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# Non-Causal Autonomous Parking System for Driverless Vehicles

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ELECTRICAL AND COMPUTER

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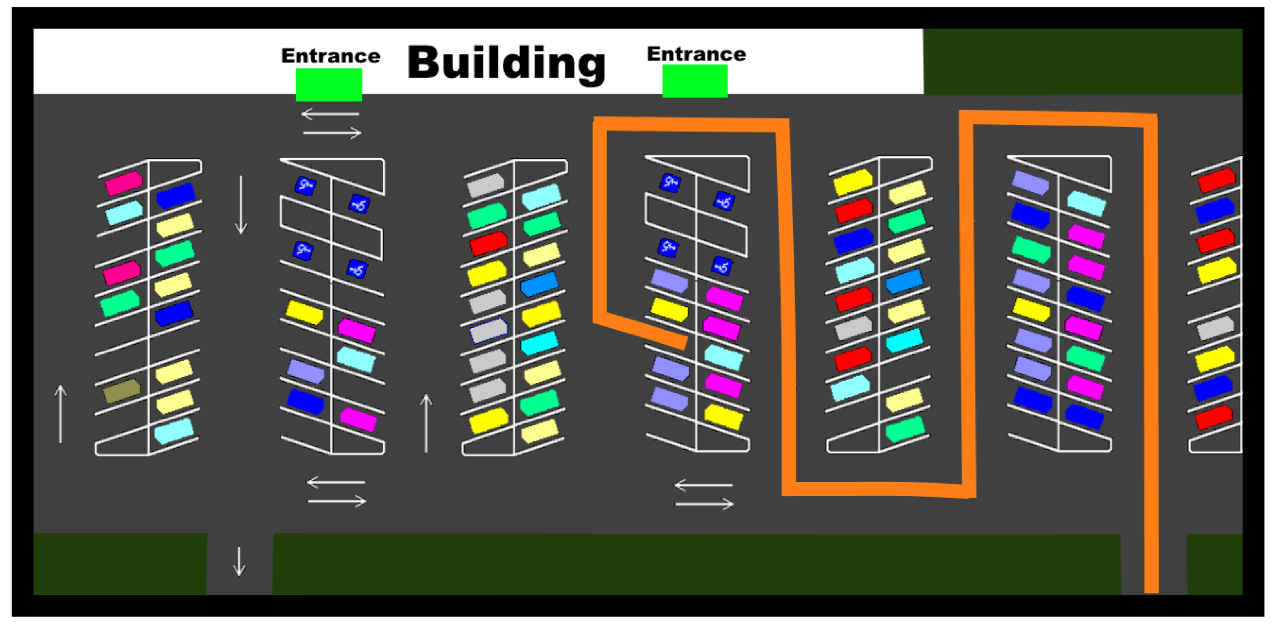
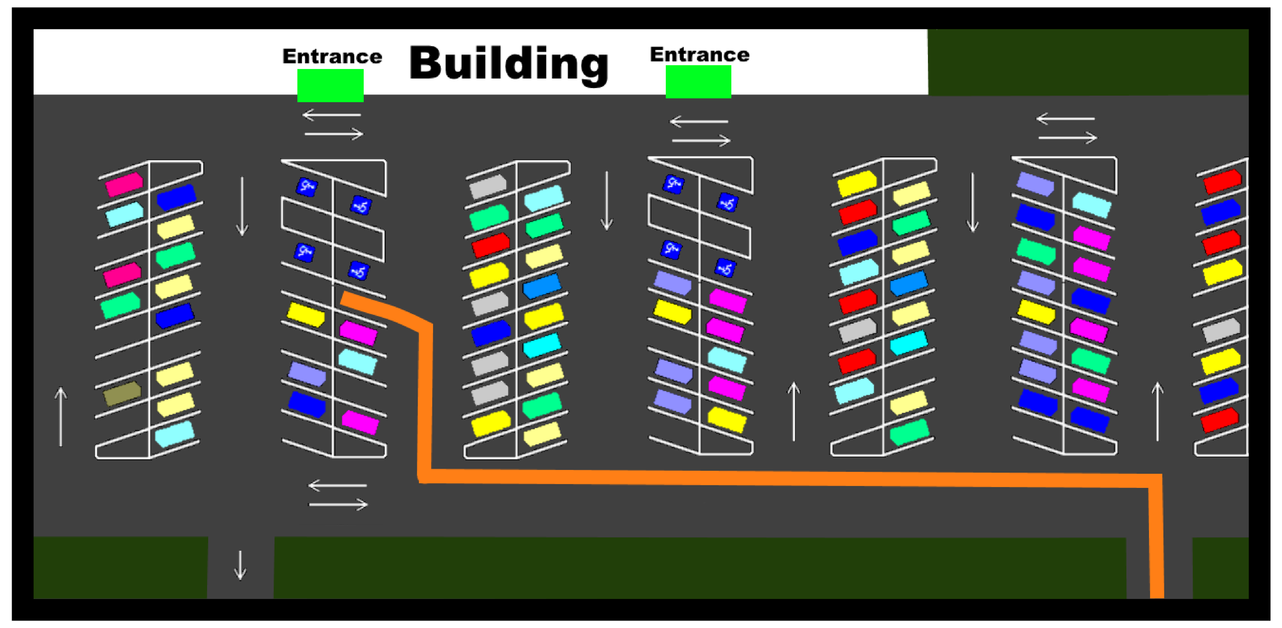
## Background

Vehicle parking is an urban problem that is only getting worse. Recent studies suggest that not only does the average person spend 106 days over their life-time searching for parking spaces, but also that nearly 23% off all vehicle accidents occur in parking lots [1] [2]. With the advent of autonomous cars there is an opportunity to integrate technology into the loop that coordinates this process to improve efficiency and safety. While modern cars are increasingly fitted with sophisticated sensory suites, a central monitoring system would enable improved decision-making based on *a priori* information – effectively giving a driverless vehicle awareness beyond its present state.

