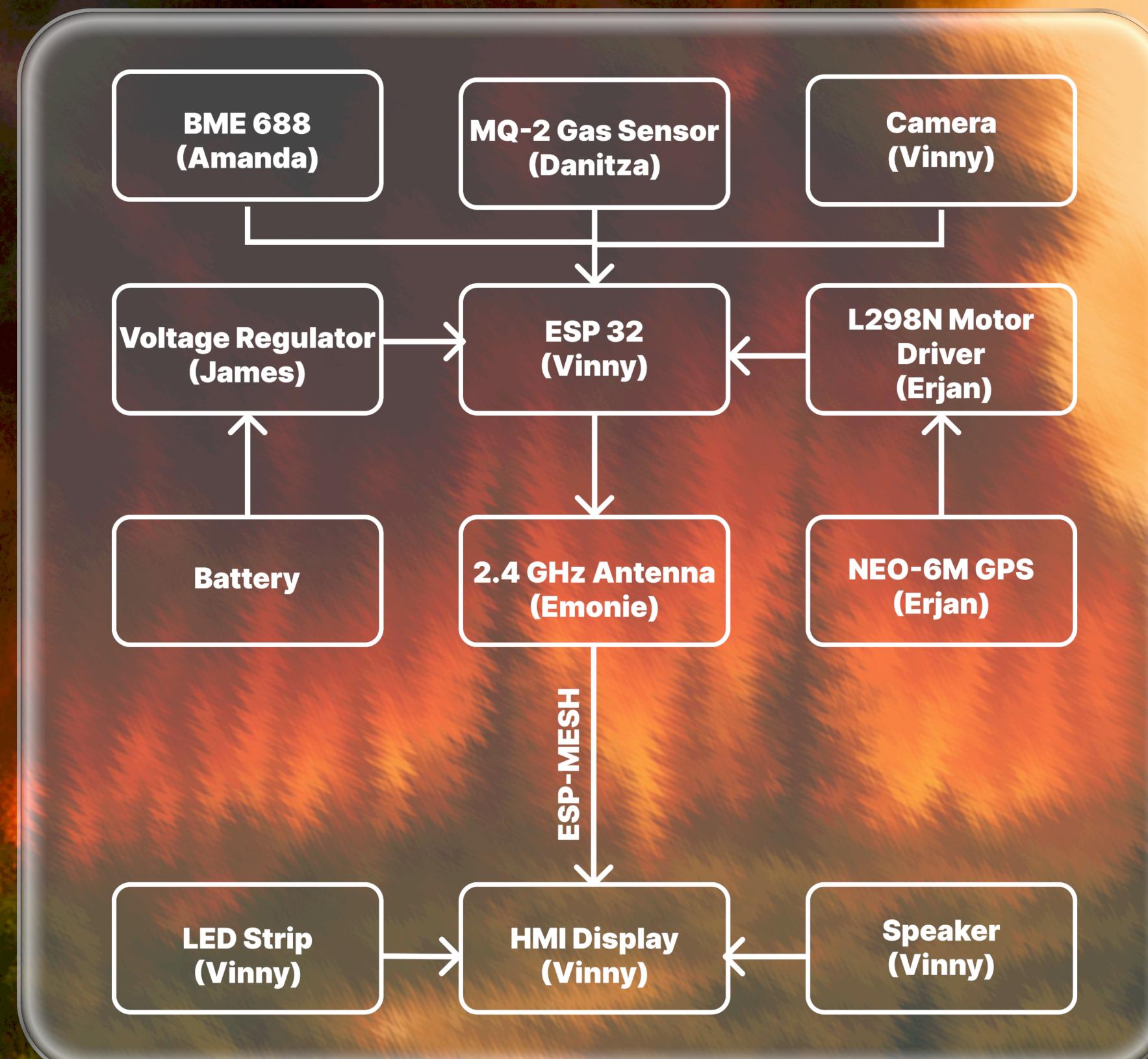
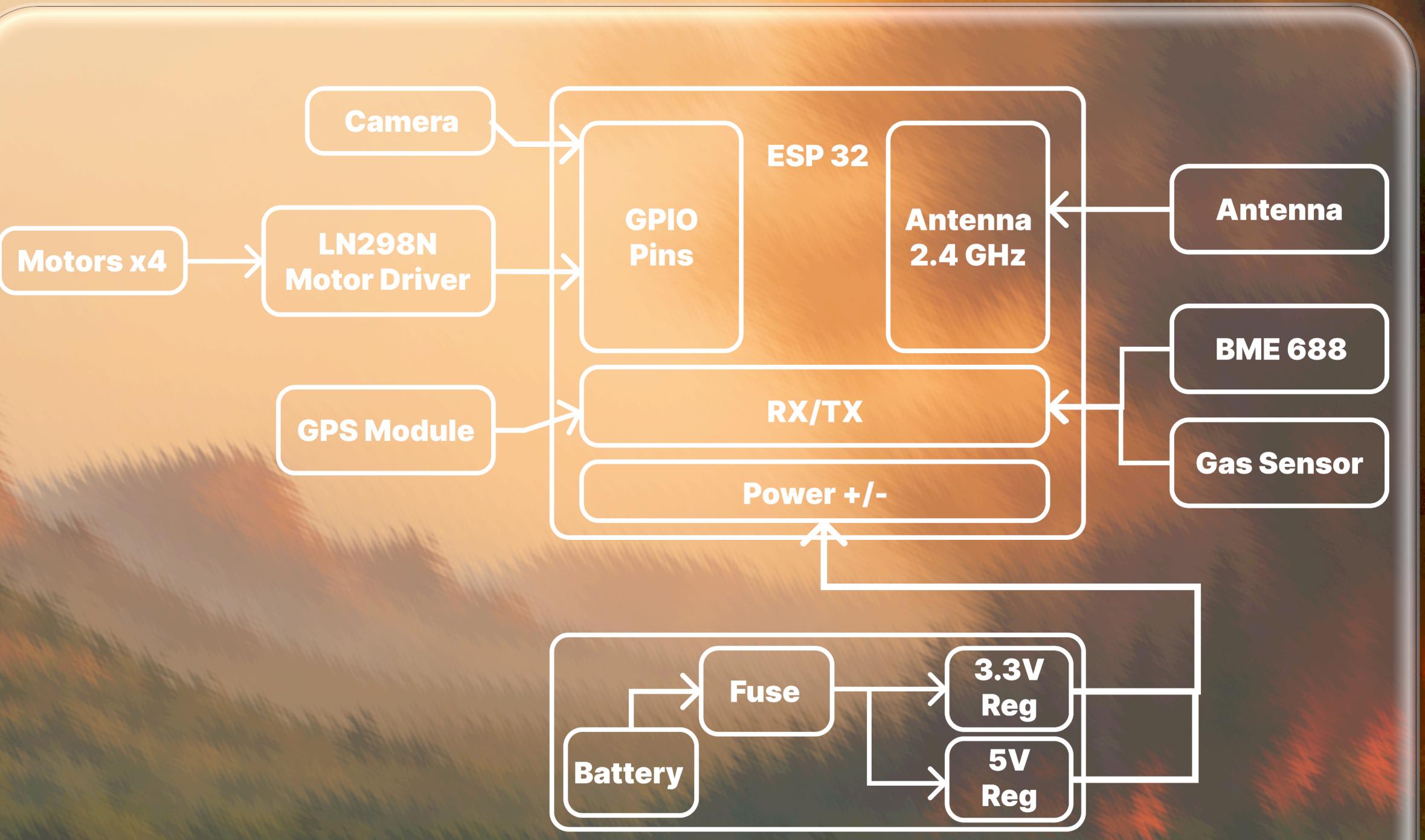
