

# Software Engineering Proposal

## **Parking Garage Automation**

Group 14

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Zhuohuan Li, Buyuan Lin, Samuel Cho, Christopher Cheng

<https://cc1539.github.io/SE-project/>  
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# Group Members

## Christopher Cheng

- *Programming (Java/C/C++)*
- *Web Development (HTML/CSS/JavaScript)*
- *UI/GUI*

## Samuel Cho

- *Programming (Java/C++)*
- *SCM (Software Configuration Manager)*
- *Documentation and Revision*
- *Project Coordinator*
- *Logistics*

## Zhuohuan Li

- *Programming (Java/Python/C++)*
- *Presentation*
- *Construction*

## Tingcong Jiang

- *Programming (Java/C++)*
- *Algorithm*
- *SCM (Software Configuration Manager)*

## Buyuan Lin

- *Arduino Programming and Setting*
- *Model Setting up*
- *Programming (Java)*

## Yiran Tan

- *Programming (Java/C++)*
- *Hardware handling*
- *Raspberry pi*

## Chenyu Cao

- *Programming(C++/Matlab)*
- *Hardware Development*

## Shijie Xu

- *Programming (Java/C/C++/Matlab)*
- *Algorithm*
- *Arduino Programming and setting*

# Problem Diagnosis

A major problem with parking garages today is the lack of modern management strategies. The current deprecated system provides an inefficient solution to the simultaneous parking of many vehicles in a single parking garage. This is in part due to the absence of proper and effective communication between the parking garage owners and its customers.

Finding parking in busy metropolitan areas has always been a constant concern plaguing commuters across the globe. This phenomenon has only worsened over time as the global population skyrockets and the ownership of a private vehicle becomes increasingly widespread and popular. The issue is only exacerbated in outdated garages that give no indication to customers about the availability of space whilst also increasing wait times with cumbersome payment options.

Our team members encounter this problem almost everyday. As commuters, we have to find a parking spot on campus. Although there are couple of huge parking lots located in different campus, we have to spend a lot of time driving through all the rows in the parking lot to find a vacant parking space.

*Sometimes, to save the time finding a vacant parking space, well park directly at a spot that is far away from the campus. However, we have to walk a lot and we might even miss those spots that's closer to the campus. What if we already know the location of the vacant parking spot when we enter the parking lot? What if there is a system which can guide you through the parking spot that suit your need the best? This will save the overall time for all the commuters.*

The problem described above is the reason we chose this project. And the potential treatment is included as well.

Besides the parking spot finding function, we are also interested in implementing an automatic payment function for those commercial parking lots.

# Proposed Treatment

Our solution is defined by four central aspects.

**The first** aspect is the ability to manage a garage by separating it into different sections and quantifying these sections in an easy-to-visualize way. Customers can view this information online in real-time, in the form of a parking garage map, to gauge the state of the lot and make informed decisions. LED displays placed around the garage indicate how many spots are available in each given section, which can significantly improve the efficiency of garage management and usage.

**The second** aspect is that users will be able to reserve spots in the parking garage as long as there are spaces available. The owner of the lot will be able to set the maximum number of reservations available for the lot in order to prevent overbooking.

**The third** aspect is that all payment will be done automatically through our website when the car leaves, which will reduce the hassle of paying at a machine or booth. Clients will be prompted to create an account with a QR code as they enter the gate. This account will be tied to the users license plate and bank account/credit card. The customer account will be systematically billed for the correct amount according to the length of their accomodation when they exit. As a result, a cashier is no longer required and this particular cost of labor can be eliminated.

**The fourth** aspect is that customers can select where they parked on the interactive map on the website upon arrival. This way, the user will be able to locate their spot when they return. Only spots that are deemed occupied by our sensors can be marked, so as to combat human error and prevent erroneous entries to the system. Optionally, customers may save information about their car make and model to their account for further identification purposes.

*We will also be including backend management software that can help the owner maintain and oversee the garage. An administrator will be able to view the live working status of the entire garage. All the cars information in each spot (e.g. entry time, exit time, car make, car model, and car plate) can be sorted to facilitate ergonomics for the management team. The owner will also be able to adjust lot pricing on the fly through this interface.*

# Features

## **Reservation**

- Specific Spots

## **Account System**

- License Plate Interpretation
- User Registration

## **App Development**

- Backend management software
- Frontend Android app and website

## **Payment System**

- Online payment
- System security
- Balance deposit (Only available to registered customers)

## **Special Needs**

- Electric car
- Disabled parking

## **Navigation**

- Online map
- LED signboard

## **Website**

- Account setup
- Parking reservation
- Parking information
- Balance Payment

# Functional Features

- Customer Account Registration
- Parking Spot Reservation
- Parking Lot Visualization
- Parking Lot Status Acquisition
- Account-User Information Binding
- Parking Lot Management
- Online Payment
- Data Submission

# Work Plan

First we need to procure the materials needed to initialize the project within the next two weeks. On the hardware side, the most practical piece of equipment that comes to mind is an Arduino board, which we can connect to various sensors (for example, distance sensors to determine vacancy), cameras, and displays. Two plate-reading cameras will be configured to log entry and exit times.

On the software side, we are planning to implement a plate recognition algorithm and set up a database for the organization of user account information. To test our system, we are planning to construct a simulation parking lot model.

## Subgroup 1 - (Software and Communication)

### **Members:**

- *Christopher Cheng*
- *Samuel Cho*

### **Contributed Functionality:**

- *Parking Spot Reservation*
- *Parking Lot Visualization*

### **Contributed Qualitative Property:**

- *Develop clean and easy-to-use online UI*

## Subgroup 2 - (Navigation and Account System)

### **Members:**

- *Zhuohuan Li*
- *Tingcong Jiang*

### **Contributed Functionality:**

- *Account-User Information Binding*
- *Customer Account Registration*

## Subgroup 3 - (Hardware + Arduino)

### **Members:**

- *Buyuan Lin*
- *Yiran Tan*

### **Contributed Functionality:**

- *Parking Lot Status Acquisition*
- *Parking Lot Management*

## Subgroup 4 - (Test Development)

### **Members:**

- *Chenyu Cao*
- *Shijie Xu*

### **Contributed Functionality:**

- *Online Payment*
- *Data Submission*



# User Experience

*Its the next generation parking experience, users can conveniently enter the parking lot and find the most compatible parking spots for them. Before they enter the garage, they can check all available parking spots on our website. After the users enter the garage, they can go to the nearest parking spot by following the instruction on LED display. They can check out just by entering car plate number. They also can bind their parking account with their Paypal account.*

# Contribution

12.5% **Christopher Cheng**

12.5% **Samuel Cho**

12.5% **Zhuohuan Li**

12.5% **Tingcong Jiang**

12.5% **Buyuan Lin**

12.5% **Yiran Tan**

12.5% **Chenyu Cao**

12.5% **Shijie Xu**