PARROT

Parallel **A**synchronous **R**obots,
Robustly **O**rganizing **T**rucks

Design Review Presentation

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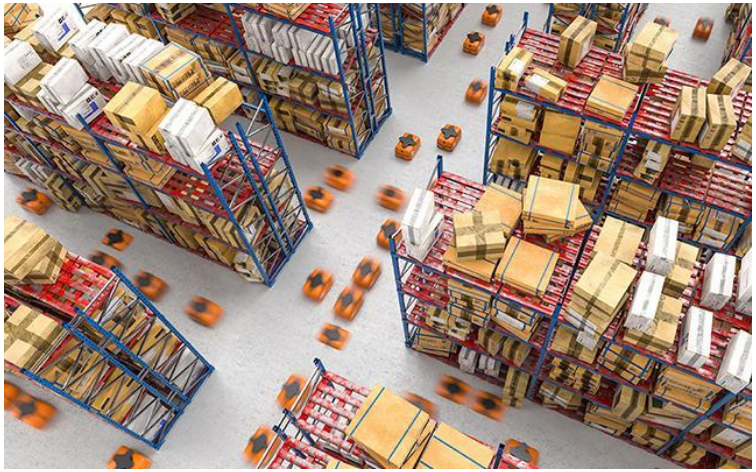
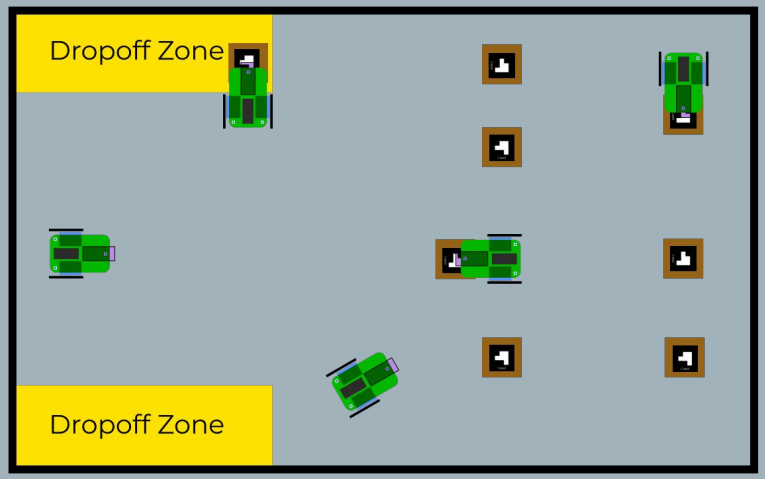
Use Case



