

E2.11 Dojo Drive

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Sponsor: Dr. Behmann



Project Overview

Autonomous battery-powered robot designed to compete in Sumo/Tug-of-War competitions.

Design Requirements

- Fully autonomous operation
- Max size: 13cm x 13cm
- Weight Limit (Push Event): 1500g
- Weight Limit (Pull Event): 1500g
- Budget: \$75
- Battery Powered, $\leq 12VDC$
- Minimum 2-wheel drive (no tracks)
- Must detect boundaries and objects/bots
- Shuts off motors if unable to move object for 3 seconds
- Start button with 5-sec countdown delay

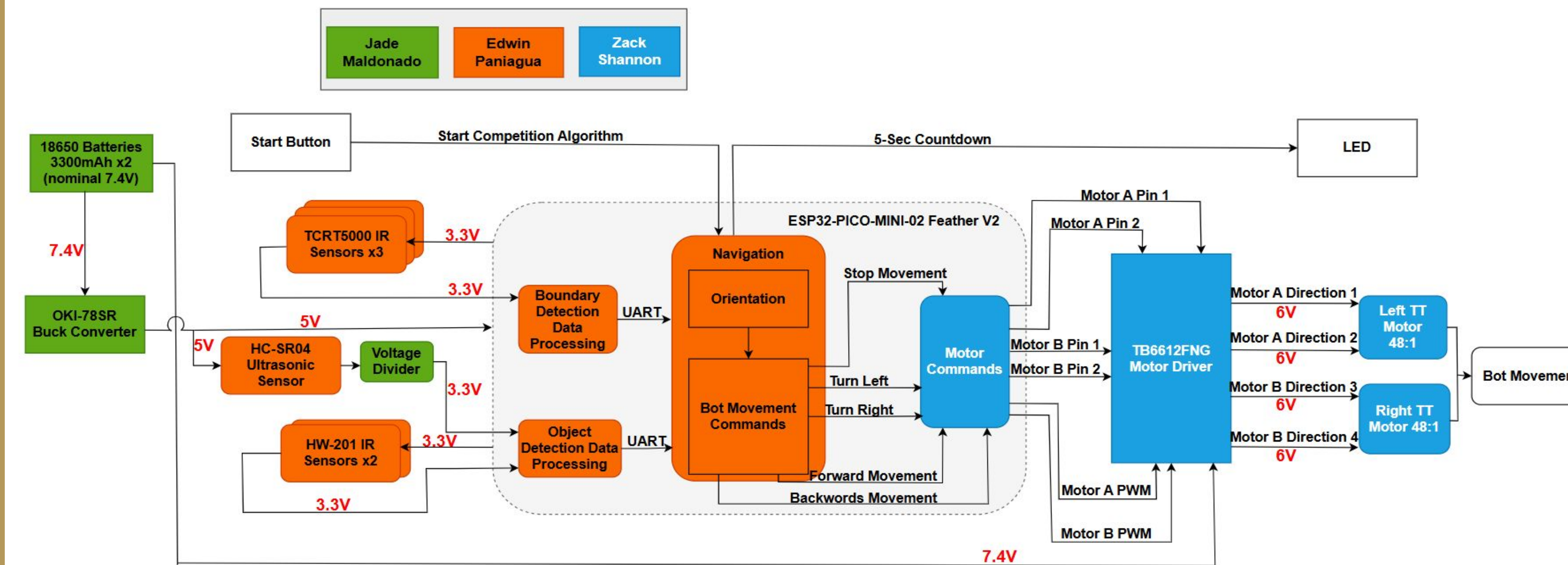
Cost & Budget

| Component | Quantity | Price Each | Subtotal Cost |
|--------------------------------------|----------|------------|---------------|
| ESP32-PICO-MINI-02 Feather V2 | 1 | \$19.95 | \$19.95 |
| TCRT5000 IR Sensors | 3 | \$1.38 | \$4.14 |
| HC-SR04 Ultrasonic Sensor | 1 | \$1.79 | \$1.79 |
| 18650 Lithium Batteries 3.7V 3300mAh | 2 | \$4.83 | \$9.66 |
| Gearbox TT Motors 48:1 | 2 | \$2.95 | \$5.90 |
| HW-201 IR Sensor | 2 | \$5.05 | \$10.10 |
| TB6612FNG Motor Driver | 1 | \$7.83 | \$7.83 |
| OKI-78SR-5/1.5-W36-C Buck Converter | 1 | \$5.92 | \$5.92 |
| Misc. Hardware | ~ | ~ | \$3.37 |
| Total Unit Cost | | | \$68.66 |

