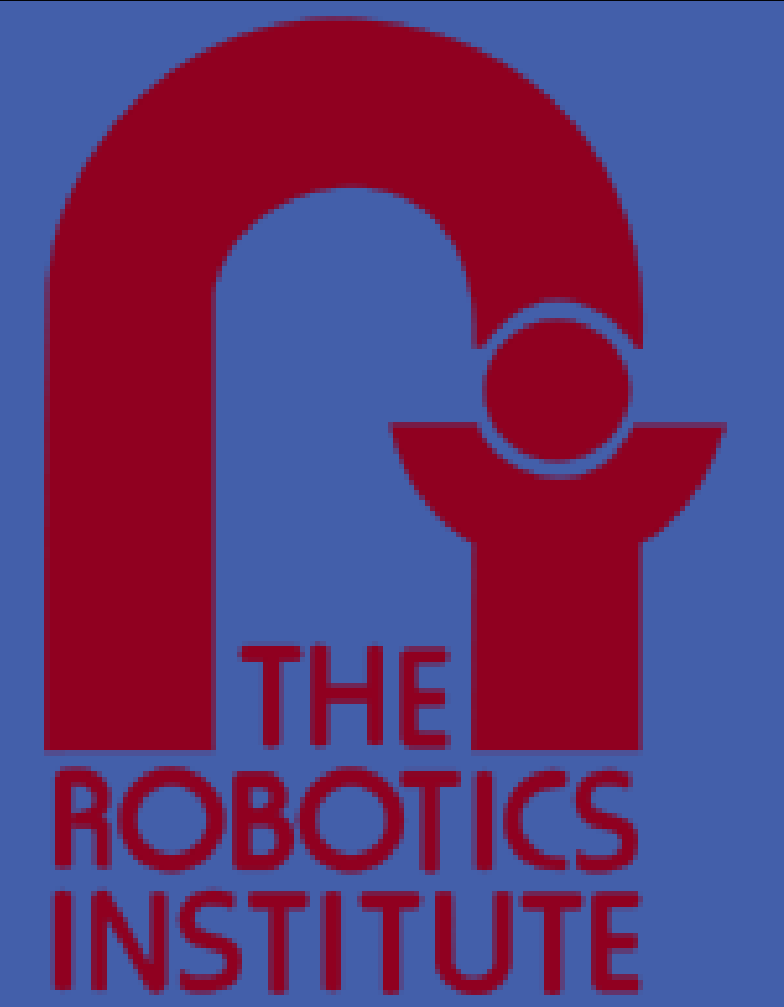




AutoPark – Collaborative Parking For Autonomous Robots

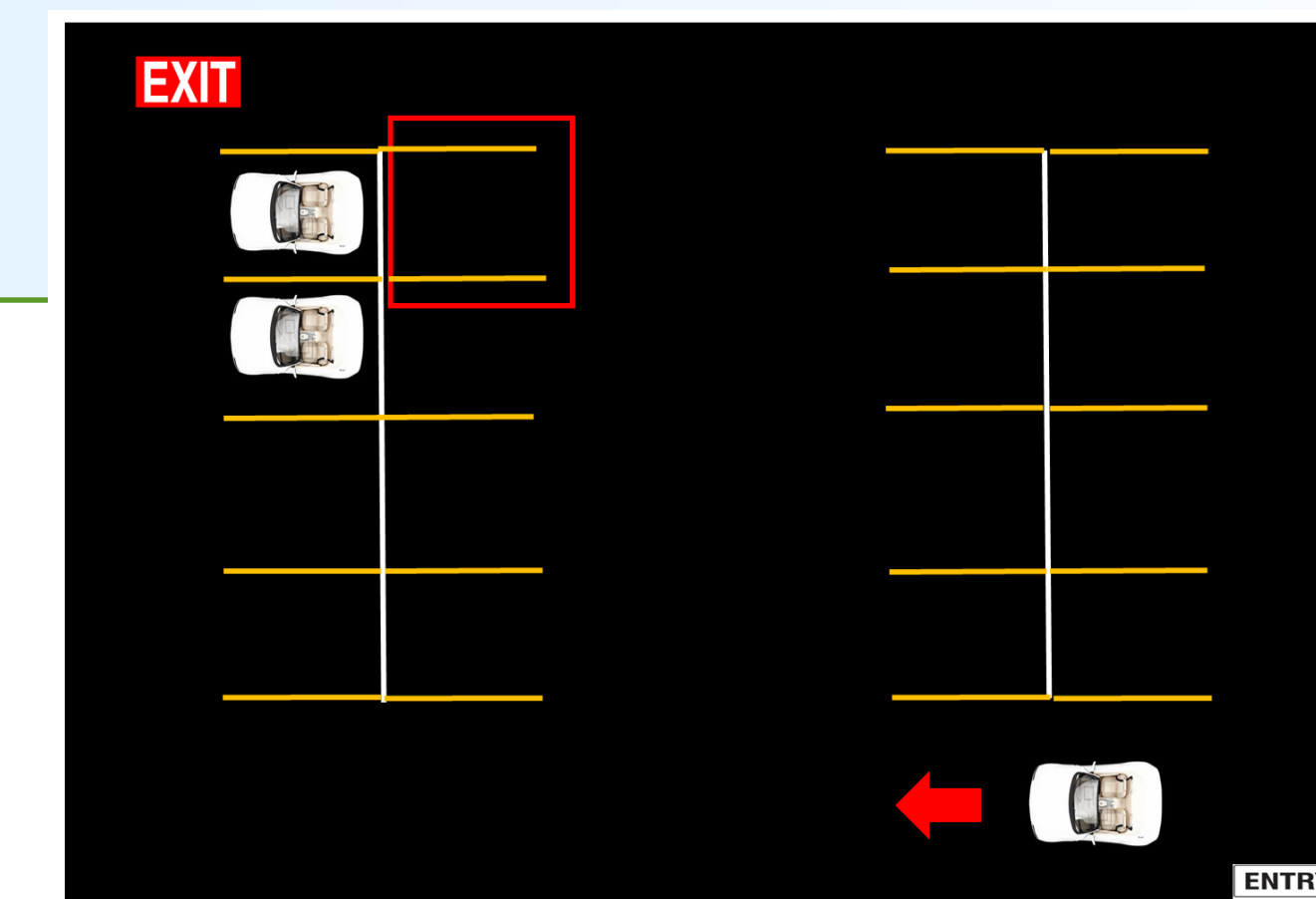
Mohak Bhardwaj, Shivam Gautam, Dorothy Kirlew, Pranav Maheshwari, Richa Varma