shdlogistics.com

Real-World Warehouse Robotics



Our Sandbox

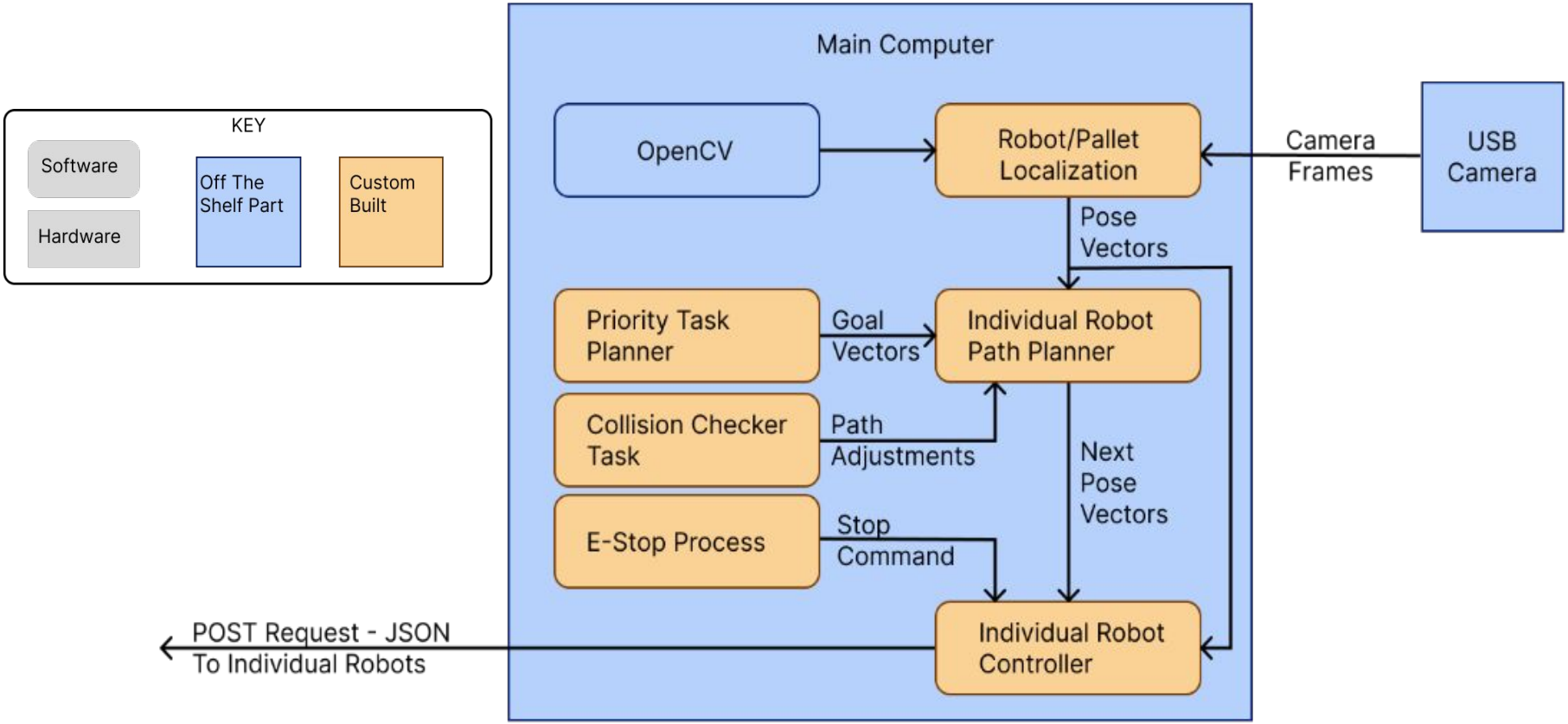
Requirements

#1 Pick-Up and Drop-Off Pallets

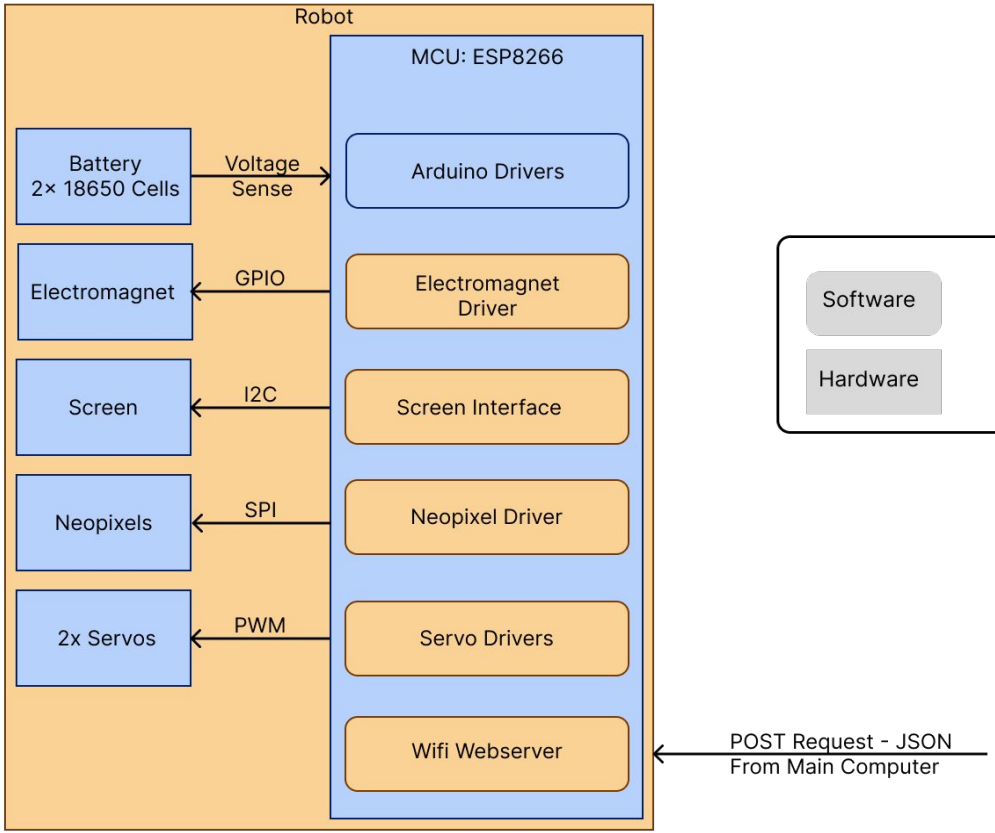
#2 Efficiently Scale to Multiple Robots