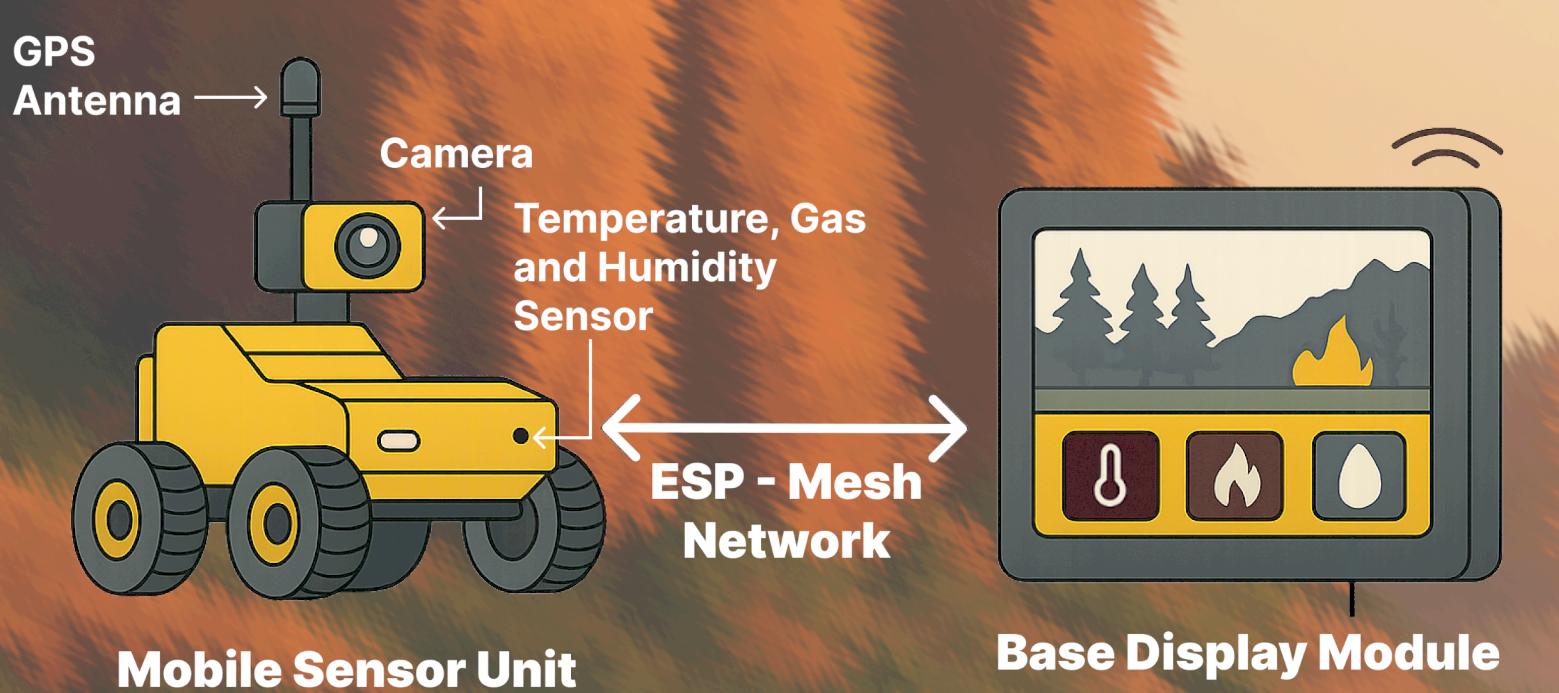


