1. Project Title: Parking Garage System, Group 19
   Members: Suva Shahria, Krithika Uthaman, Andrew Schneeloch, Josh LoGiudice, Gabriel Shen, Anthony Lau, Jahidul Islam, Yu Liu
2. URL of project's website:
   https://sites.google.com/a/scarletmail.rutgers.edu/parking-garage-se/
3. Team profile
   A.

      Suva Shahria - App development, Sql/database
      Krithika Uthaman - Database Management, organization, documentation,
      Gabriel Shen - Python script coding, website development, organization
      Anthony Lau - App development, organization, documentation
      Jahidul Islam - Documentation, Database management, App Dev, Research
      Andrew Schneeloch - Research, App development
      Josh LoGiudice - Database Management, Research, Python Coding
      Yu Liu - App development, organization, documentation

   B. We will not have a team leader but will have weekly meetings. Missing multiple meetings will result in loss of grade.
4. Proposed Project Description

Problem Diagnosis

Parking is a key component of any city's transportation and problems with parking are an everyday occurrence. Currently parking garages still depend on employees to visually scan the availability in garages or use minimal technology to record vehicles entering and exiting. These parking structures are disorganized, lead to an inefficient use of existing parking capacity and cause excess congestion due to drivers searching for vacant spots. Some floors of a garage might get disproportionally congested with too many cars while other floors lack traffic.

Parking garages are poorly optimized to maximize profit and tend to have vacant spots during dull periods of the day resulting in lost profits. Traditional parking systems offer no incentive for customers to return. A frequent commuter that uses the parking garage has no incentive to continue using the garage. The customers have no incentive for loyalty. Customers might be more willing to use the garage if they know in advance they are guaranteed a spot.

Even greater problems arise when considering special events with considerable amount of people from out of town. The inability to predict parking accommodations for such occurrences hinder the situation further leading to prolonged searches and confusion. Additionally, after persistent searching, the parking spot attained can be undesirable as well as lead to greater frustration and an overall unsatisfied customer directly translating to financial loss. Furthermore, in consideration of the consumer, many parking spots can be confusing in terms of rules and regulations as well as pricing. The parking garage's pricing, availability, and

restrictions must be translated simply to the customer for a pleasant experience resulting aforementioned loyalty.

With the parking problem being a well known issue, solutions have been proposed before. In light of improving the the situation, understanding of attempted solutions can yield great results. Some prior proposed solutions, although show some results are old-fashioned and business focused, failing to really solve the issue. To elaborate, one proposed solution was to advertise parking facilities and pricing which focused on creating new parking facilities for more space and intending the advertising to lead to seperation of congestion between multiple facilities. Not only is this more financially taxing, but little is done to actually control the congestion. Customers will show up to either garage clueless on the actual availability for the space and resort to the problematic pattern of searching for a spot. The old fashioned method of just creating more space does not tackle the core of the issue. Furthermore, in prioritizing creation of more parking spots it may reduce overall transportation as it neglects space to accommodate other modes of travel such as biking or even possible locations for public transport such as bus stations. By reducing options for other modes of transport, the congestion dilemma remains prevalent. An increase in traffic surrounding the new garage is also to be expected. A consumer focused improvement on existing garages is needed rather than an increase of capacity.

Proposed Treatment

Instead of a valet we will have a computerized system. The system will let in users who have reserved based on their license plate and create accounts for walk-in parking. This reduces the need for employees and will reduce any human error. Management will be able to fully oversee the entire system from any device at any given point in time. The system will be able to send management notifications in case there are any issues.

Customers have no knowledge about the garage until they arrive and we have no knowledge of the customer. To combat this we will create a website where users can create an account using their name and driver's license. Each user must register their vehicle by license plate. On the website user's can reserve select parking spots in intervals of 15 minutes on any given day. Reservations will allow guaranteed income for the garage and incentivize customers to use the garage. Users can choose between long-term, for example an entire weekend, and short-term parking options. Users will also be able to choose an extendable reservation for a higher fee. Extendable reservations give them the option by text to extend their reservation if needed. When their parking time is almost up they will receive a notification text. Registered users have the option of canceling/editing their reservations through the website. Users who do not show up to their reservation will be given a grace period before they are fined and their reservation is canceled.