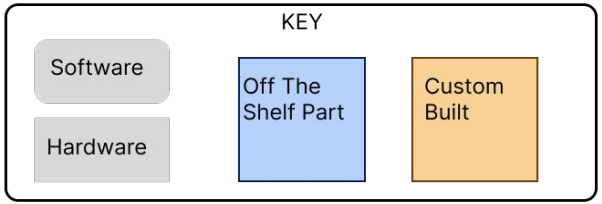
#3 Long Runtime and Low Latency

Solution Approach - Main Computer

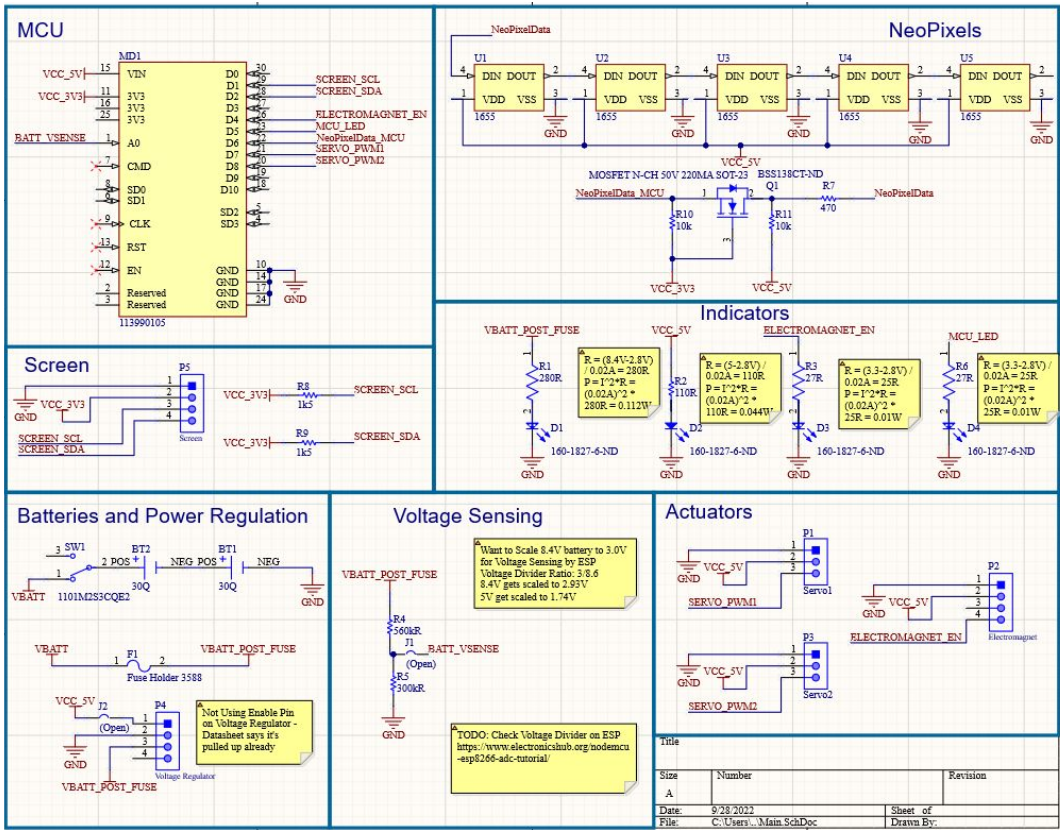


Solution Approach - Robots

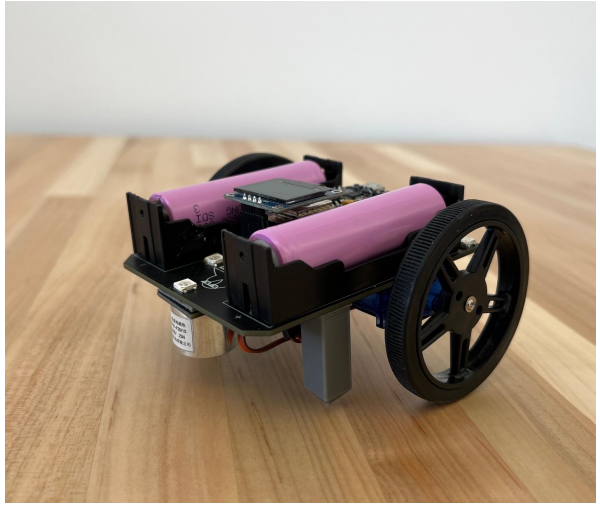


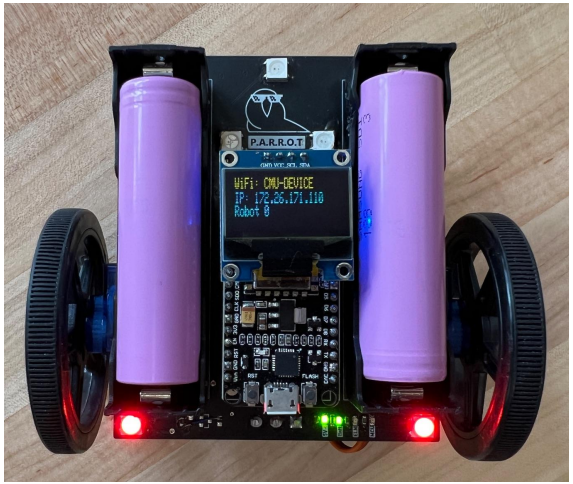


