ParkODU

Group Gold Fall 2017

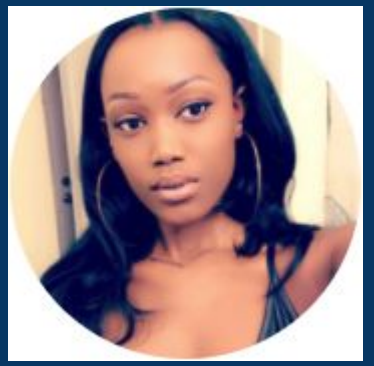
CS 410

December 7th 2017

The Awesome 8

“We are so awesome”

Cody
Project Manager,
Scrum Master



Imani
Marketing
Technologist

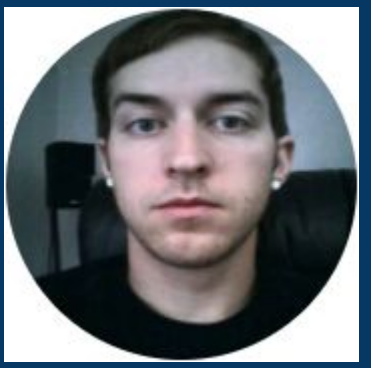
Sangeet
Business Analyst

Isaac
User Experience
Designer

Michael
Web Analytics
Developer

Ahsif
Content Manager

Gerard
Sr. Software Engineer,
Software Lead



Matthew
Software Engineer,
Deployment Lead

Table of Contents

Background

- “Parking at ODU sucks, there are not enough spaces for everyone and if you are a commuter you better get to class an hour early if you want a spot. It is like The Hunger Games for parking spaces. May the odds be ever in your favor.” (1)

- “According to Old Dominion[’]s school site, last year’s enrollment at Old Dominion was 24,828 students. Around 76% of students live off campus, this also includes students who take classes online, but out of this 76%, the majority of the group do commute.” (2)

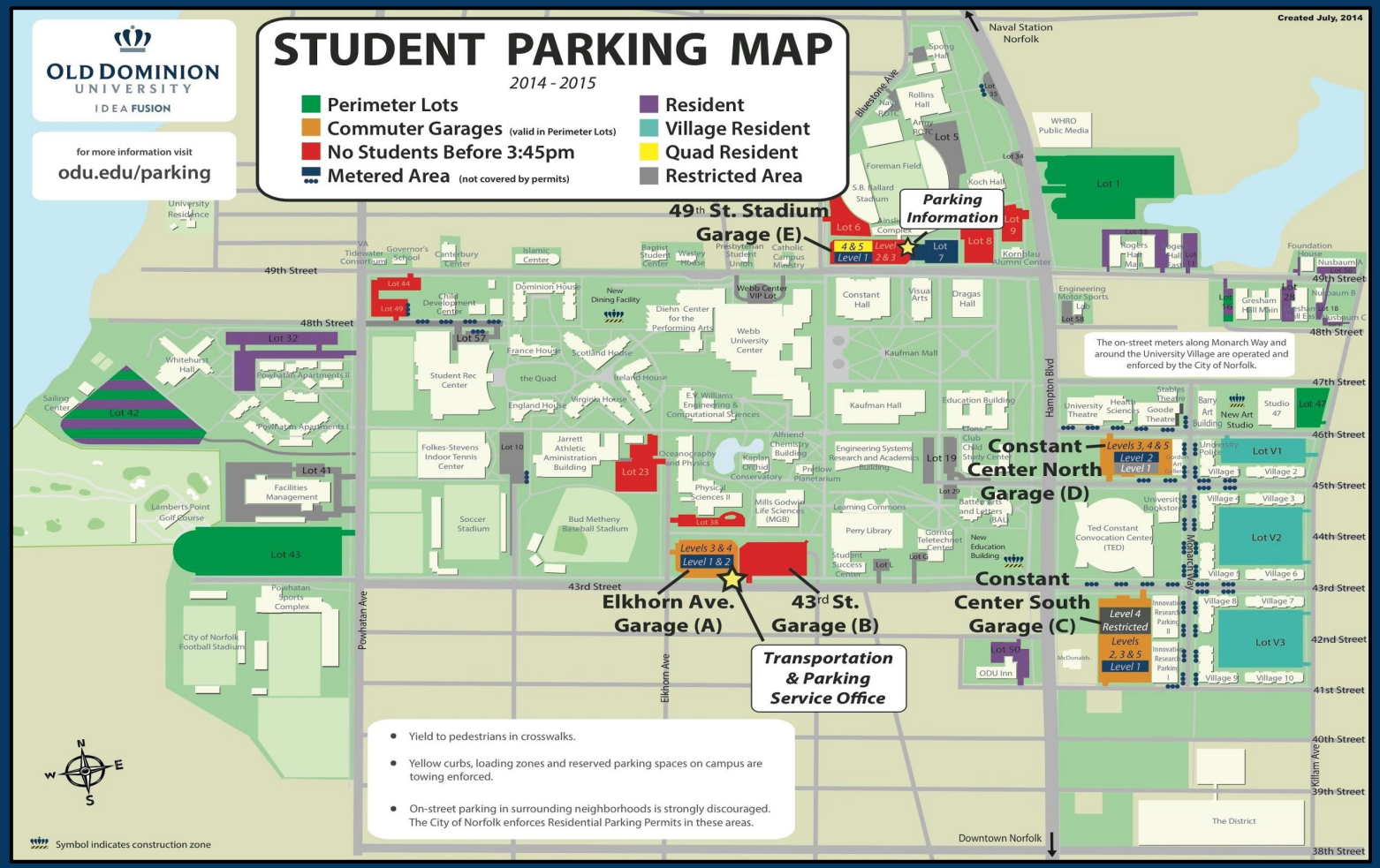
- Roughly 9,400 student commuters need to park at ODU daily
- 1511 Faculty Members (835 Full Time, 676 Part Time) (3)

- 5 Parking Garages (~3013 spaces) (4)
  ~37% Faculty (1115 spaces)
  ~26% Metered (783 spaces)
  ~33% Commuter (994 spaces)
  ~9% Other (121 spaces)

Why Not Build More Garages?

F.1.