2015-2016 MRSD Team I

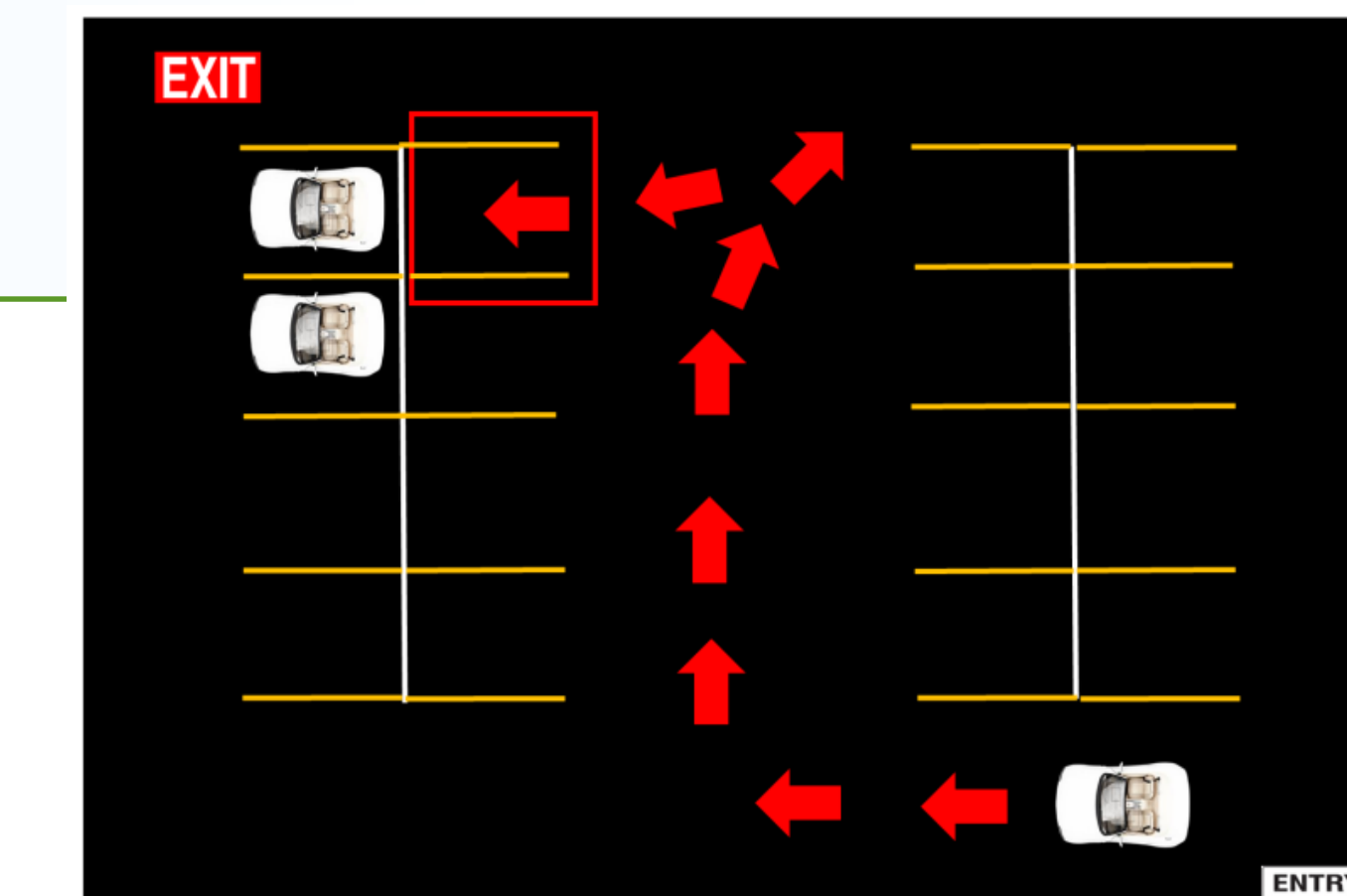


Project Description

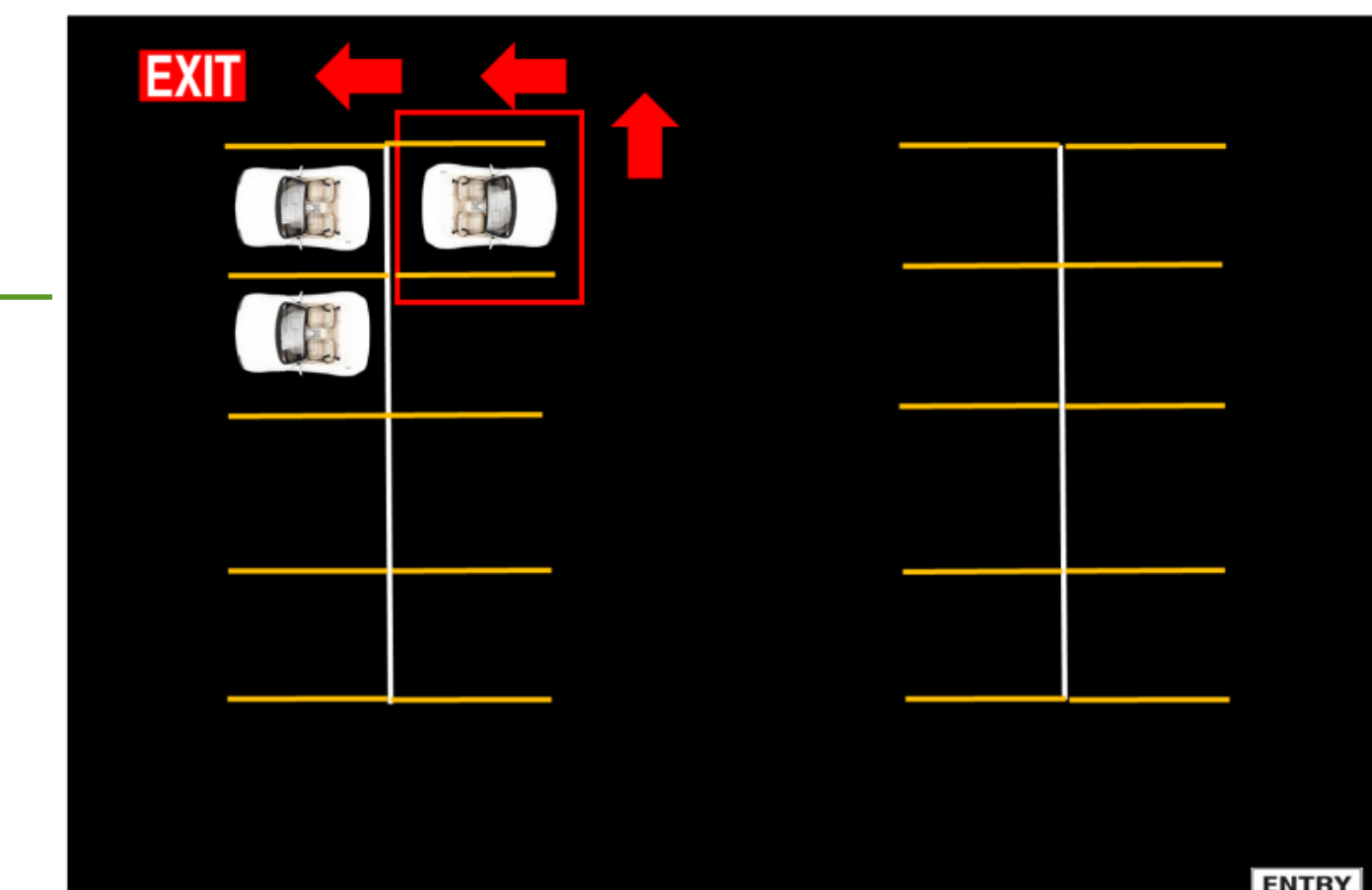
With the ever increasing presence of autonomous cars in our world, vehicles no longer need to operate as disjoint systems. Vehicle to vehicle communication enables a vehicle to communicate and collaborate, leading to more optimized performance and higher safety. AutoPark showcases these capabilities in the context of a parking lot, by enabling cars to autonomously park in a lot and exit the lot as efficiently as possible with no human interference.