TerraGuard Rover

Vinny Panchal, Emonie France, Amanda Pizzaro,
Danitza Jimenez, James Austin, Erjan Baigenzhin



Mission Statement

Our mission is to create a rugged wildfire-response system that detects early cues, alerts clearly, and communicates reliably without relying on public networks. The design focuses on providing fast, accurate, and easy-to-understand information so responders can make safer decisions in the field.

Team Charter

Phoenix Force is committed to developing a field-realistic prototype that meets measurable engineering standards for latency, accuracy, and reliability. We emphasize a glove-friendly interface, defensible engineering trade-offs, strong documentation, and a final product that strengthens our technical skills while demonstrating real impact beyond the classroom.

Audience

The primary audience for this system is frontline wildfire responders, including firefighters, fire-watch volunteers, and emergency management teams.

Critical User Needs

During concept generation, we identified the most important user needs for field operation. Responders require clear alerts through visual, auditory, and tactile cues. They need simple, glove-friendly controls and icon-based screens that minimize the number of actions required. Durability is essential, including fire-resistant, waterproof, and dust-protected hardware.

Major Components

ESP 32 S3
L298N Motor Driver
BME 688 Bosch Sensor
2.4 GHz Antenna
7" Touch Screen
NEO-6M GPS Sensor
MQ-2 Gas Sensor
OV5640 Camera

SubSystem Distribution

HMI Display & Camera - Vinny
Drive & GPS - Erjan
BME688 Sensor - Amanda
MQ-2 Gas Sensor - Danitza
Power Distribution & Conversion - James
ESP Mesh communication & Antenna - Emonie

Communication Sequence

The wildfire environment is detected by the rover's sensing hardware. The sensor suite (temperature, humidity, gas/air-quality, and pressure sensors - Amanda & Danitza) measures conditions and sends all readings to the ESP32 microcontroller (Vinny) over I²C/analog inputs.

The GPS module and motor driver subsystem (Erjan) also communicate with the same ESP32: GPS provides position and time, while the motor driver receives movement commands and returns status. The camera module (Vinny) sends image or video data into the ESP32 as well. All components are powered through the battery and voltage regulation subsystem (James), which supplies stable power to the ESP32 and peripherals.

The ESP32 processes and packages all sensor, GPS, motor, and camera data, then transmits it through the onboard antenna via ESP-Mesh to the HMI display node (Emonie). The HMI ESP32 decodes the packets and updates the interface with live sensor readings and the camera video stream for real-time monitoring.