- 2017 proposed budget aims for $5.572 million revenue surplus [5]
- National average to build a parking garage is $8.56 million(~$35-65 per sq. ft.) [6]
- Geographic constraint
- Priority of building additional academic facilities over parking structures



Problem Statement

The current state of ODU parking demands a more efficient method to utilize existing parking without building additional parking garages. Without improvement, drivers experience difficulty finding parking spaces, during the hours of 10:00AM - 2:00PM, due to:

- lack of signage and notifications for available spaces,
- preferences for specific parking locations,
- and limited choices during peak hours.

F.2.

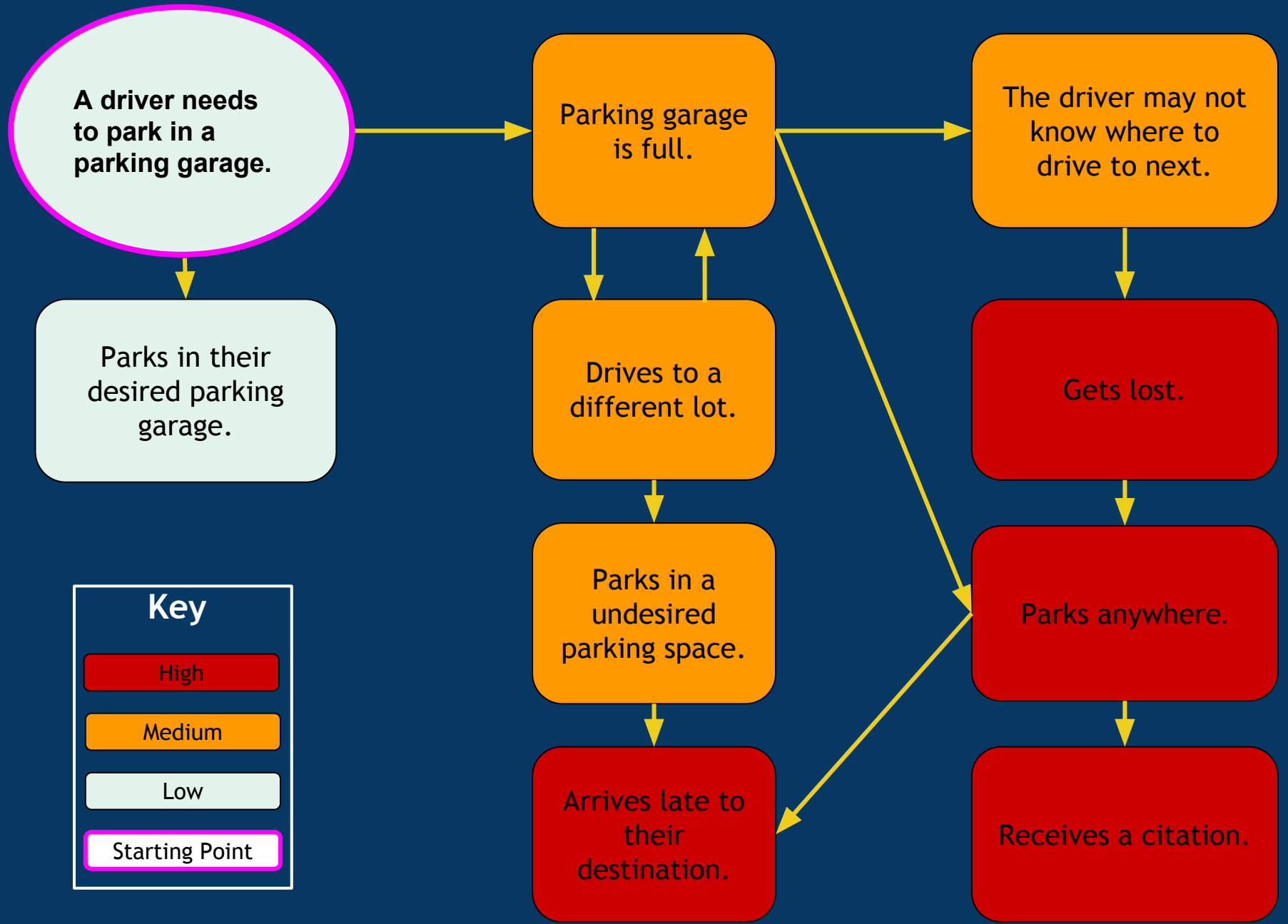
Customer

The customer is Scott Silsdorf along with his team. He is the the Director of Transportation & Parking Services for ODU. He is the primary decision-maker for purchasing any solutions for ODU garages and lots.

End Users

The end users who will benefit from our web application are any drivers that need to park at ODU as well as parking administrators.