Enter and Select Spot



Plan Route to Spot



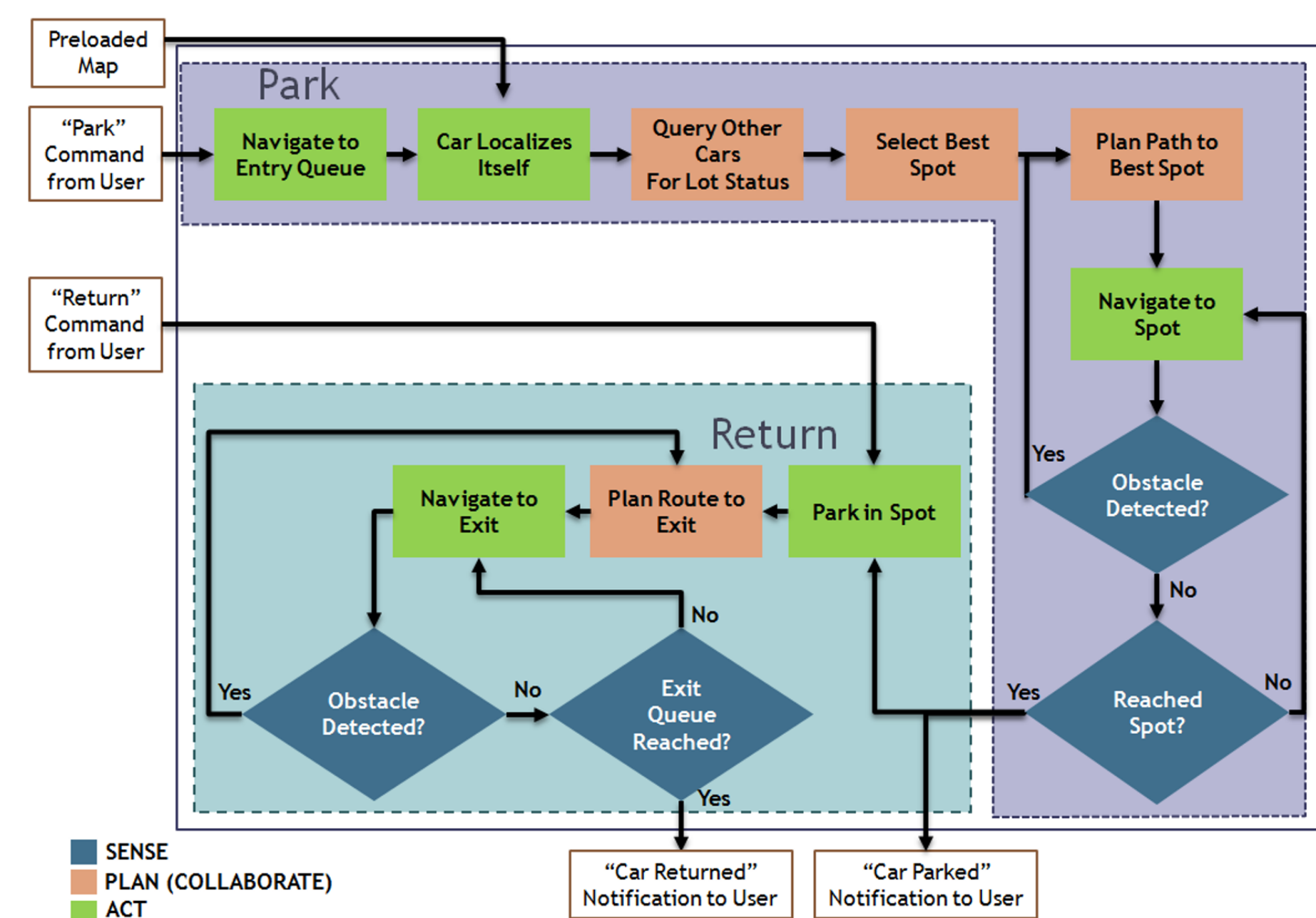
Plan Route to Exit

Physical System

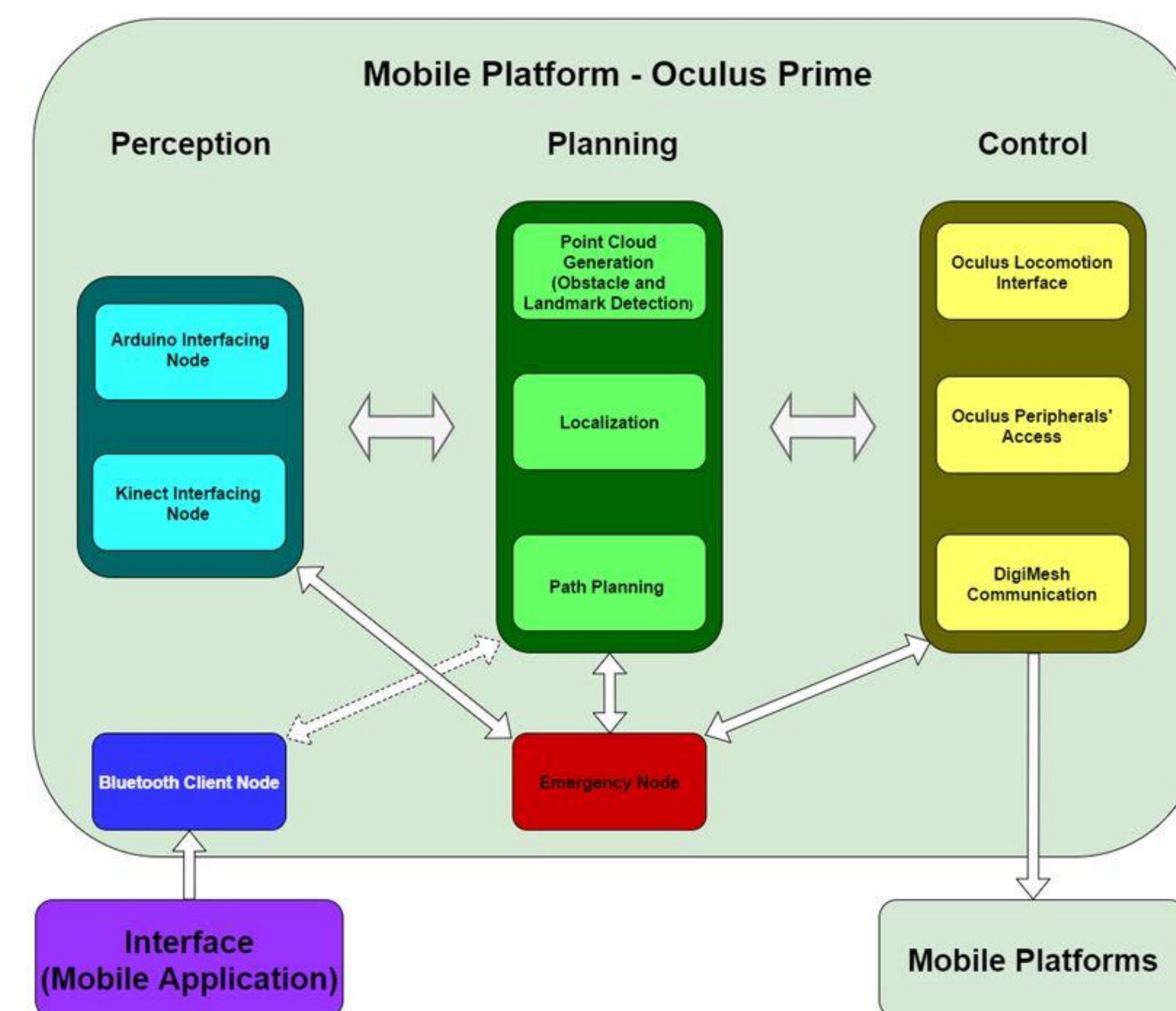
Problem Statement

Create a system that allows multiple autonomous vehicles to cooperatively and efficiently park in a parking lot by sharing information. Interface with drivers to drop-off and recall vehicles through a mobile device.

