E1.06 - Autobots

TEXAS STATE UNIVERSITY
Ingram School of Engineering

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Sponsor: Mr. Welker

TXST AUTOBOTS

Design Overview

The system enables a miniature vehicle to autonomously navigate using real-time sensing and control.
Key points:

- Detects lanes, traffic lights, and stop signs
- Processes data with an embedded controller
- Controls motors with closed-loop feedback
- Uses custom PCB and regulated power
- Ensures reliable autonomous operation

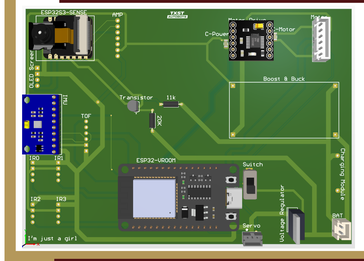
D1 Requirements

- Demonstrate a functional baseline of the autonomous system
- Ensure each subsystem operates independently and supports integration
- Include a start button with indicator
- Perform basic navigation (lane keeping and intersection turns)
- Detect lanes, intersections, traffic lights and stop signs
- Display elapsed time for performance tracking
- Complete chassis PCB design ready for manufacturing

D1 Achievements

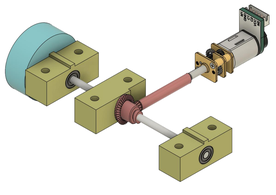
- Completed major hardware and software development for the system.
- Established wireless communication between ESP32, camera and PC
- Designed chassis with motor and steering control
- Developed PCB layout
- Developed computer vision for traffic light and stop sign detection

PCB



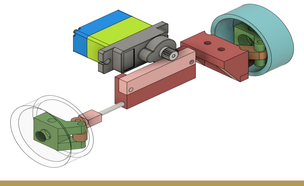
The custom PCB integrates the main microcontroller, IMU, motor driver, voltage regulator, boost/buck converter, and charging module onto a single board. Other components such as the IR sensors, ToF sensor, servo, and OLED display connect to the board using wires.

Differential Drive Model

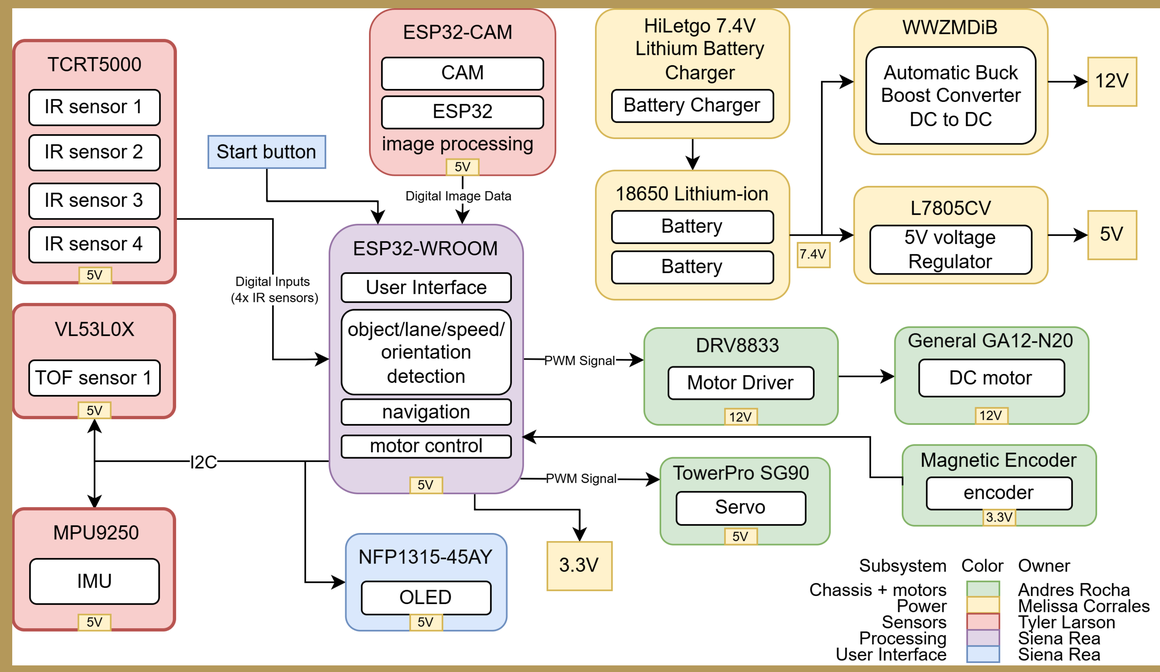


The drive train is powered by an 12V N20 Metal Gear DC Motor

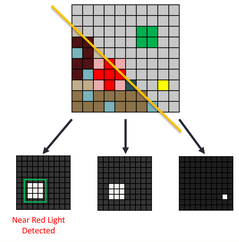
The steering column is actuated by an SG90 Servo Motor