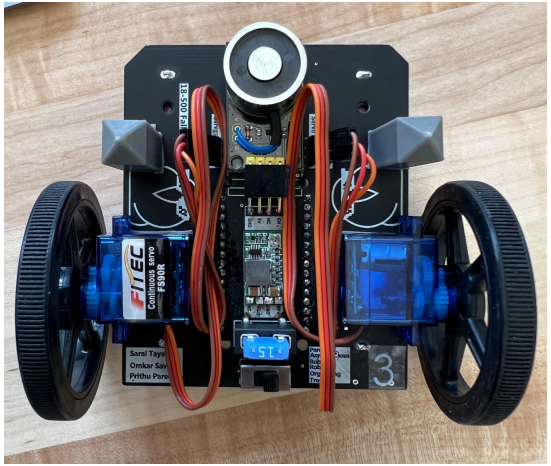
The Robot Schematic

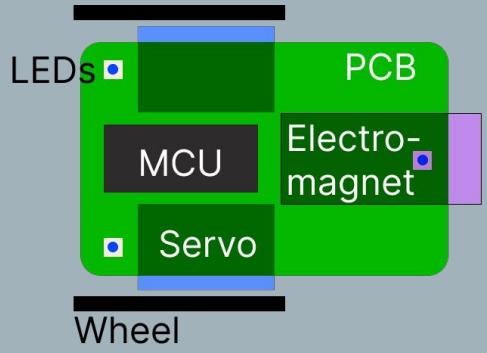


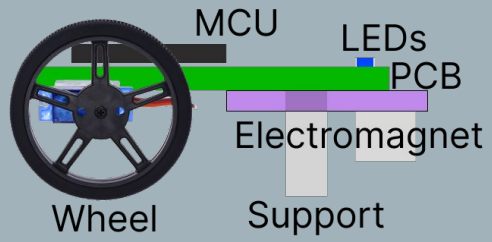
The Robots



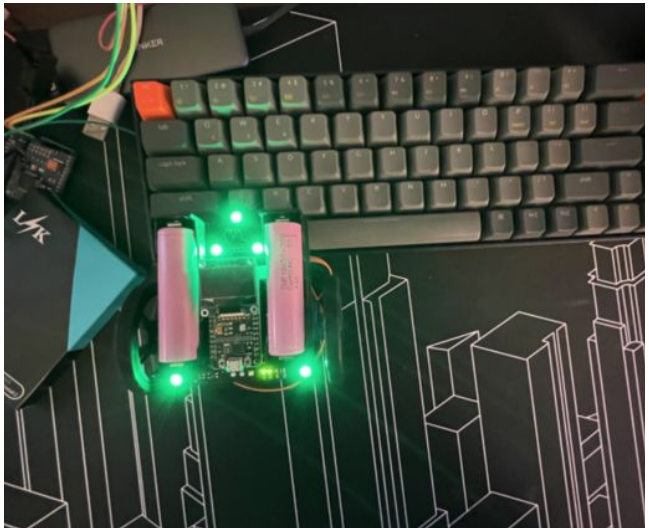

P.A.R.R.O.T
WiFi: CMU-DEVICE
IP: 172.26.171.110