Design 2 Accomplishments

- Integrated all subsystems into one system
- Implemented navigation state machine
- Tuned PWM motor control
- Integrated IR + ultrasonic sensing
- Designed PCB-based chassis
- Completed debugging and validation

Top Level Diagram



Meet the Team



Edwin

- Object/Boundary Detection
- Navigation
- Orientation

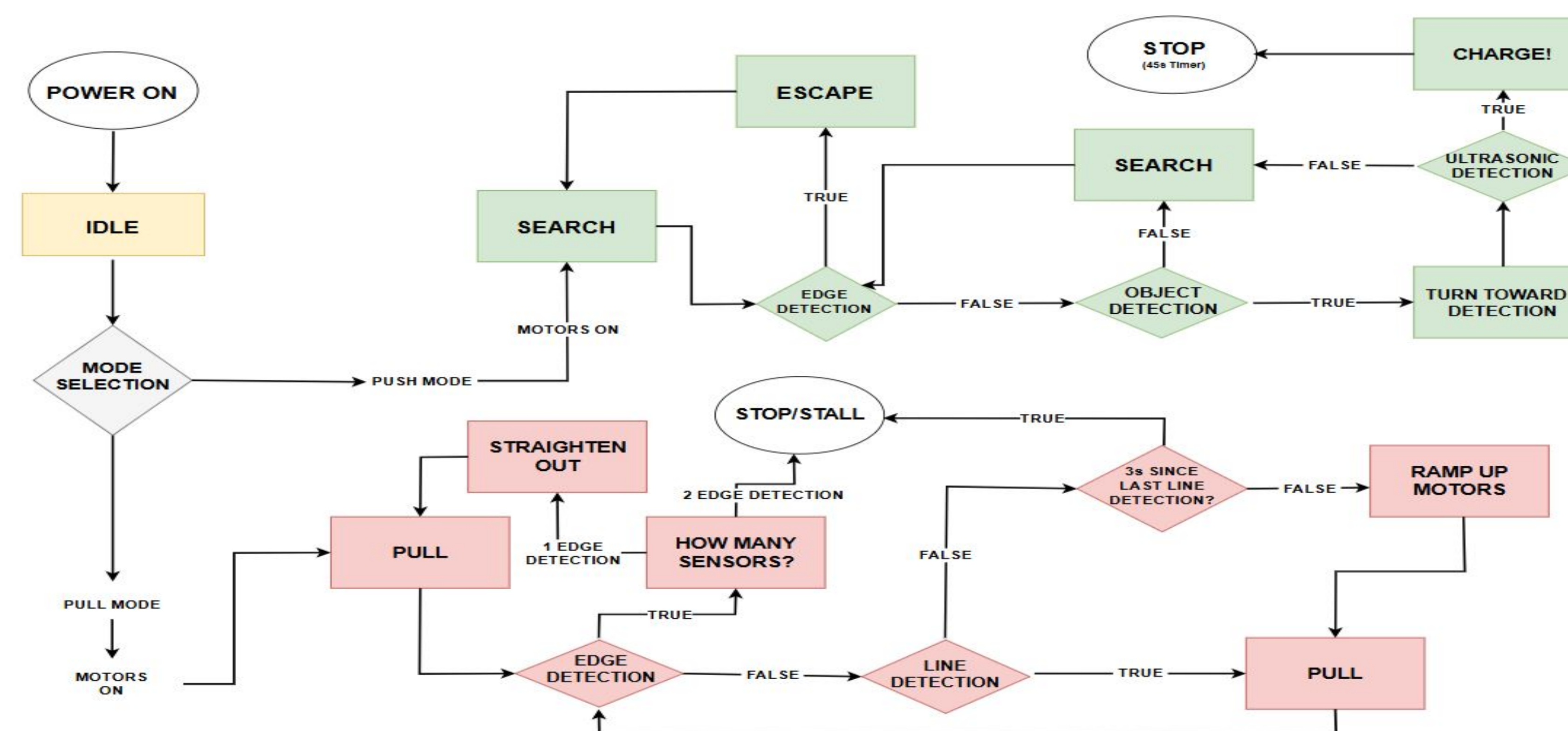
Zack

- Motor Control
- Chassis Design

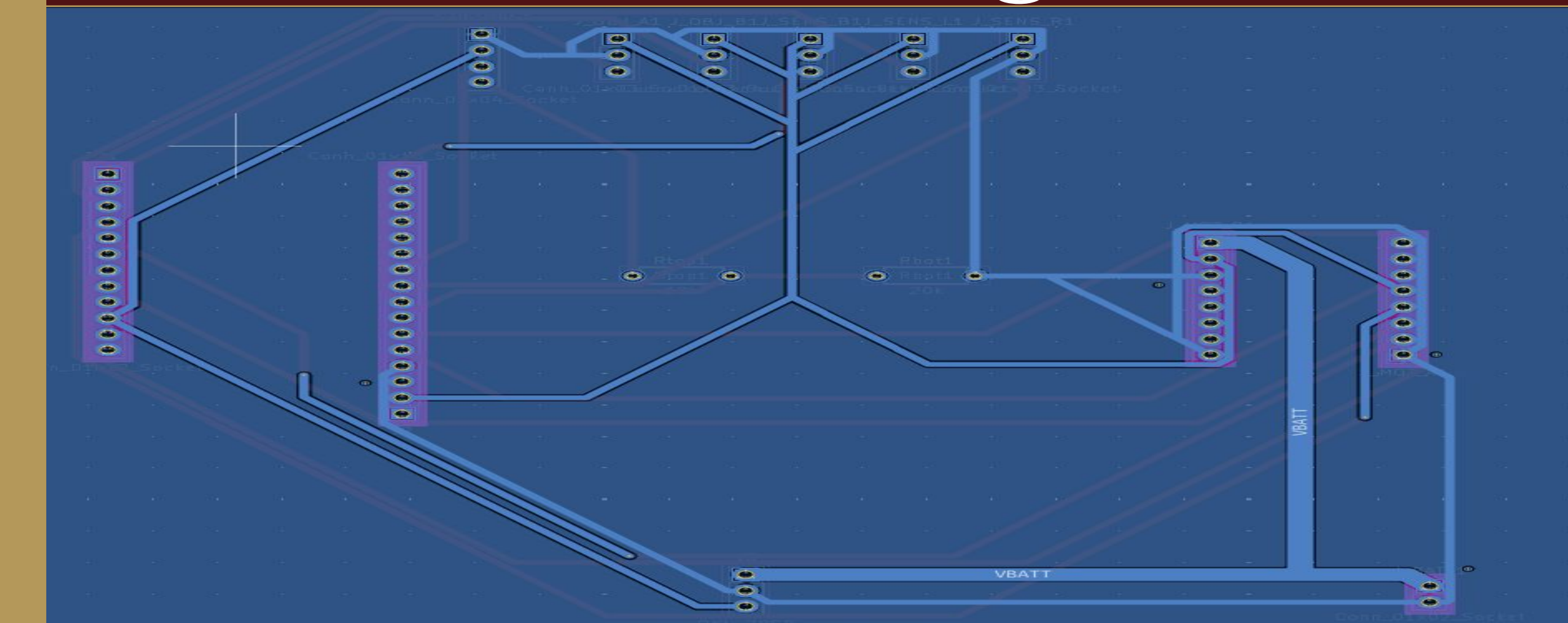
Jade

- Power
- PCB Design

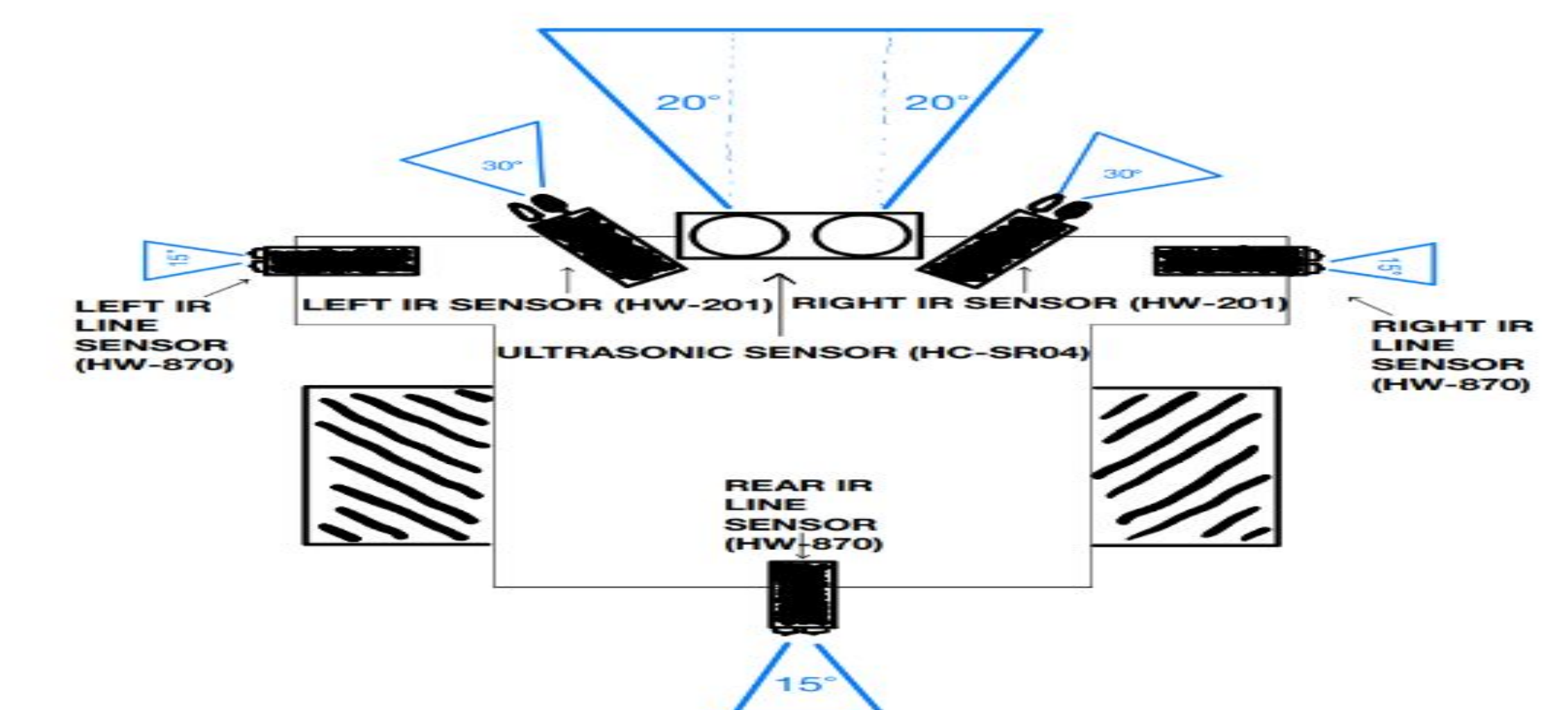