In congested areas cars will circle blocks endlessly to find parking. The website and an electronic display outside the garage will give information to potential customers on the current availability in the garage and predicted availability in the next hour. In an effort to reduce

congestion the system will make sure floors are not disproportionately occupied. It will also assign parking to floors that don't have cars about to leave to reduce situations where cars are waiting for other cars to pull out.

While we offer reservations it's important to accommodate walk-in parking. We will always have a large selection of parking spaces designated for walk-ins. During times when the garage does not have as many walk-ins due to a slow time of day we will offer more reservations than usual.

Walk-in users also include people who are using the garage for the first time and have never registered on the system before and/or expect to use the system only once. The system will accept pictures of first-time user's drivers license and vehicle license plate as registration before letting them park. First-time users will be encouraged to finish the registration process on the website. This simplifies the process on the spot. However, the system will recognize if a user attempts to masquerade as a first-time user multiple times. To incentivize customers to return we will set up a tier/rewards system. Customers higher on the system will be offered discounts.

Another factor in increasing profits lies in with our central design of selecting the amount of time the customer wishes to park. With most things in life, it is sometimes unpredictable how long a certain task will end up taking. By simplifying the ability to extend time for a parking spot with a functional website customers get peace of mind, knowing that no fees will be accrued as them have specifically updated the website on their extension necessity. In achieving a customer's peace of mind, not only are they more likely to park at said garage, but without the pressure of remembering to leave on time, the business stands to gain more profit through time extensions. Customers can choose to not have the option to extend time for a lower rate.

In developing the garage solutions, information needs to be known by the program regarding a parking garage's specific availability during a specific time in order to best accommodate a customer and ensure space is available. Data must be collected on the amount of users each garage retains during each hour of the day. The day of the week and holiday, exceptions must also be taken into consideration. By having this information, congestion can be reduced with, for example, limits on amount of time parking during a special event, or parking at higher floors of the garage for parking time that exceeds a certain threshold as these higher floors are typically less frequently used.

The current system relies on too many unknowns such as when a user enters the garage, which spot they will actually park in and for how long. These unknowns directly translates to a customer's unsatisfactory experience and less profit. By increasing knowledge around the system of the parking garage, parking experience can be guided creating a simplified easily accessible method. Simply put the less the customers have to do anything themselves, the more profit. In knowing exactly where one will park before arriving, congestion is heavily reduced and user experience is improved. Another solution of the current system, creating more parking lots, then in turn acts as expected meaning new garages actually translates to less congestion. Due to the

already solved problems of an existing garage, a new garage only serves to create more options for the customer thus maintaining a healthy system.

In consideration of some problems that may arise with our system, specific measures may need to be taken. For example, consider a customer choosing a parking spot that would take them an hour to arrive to versus one waiting just outside the parking lot. Both are placing reservations at the same time for the same amount of time. In order to tackle this, a reservation made needs to have the functionality of a start and end time. By doing so, the person an hour away can reserve a spot starting an hour after the time of reservation. If someone much closer to the garage is also requesting a spot they need to be given a different variety of options. One, they can choose to park in the spot the long distance user reserved until the long distance user arrives, but it must be known that this spot will allow no time extensions. Or, the closer person can choose a fresh parking spot.

If the person chooses the long distance user's parking spot say due to it being on a lower floor, then they must be only allotted time that ends 15 mins before the start of the next user in order to allow ample time before the next user arrives. This methodology will allow maximization of customers yielding greater revenue.

To expand on and resolve the problem above, a new system can be implemented of dynamically changing discounts and deals. For customers choosing to park in a spot that puts restriction on the amount of time they can park with no extensions, a discount can be applied in order to incentivize choosing the limiting spot. Also dynamic pricing can provide special offers of parking at a higher level, typically unwanted, during a busy time of day. These changes would depend on the cooperation of the company owning that garage. If cooperation is not done than a way to still incorporate this feature would be to raise regular reservation price on a particular garage based on the total from fees of the garage and the fee for website use and then reduce the pricing with special offers where the website use fee is decreased rather than the garage creating the impression of a parking pricing decrease.