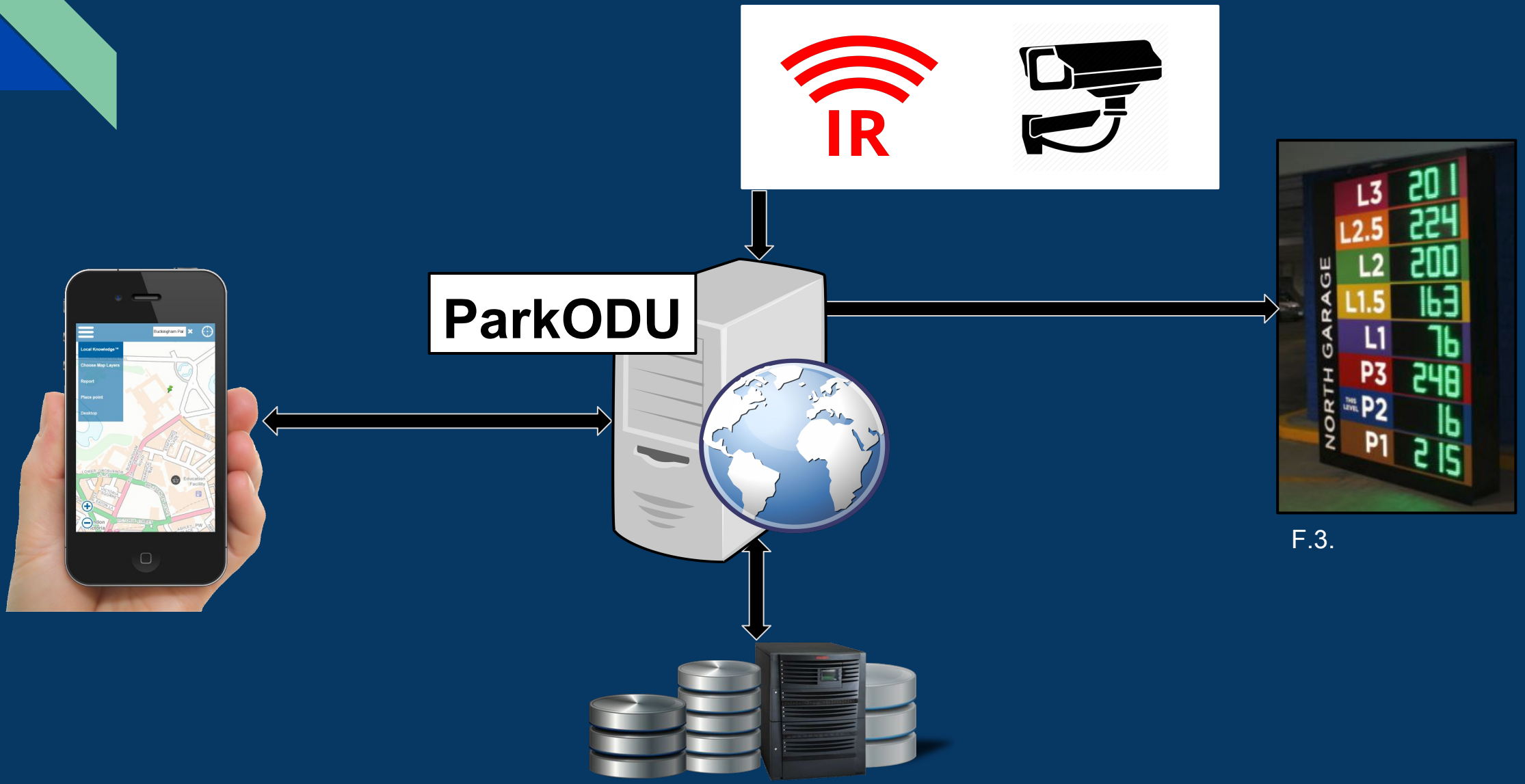
Current Process Flow



The Solution: ParkODU

A software solution that analyzes parking availability in real-time and helps drivers find the vacant parking space closest to their destination

Major Functional Components



F.3.

Out of the Box Requirements

- Customer will need vehicle detection technology.
- Customer can have parking garage signs to display garage occupancy (Not Required).
- Application must be hosted on a server (Physical or Virtual).
- MongoDB will be the supported database.
- Application server and user application will be open-source and downloadable http://www.cs.odu.edu/~410gold/download.

Development Tools

- Language: Java
- Framework: Spring Framework
- IDE: IntelliJ Community Edition
- Build Tools: Jenkins, Gradle
- Data Stores: Hazelcast, MongoDB
- Version Control: Git
- Third-Party API: Google Maps API

Floor Plan / Demo

ParkODU

ParkODU Search... Dashboard Settings Profile Help

Garages

Garage A: Elkhorn Avenue

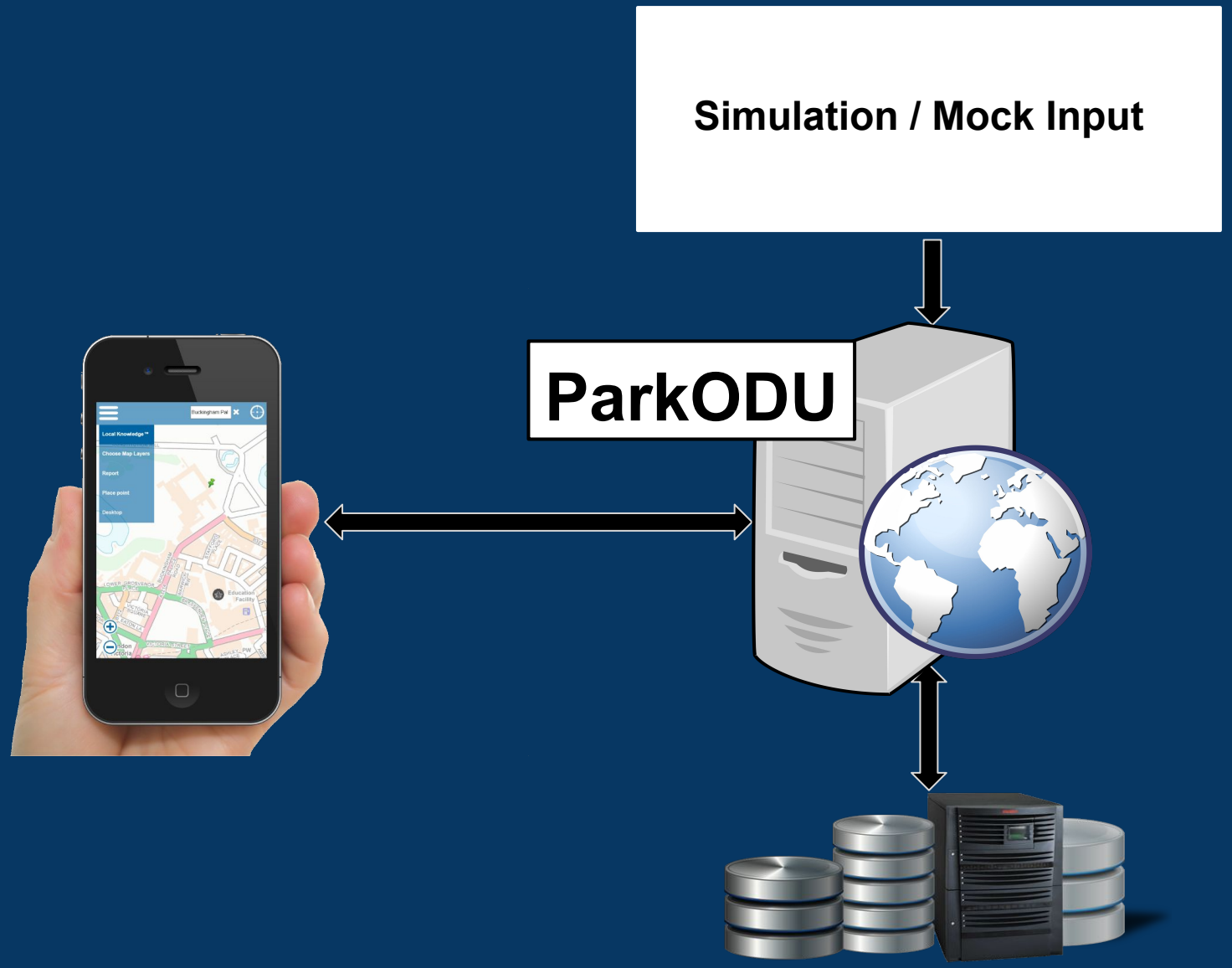
Last Updated: Mon Oct 30 20:56:51 EDT 2017