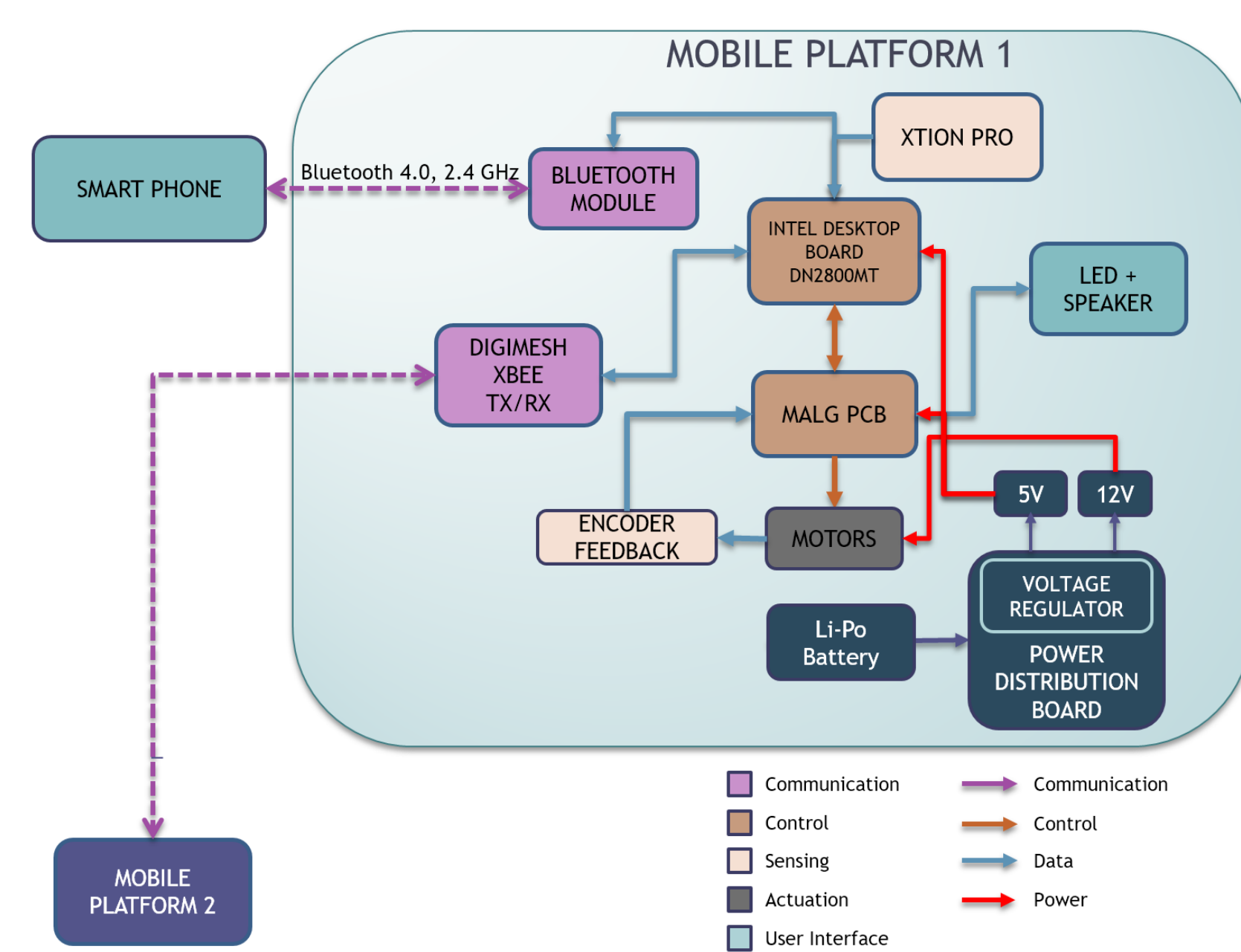
Functional Architecture



Software Architecture



Implementation



Cyber-Physical Architecture



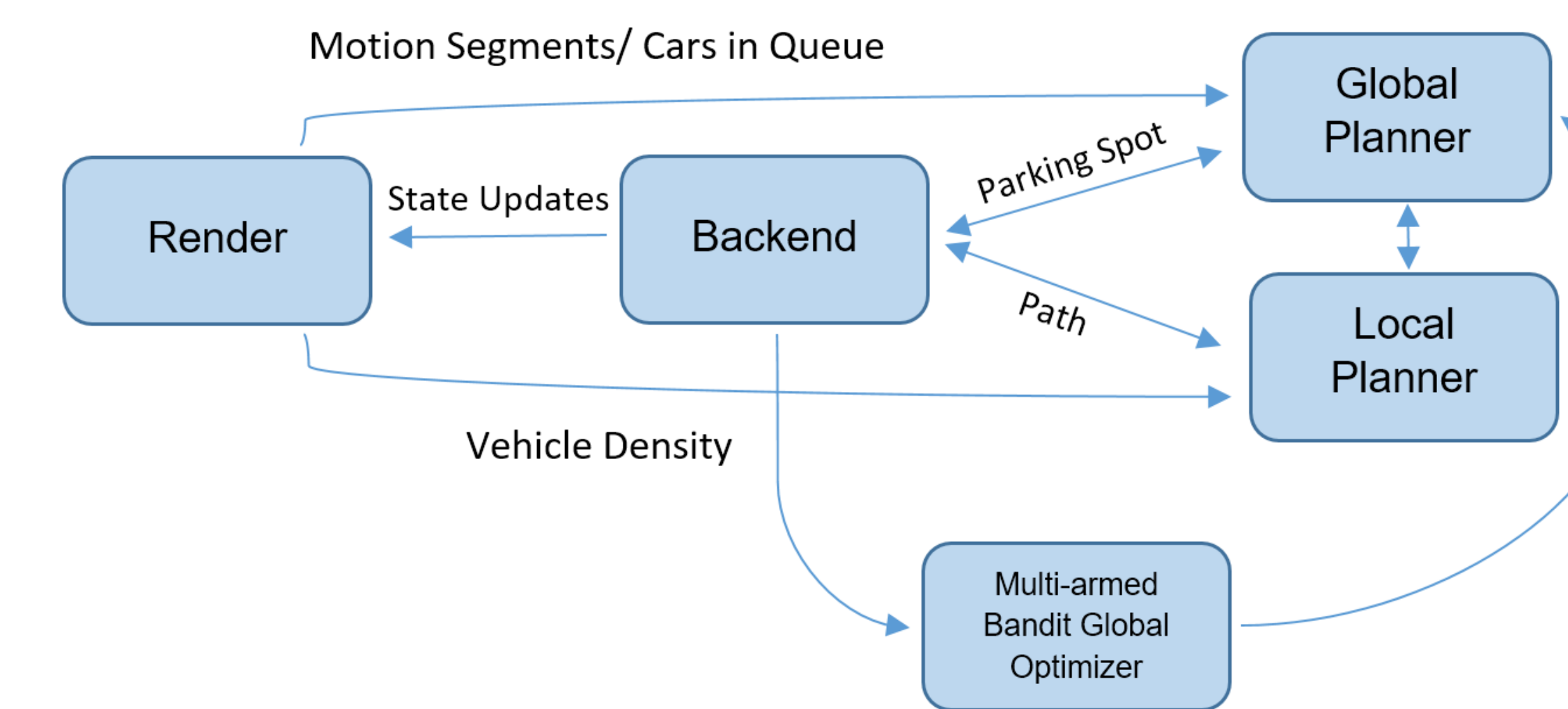
Platform

Environment

User-Interface

Simulation System

System Architecture



Optimization

Global Optimization:

Multi-armed bandit based exploration vs. exploitation approach in search of Global Maxima