Another new feature to improve garage use can be to purchase a package. This would allow users to claim a parking spot for a certain amount of days for a certain amount of time on each day. Multiple license plates can be added to the package in order for the parking space and garage to be made accessible to for example a family with two or more cars.

Finally, another feature necessary for maintenance of proper garage flow would be to track user habits. If a user tends to be late in exiting a parking spot creating issues with the next person, that user can be excused the first time, charged the second, and taken into consideration by the parking garage on whether to allow the user to park there anymore or whether to force the user to purchase an increased amount of alloted time in order to proceed with the reservation or an error otherwise due to poor habits. Monitoring users would strengthen punctuality.

Functional Features

A. Website

Allows a user to register parking in advance. It will have the features to create account with name, licence plate, phone number and any other necessary criteria. One will be able to register date/time/duration and with that information, receive a text when parking time limit is nearly done. User will also receive options to extend their current parking reservation if possible or create a new reservation. A website will centralize the process of parking reservation and create an easily accessible tool anywhere with an internet connection. This will bypass the need for active workers monitoring a garage or at least reduce it.

B. Unregistered first-time users parking via phone

First-time unregistered users will be able to quickly register with just a picture of their drivers license and their vehicle license plate number. They will be encouraged to complete their user account later in case they expect to use this parking system again.

Multiple options to pay may yield greater profits as someone driving while making the reservation will not be able to access the website, thus an on phone one time reservation system can be implemented.

C.Parking spot “taken”, “available”, or “available until”

Gives customer choices as well as makes sure each parking spot is being utilized to the fullest.

D.Sign Out

Option for user to select leave early if they are ready to leave earlier than expected time. Can provide user with future benefit or discount to incentivize checking out early during high demand times as it frees up parking spots for others

E. Interactive Map/Phone App or Notification

Creates a friendly UI allowing for easy reservation making as well as reminders

Qualitative Features

A.Database Utilization for Recommendations

The program might suggest a different parking garage based on statistically where there would be more openings on a particular day or time of day.

B.User Record

User records and habits can be used to determine whether the user in trustworthy in meeting time allocations to determine whether to:

1. Allow normal reservation
2. Send warning or fee

3. Only provide option for longer than chosen reserve time in expectation of user lateness

Having user records also allows for the possibility of suggesting special offers and deals based on their use of the system. From a business perspective it can allow companies to target advertisements towards certain users.

User Records can be used but is not limited to:

- Management can monitor entire structure on any device
- Long term vs short term parking
- Math/algorithms - Maximize profit. Walk in vs reservation. Walk in more expensive. Overstay fees. Offer coupons/lower rates if high availability Leave space for walk- in not just all preserve
- Reduce the number of cars entering/exiting the same floor
- More reserve on slower parts of day
- Computer system lets in people who have reserved. Assigns walk-ins space. Keeps track of which spots are open
- System collects walk in info - names

C. Dynamic price changing for discounts

Discounts and deals are dynamically changing. Examples:

1. Situation: User selects parking spot with no choice of extension as someone else reserved it afterwards
   Pricing: Offered special deal or future benefit in choosing limiting spot which maximizes parking spot use
2. Situation: Busy time with minimal parking space
   Pricing: Special offer to park in unwanted higher level parking spots in the garage so that those that want lower levels can have a better chance at attaining them while the higher level gets filled with at least some customers that are willing to take them creating greater customer satisfaction.

<u>Division of Labor:</u>

Subject to change*

Dynamic Pricing (Code updates pricing based on multiple aforementioned variables)

Jahidul Islam, Anthony Lau

Website UI (Website and user interface management)
Gabriel Shen, Help will be provided as we progress
Parking Assignment (Code for parking reservation)
Andrew schneeloch, Yu Liu

Database Utilization (Code incorporating collected data and maintaining user records)
Suva Shahria, Josh LoGiudice, Krithika Uthaman