Total Available Spaces 4
Total Spaces 648
Capacity 99.38%
Description Located at the corner of 43rd Street and Elkhorn Avenue. The garage is zoned for meter parking and commuter students. There are meter spaces located on 1st and 2nd levels that are controlled by multi-space meters located at the pedestrian exit in the northeast corner of the facility. When parking in a metered space, you must pay the pay station before leaving the garage as soon as you park your vehicle. Each parking space is individually numbered. Enter the space number at the multi-space meter when you pay.

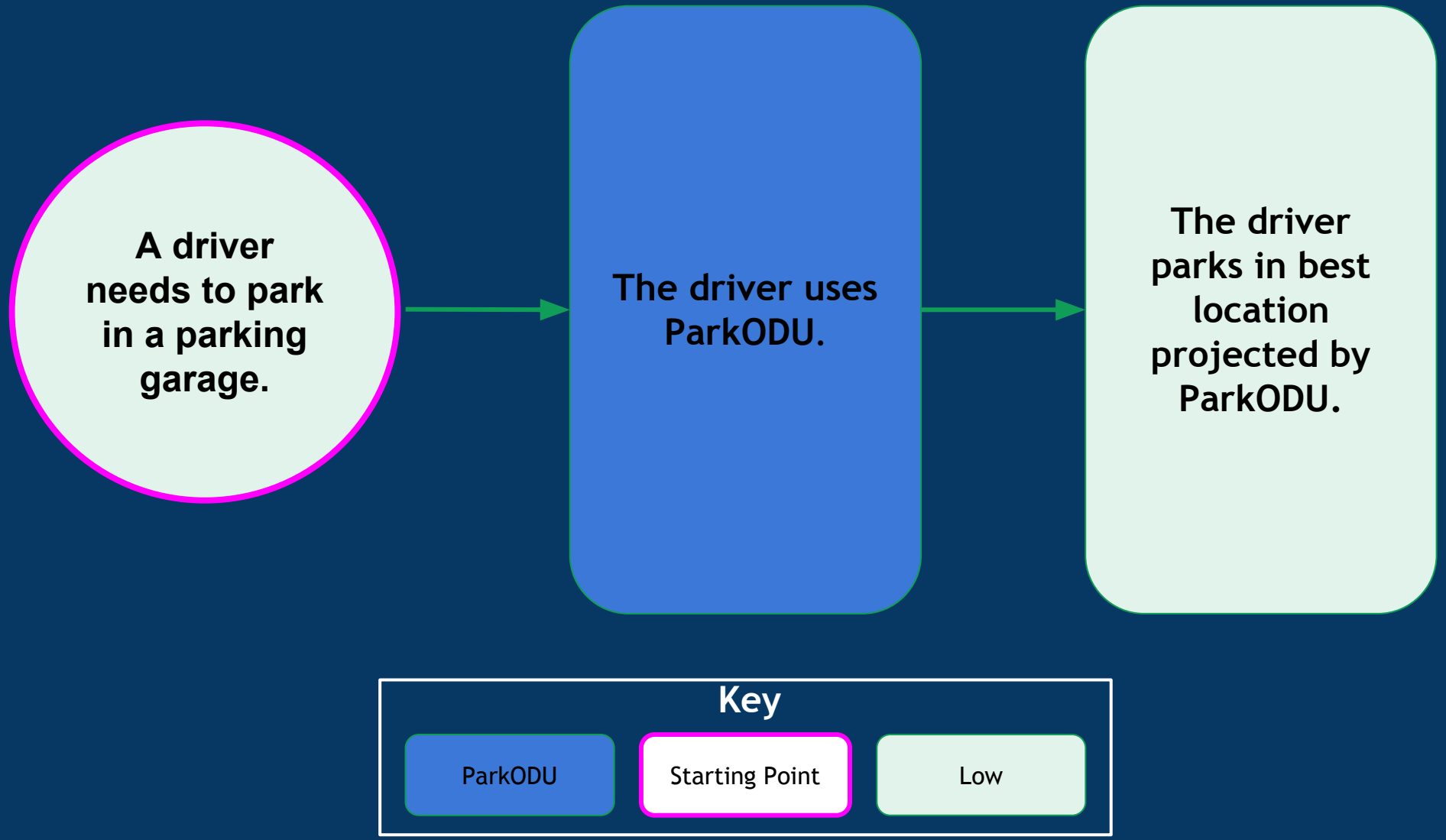
Note: The FloorKey column is for testing purposes only.