Robot 0


FITEC
Continuous servo
FS90R

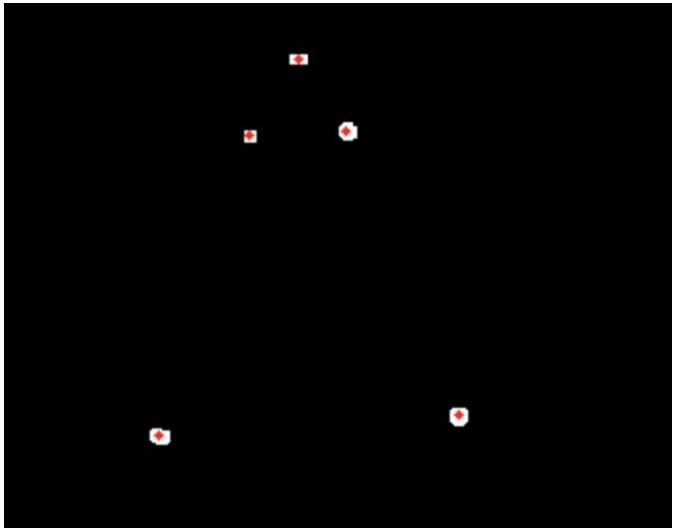

LEDs
PCB
MCU
Electro-
magnet
Servo
Wheel


MCU
LEDs
PCB
Electromagnet
Wheel
Support

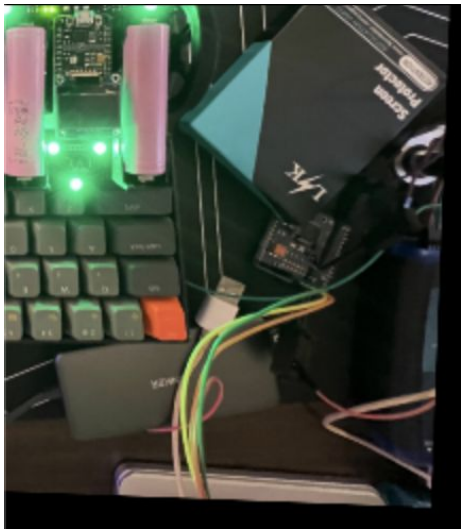
Computer Vision



Original Image