Navigation Algorithm



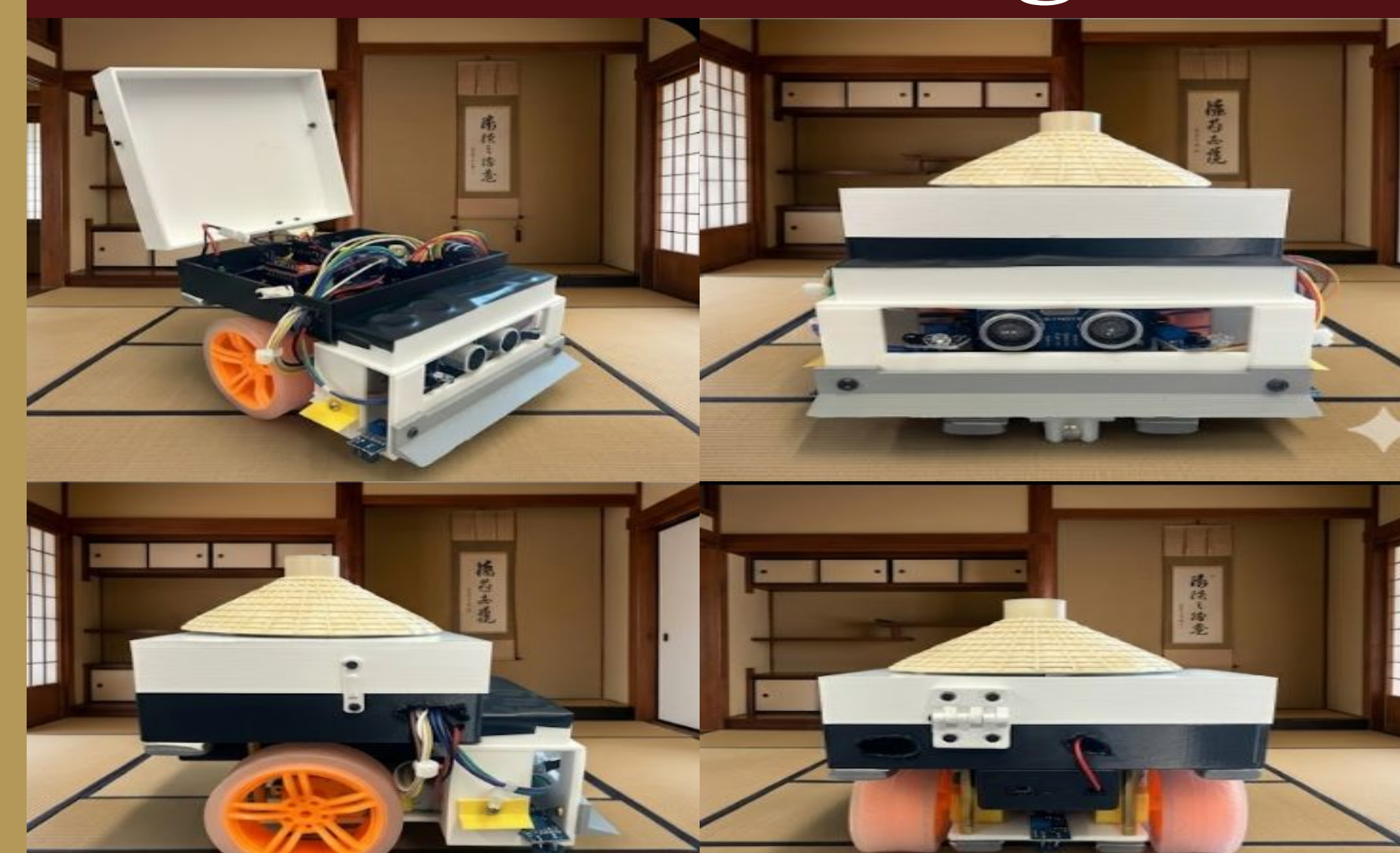
PCB Design



Sensor Layout



Chassis Design



System Performance & Validation

- PWM step response reaches steady-state in ~ 2 seconds with no oscillations
- Drift ≈ 3 cm over 100 cm ($\sigma \approx 0.25$ cm)
- Reliable boundary detection
- Object detection up to ~ 25 cm
- Power: ~ 0.12 A (idle) to ~ 0.83 A (load)
- Runtime (under load): ~ 4 hours

Acknowledgements

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