Floor	Description	Available Spaces	Capacity
Level 1	Metered Parking	3	98.15%
Level 2	Commuter / Commuter Parking	0	100.0%
Level 3	Commuter Parking	0	100.0%
Level 4	Commuter Parking	1	99.38%

Prototype Major Functional Components



Proposed Process Flow



Competition Matrix

Functionality	ParkODU	T2systems	PureTech	SWARCO	KiwiSecurity	Access Automation	JMU Parking
Vehicle Count by Garage	X	X	X	X	X	X	X
Vehicle Count by Floor	X	X	X	X	X		
Vehicle Count by Space	X						
Vehicle Count Anywhere				X	X		
Navigation	X	X					
Statistical Analysis	X	X		X	X	X	X
Occupancy Signage	X	X	X	X		X	
Mobile Application	X	X					X
Web Application	X	X					
Reconfigurable	X		X	X	X		
Low Cost	X		X	X	X		X
Vehicle Security/Intrusion Monitoring					X		
Import Event/Personal Schedule	X						

Competition Matrix: Counting

Functionality	ParkODU	T2systems	PureTech	SWARCO	KiwiSecurity	Access Automation	JMU Parking
Vehicle Count by Garage	X	X	X	X	X	X	X
Vehicle Count by Floor	X	X	X	X	X		
Vehicle Count by Space	X						
Vehicle Count Anywhere				X	X		

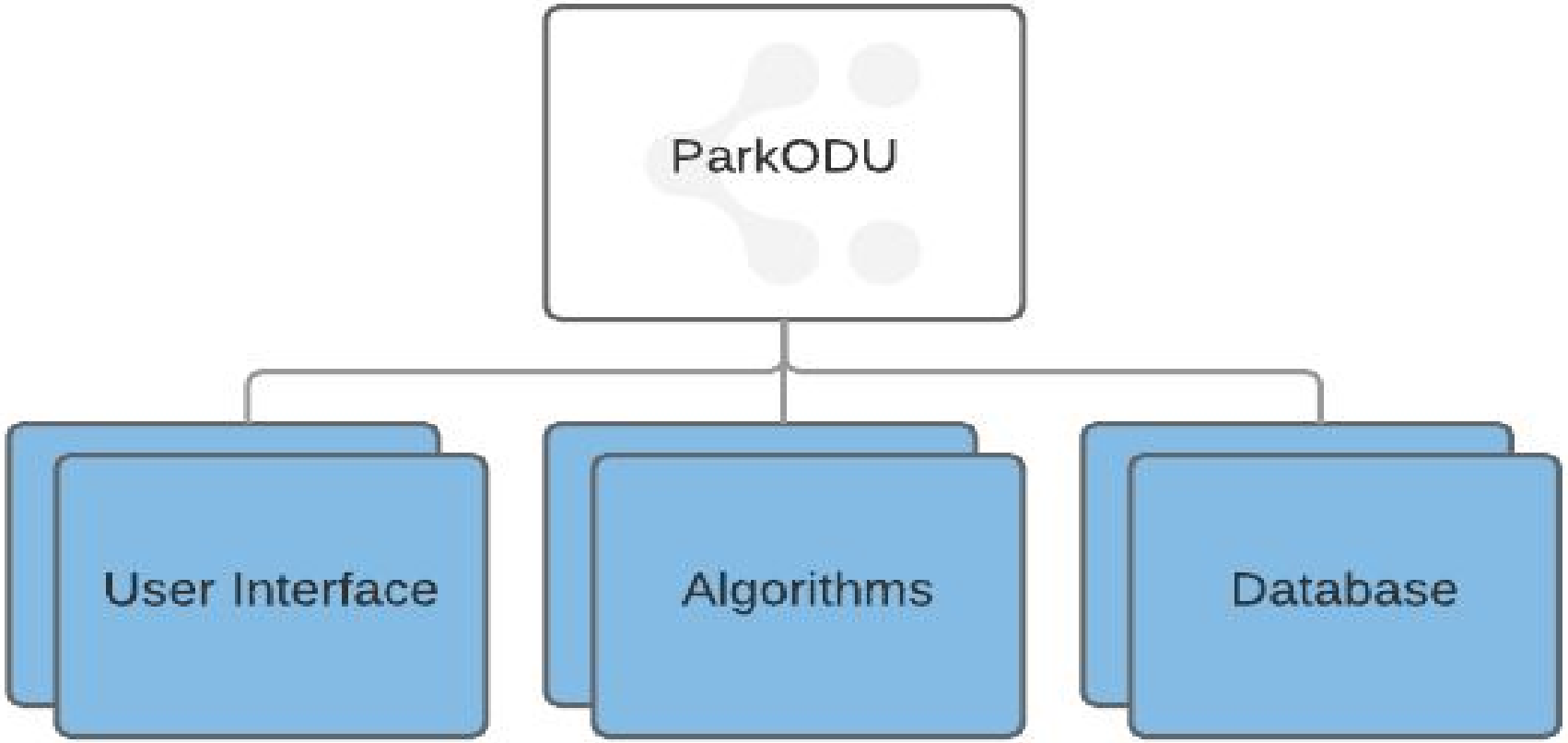
Competition Matrix: Navigating

Functionality	ParkODU	T2systems	PureTech	SWARCO	KiwiSecurity	Access Automation	JMU Parking
Navigation	X	X					
Occupancy Signage	X	X	X	X		X	
Statistical Analysis	X	X		X	X	X	X
Import Event/Personal Schedule	X						