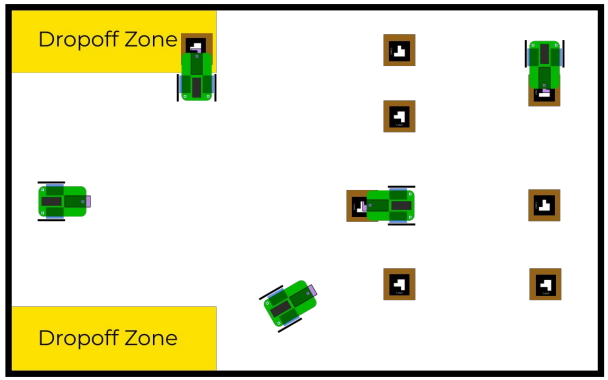
Dynamic Mask + Moments

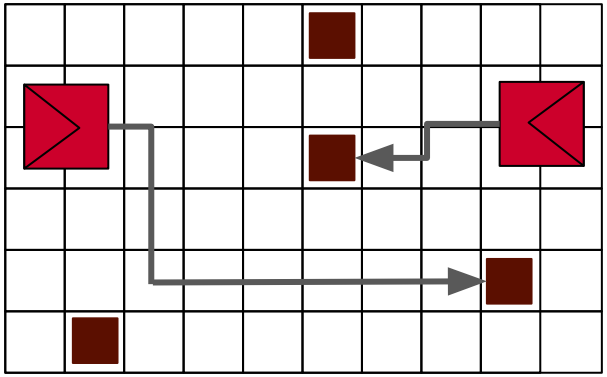


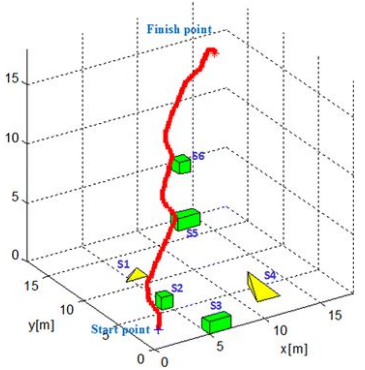
Transform Demo

```
Pose: 200.07005508105925, 236.04813968961145, -177.83771416829532
```