Multi-layered Optimization

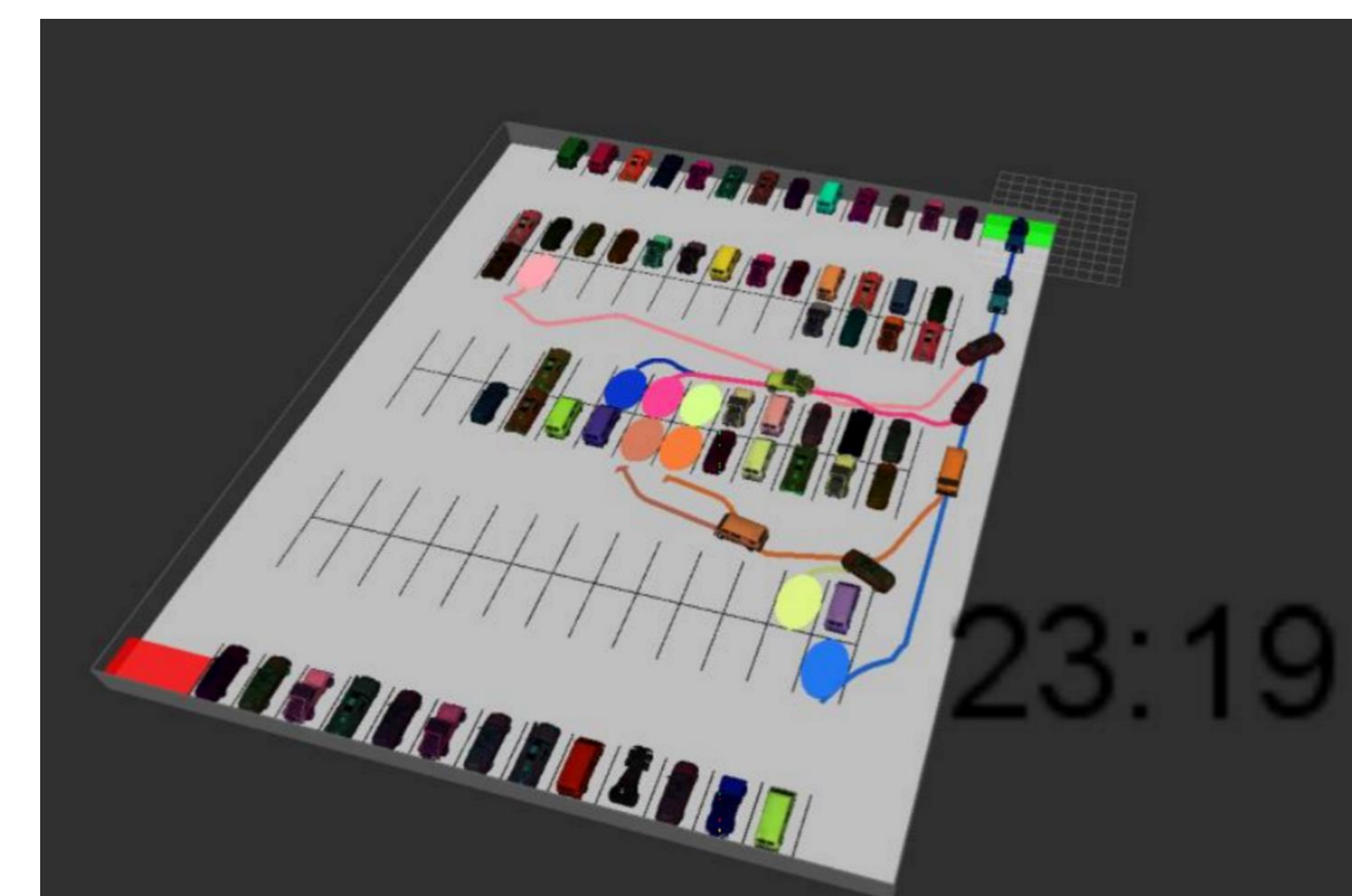
Heuristic Driven Local Optimization:

Track and guide system towards a state of less entropy

Event Triggered Reward Maximization:

Alter state of Vehicles via Numerical Optimization in a tradeoff between cost minimization and reward maximization

Implementation



Performance

Greedy Approach

| Average Parking Time | Average Pause Time | Average Return Time |
|----------------------|--------------------|---------------------|
| 33.52 seconds | 23.57 seconds | 28.64 seconds |

AutoPark Approach

| Average Parking Time | Average Pause Time | Average Return Time |
|----------------------|--------------------|---------------------|
| 12.5 seconds | 15.37 seconds | 15.6 seconds |

Results

| Success Criteria | Performance |
|--|--|
| The entire routine is followed in a predictable manner and the vehicles park themselves in the most optimal spot | ✓ |
| Time taken by the system with collaboration is less than that by the platform without collaboration | ✓ |
| Vehicles do not collide with any obstacles and stay clear of the infrastructure | Some collisions occurred between vehicle and infrastructure leading to manual intervention |
| User Interface accurately shows the state of the parking lot | ✓ |
| The app accurately shows the state of its vehicle | ✓ |

Conclusion

Systems that facilitate collaboration between vehicles hold great potential and will be a direct demand of the new age autonomous systems which will be much more aware of their surroundings than present manned systems. Continued work should focus on optimization strategies in varied use cases and encryption of shared data.

Acknowledgements

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