Competition Matrix: Other

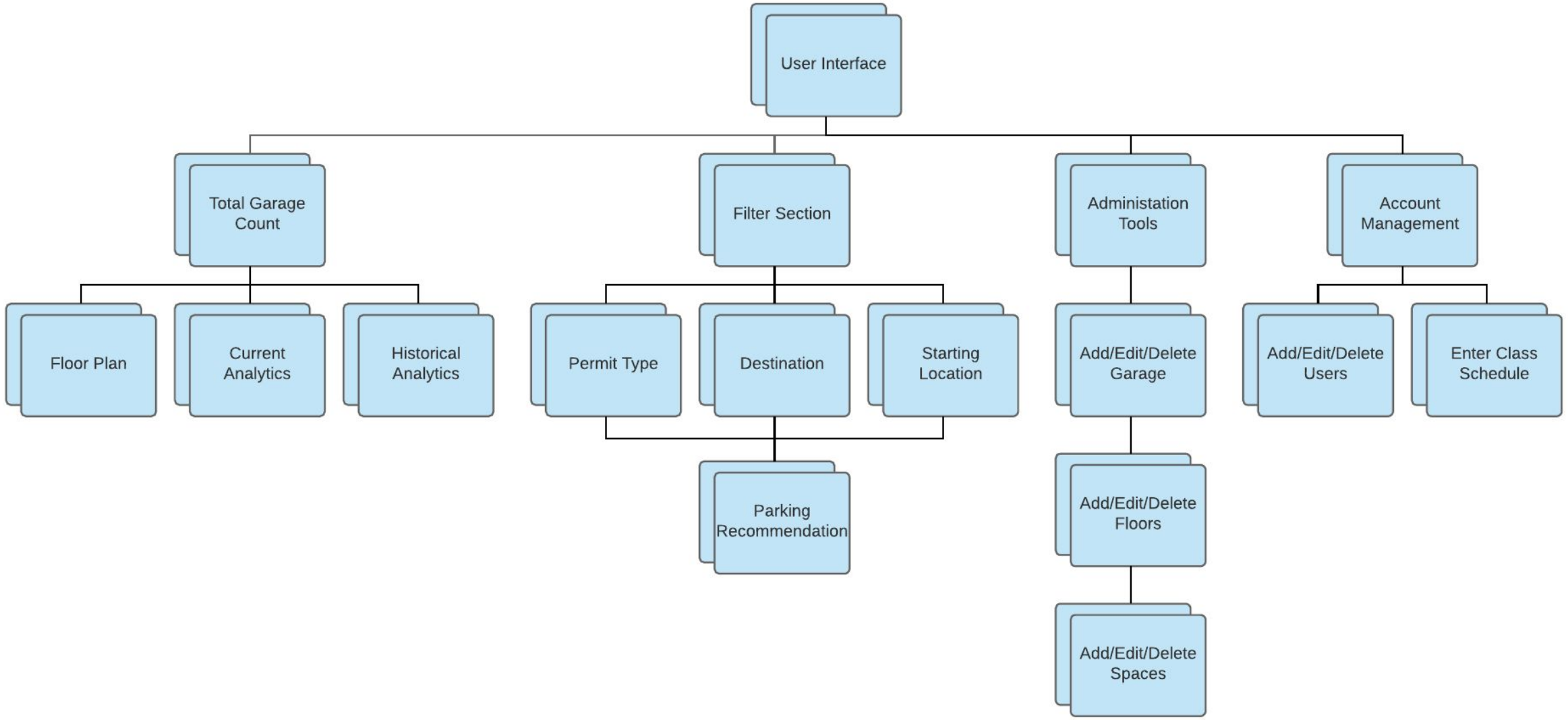
Functionality	ParkODU	T2systems	PureTech	SWARCO	KiwiSecurity	Access Automation	JMU Parking
Mobile Application	X	X					X
Web Application	X	X					
Reconfigurable	X		X	X	X		
Low Cost	X		X	X	X		X
Vehicle Security/Intrusion Monitoring					X		