Top Level Diagram



Camera



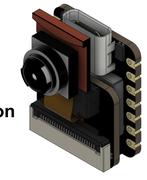
Traffic Light Detection:

- Convert RGB image → **HSV color space**
- Apply hue thresholds for **Red** / **Yellow** / **Green** LEDs
- Generate binary masks for each color
- Perform blob detection on masked regions
- Compute centroid → position in field of view
- Use blob size (pixel area) → estimate distance

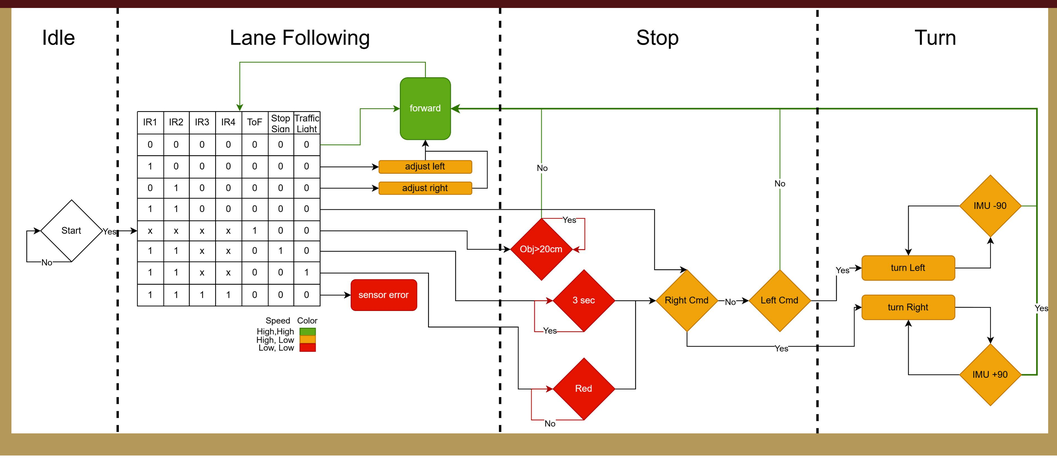
Generated text Data packet will be transmitted over Wi-Fi to main processor

Seed Studio XIAO ESP32 Sense:

- ESP32 + onboard camera module
- Captures RGB frames (configurable resolution)
- **Runs HSV + color detection onboard**
- 3.3-5V, low power
- **Wi-Fi data transmission**



Autonomous Vehicle Control Flow



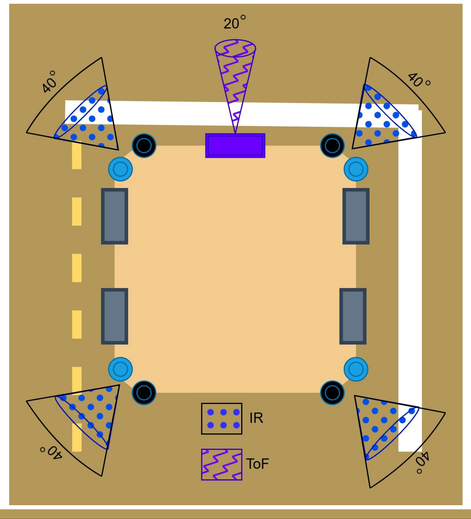
Meet The Team

Andrés Rocha	Siena Rea	Melissa Corrales	Tyler Larson
Locomotion	Processing	Power	Sensors

D2 Plans

- Implement camera-to-ESP32 communication for real-time decisions.
- Improve chassis design for durability and steering
- Develop wireless HMI for control and monitoring
- Enhance computer vision accuracy
- Refine and test PCB layout
- Optimize power subsystem for efficiency and reliability

Sensor location



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