**Vehicle Route without Non-Causal Parking System**




**Vehicle Route with Non-Causal Parking System**



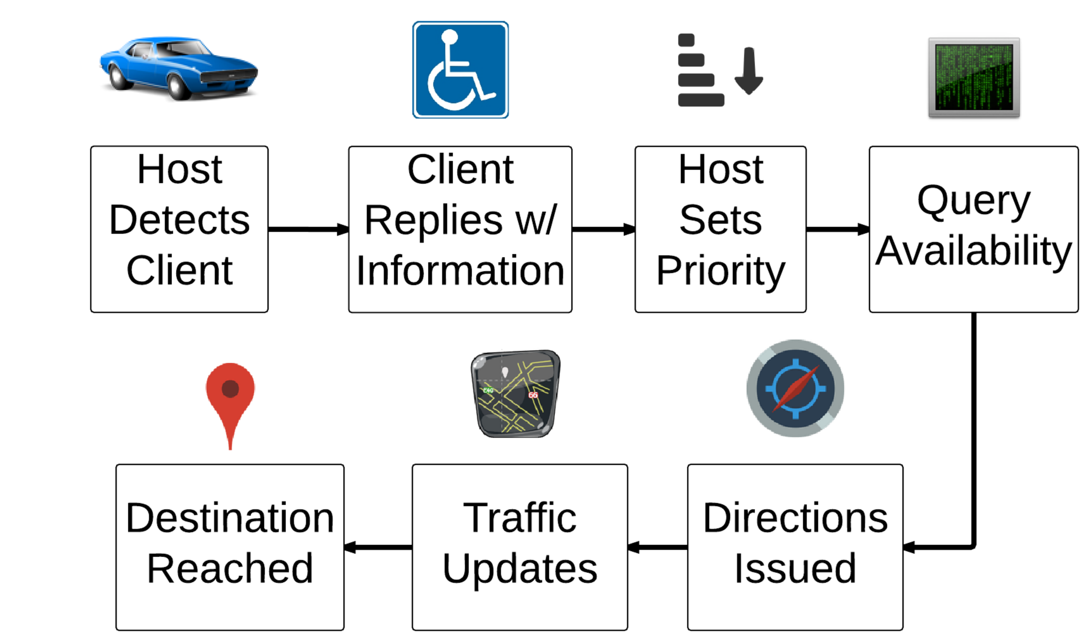

## Objective

The project strives to streamline the process of finding a vacant parking space while ensuring client safety through the direction of localized traffic. The solution places great importance on affordability and scalability while maintaining relevance in a dynamic technological ecosystem.

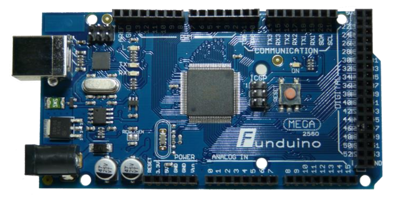
The elements of the design are:

- Parking Space Proximity Sensor
- Central Host Microcontroller Unit (HMCU)
- Vehicle Microcontroller Unit (VMCU)
- Communications & Networking
- Data Fusion & Processing

## Process

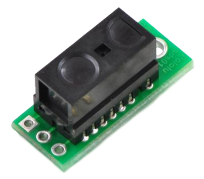



## Implementation



**Arduino Mega 2560 R3**
- 54 Digital I/O Pins
- 16 MHz Clock Speed
- Widely Used

**Xbee Series 1 Module**
- Point-to-Point or Mesh
- 100m Range (1mW)
- 250 Kbps Data Rate



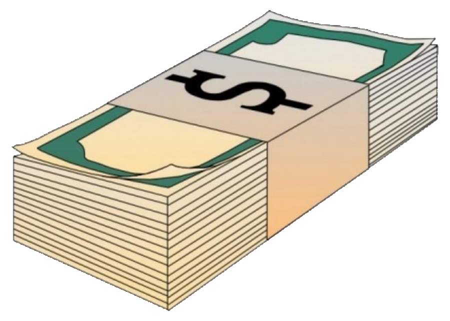
**Sharp Distance Sensor**
- Small & Low Power
- 0.2" to 6" Range
- Digital Detection

**Model Parking Lot**
The trial board utilizes COTS products (seen above) to demonstrate the process on a small scale using a model electric car. The digital sensors are embedded throughout the board to provide reliable state information to aid in vehicle marshalling procedures. The HMCU acts as the hub of the entire network and performs data fusion and processing functions.

**Model Electric Car**
The car itself is driven with four DC motors that are monitored with encoders to measure the radial motion of the wheels. The VMCU is an Arduino Uno R3 and a DC motor shield with another Xbee Wireless Module to interface with the HMCU.

## Challenges


- Cost vs. Benefit
- System Awareness
- Deployment Requirements
- Universal Standards
- EM Spectrum Management
- Cyber Vandalism
- Future Upgradability



## References

[1] Malz, Charlotte. "How Technology Can Reduce the Frustration of Looking for Somewhere to Park." Audi Urban Future Initiative. Audi AG, 03 Apr. 2014. Web. 21 Sept. 2014.

[2] Stark, John A. "Parking Lots: Where Motorists Become Pedestrians." University at Albany, SUNY. 23 Apr. 2012. Web. 21 Sept. 2014.