Work Breakdown Structure

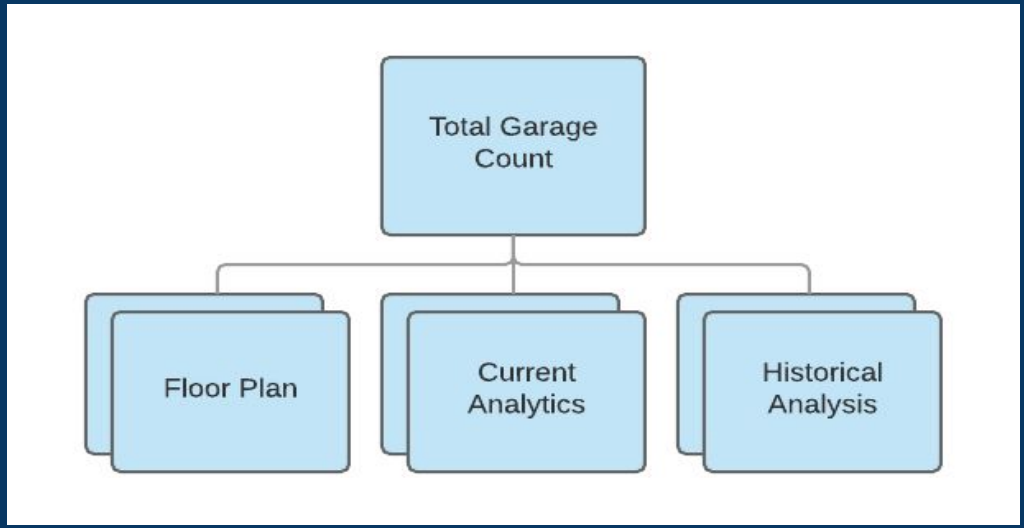


User Interface

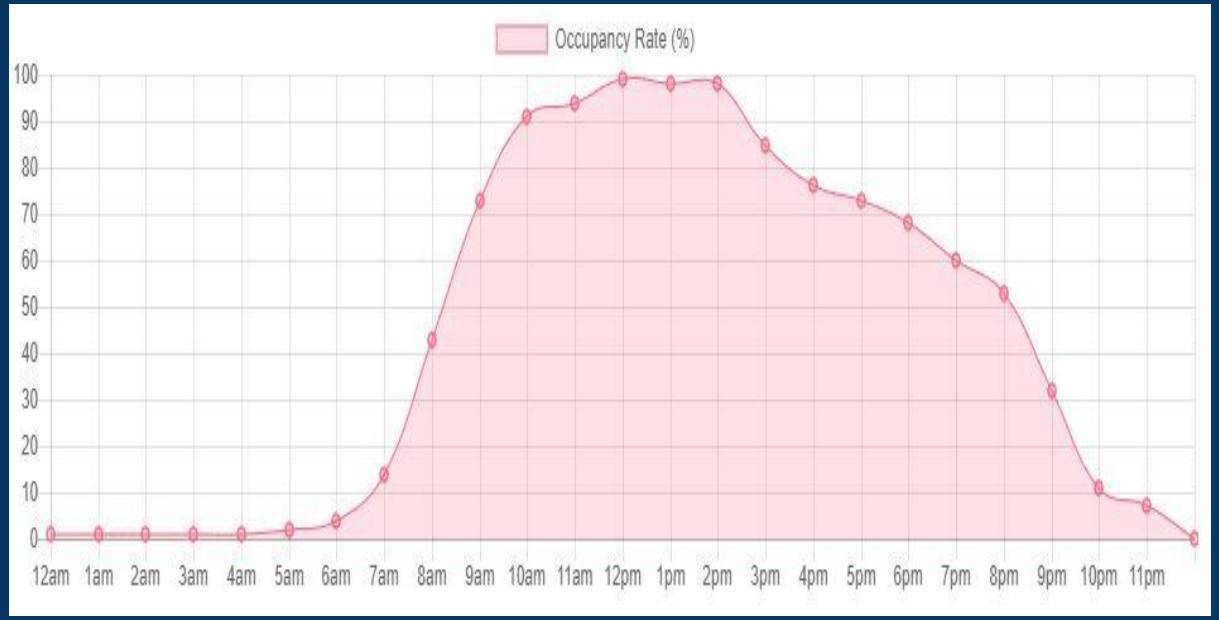
User Interface



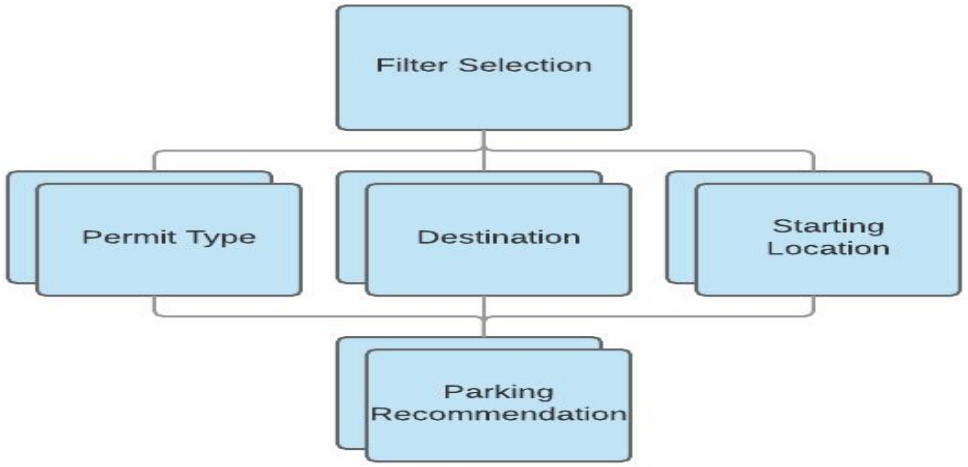
User Interface: Total Garage Count



- For a garage, displays will show a real-time floor plan based on occupancy of each parking spot separated by floor.
- Each floor will be accompanied by a working graph representing the statistics of availability by day of the parking conditions being updated on an hourly basis.



User Interface: Filter Selection

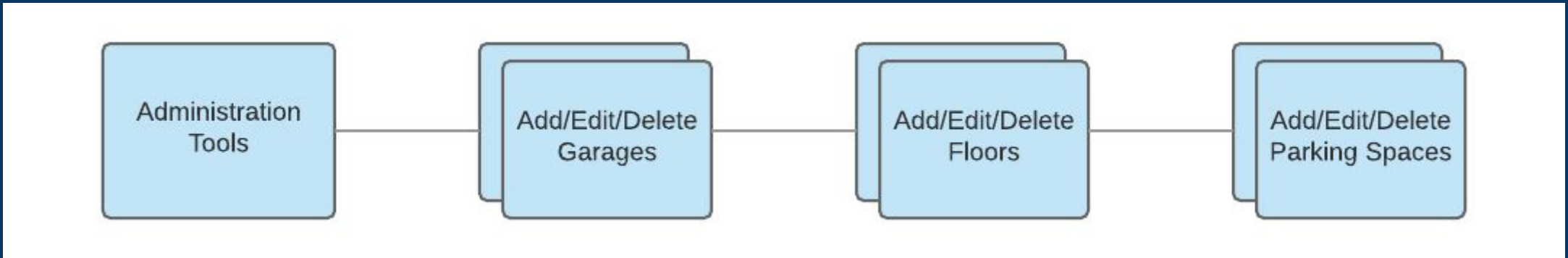


For this section of the user interface, the user will be able to filter to view their specific selection. The selection includes:

- starting location
- permit type
- destination

The goal of this section is to provide a mechanism to allow the user find the best parking space while using ParkODU

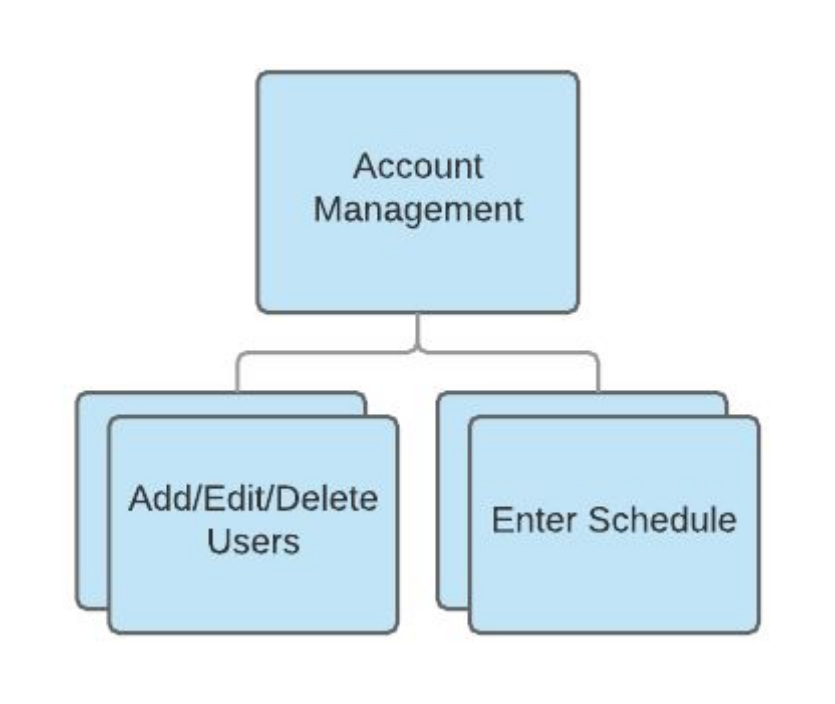
User Interface: Administration Tools



The functionality of this section allows for an administrative user to manipulate allocations of parking spaces if conditions change based on parking needs changes. This feature of the UI allows for flexibility using ParkODU to adapt to any parking allocations per implementation.