Motion & Task Planning







https://link.springer.com/article/10.1007/s40815-017-0403-1

Our Sandbox

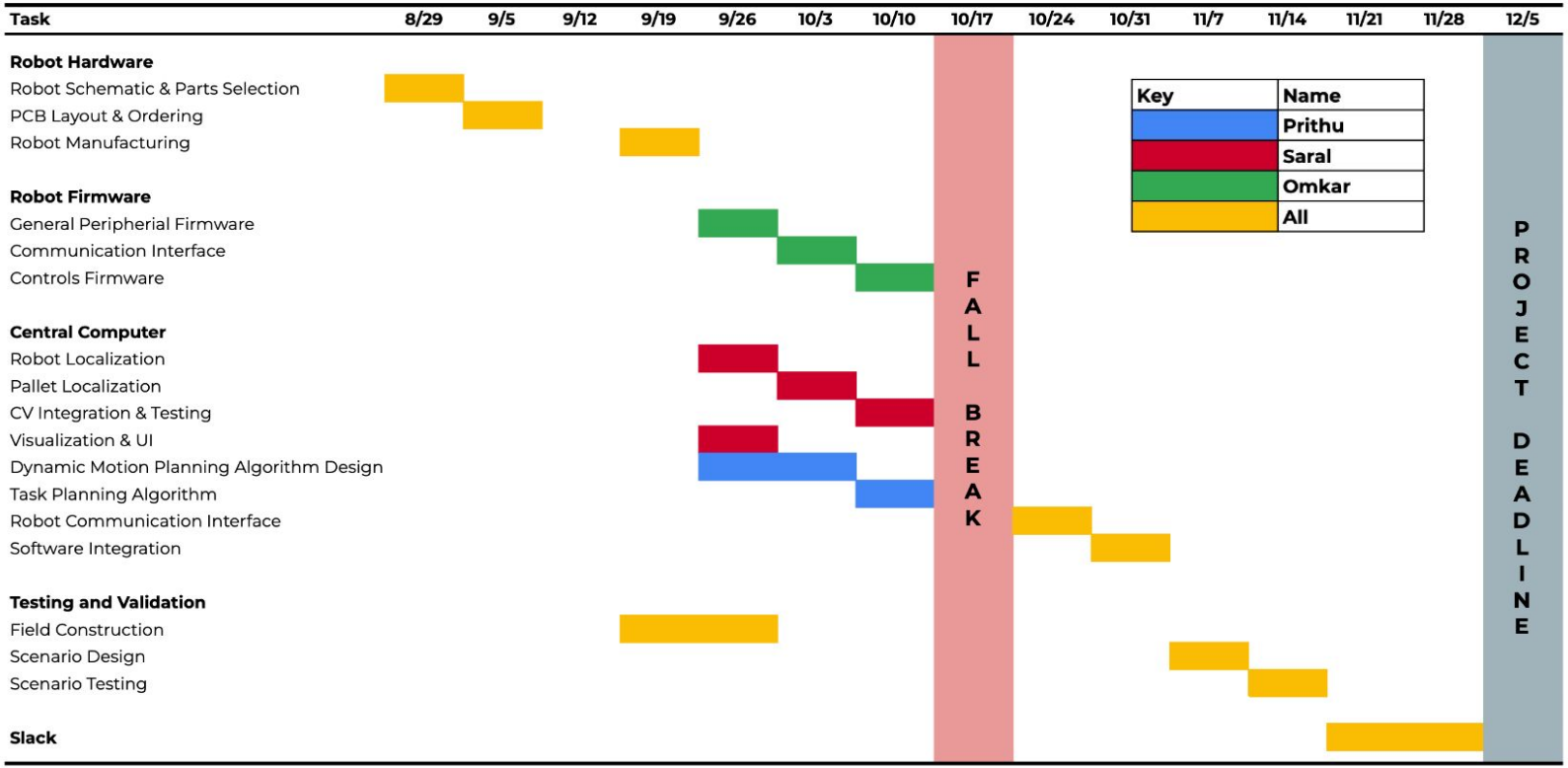
Planner Abstraction

- State Space → {x, y, theta, velocity, **time**}
- Set of motion primitives/lattice graph representation
- Robots **assigned priority** based on task and **plan around others**

Testing & Verification

Localization Tests	• Test Localization accuracy in 10 spots on grid • Test Localization against different colors
Planner / Controller Tests	• Test Motion accuracy against 10 start-goal pairs • Test Collision avoidance over 10 map layouts
Pickup / Dropoff Tests	• Test approach angles between 0-180 degrees • Test acceptable Electromagnet Duty cycle
Scalability Testing	• Test task speedup against multiple robots

Gantt Chart


Task
8/29
9/5
9/12
9/19
9/26
10/3
10/10
10/17
10/24
10/31
11/7
11/14
11/21
11/28
12/5
Robot Hardware
Robot Schematic & Parts Selection
PCB Layout & Ordering
Robot Manufacturing
Robot Firmware
General Peripherial Firmware
Communication Interface
Controls Firmware
Central Computer
Robot Localization
Pallet Localization
CV Integration & Testing
Visualization & UI
Dynamic Motion Planning Algorithm Design
Task Planning Algorithm
Robot Communication Interface
Software Integration
Testing and Validation
Field Construction
Scenario Design
Scenario Testing
Slack
FALL BREAK
PROJECT DEADLINE
Key
Name
Prithu
Saral
Omkar
All

Conclusions

- Scaled down version of factory organizing problem to test CV and planning algorithms