Only administrative users will be able to access this portion of the UI and will be protected by username and password created at time of installation of ParkODU. All administrative users will have the availability to add users as needed.

User Interface: Account Management

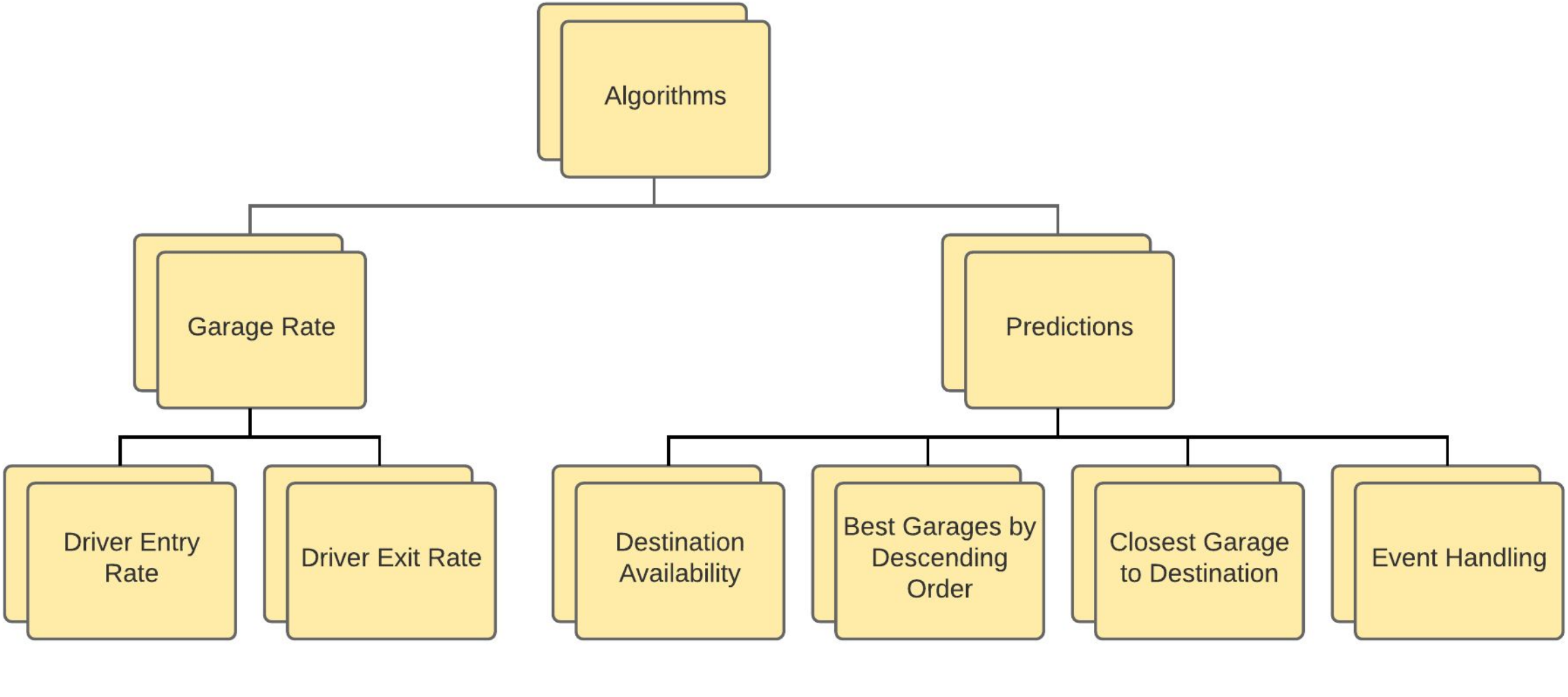


Account management allows for an administrative user to add notifications for any future events that affect parking. Such events will display as a notification for user to notify them of future parking conditions and any preparations that need to be taken in accordance with the event.

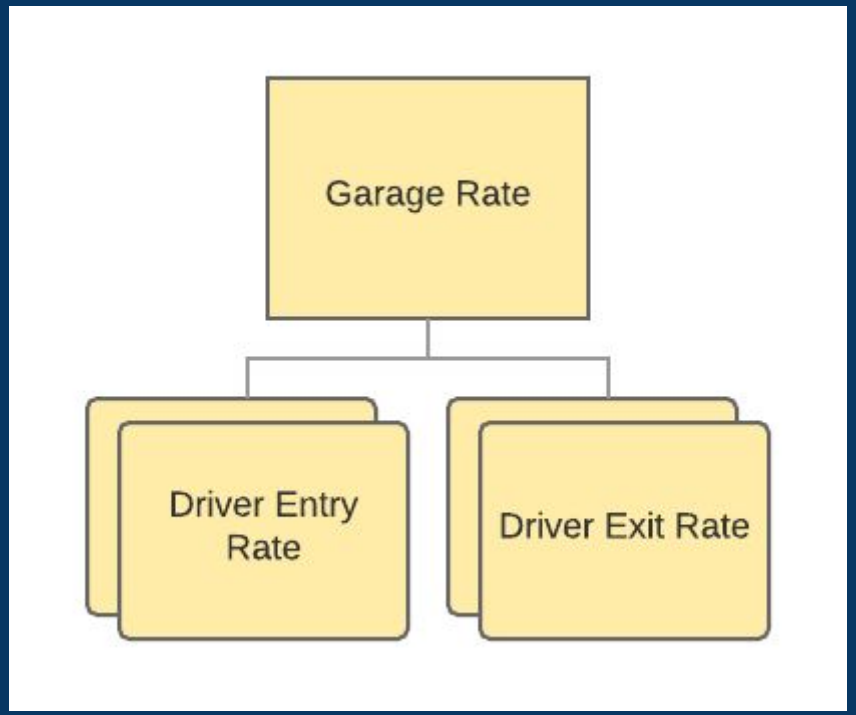
The availability to add, remove, and edit access roles that may need to access the administrative UI can also be configured.

Algorithms

Algorithms


Algorithms
Garage Rate
Predictions
Driver Entry Rate
Driver Exit Rate
Destination Availability
Best Garages by Descending Order
Closest Garage to Destination
Event Handling

Algorithms: Garage Rate Entry/Exit



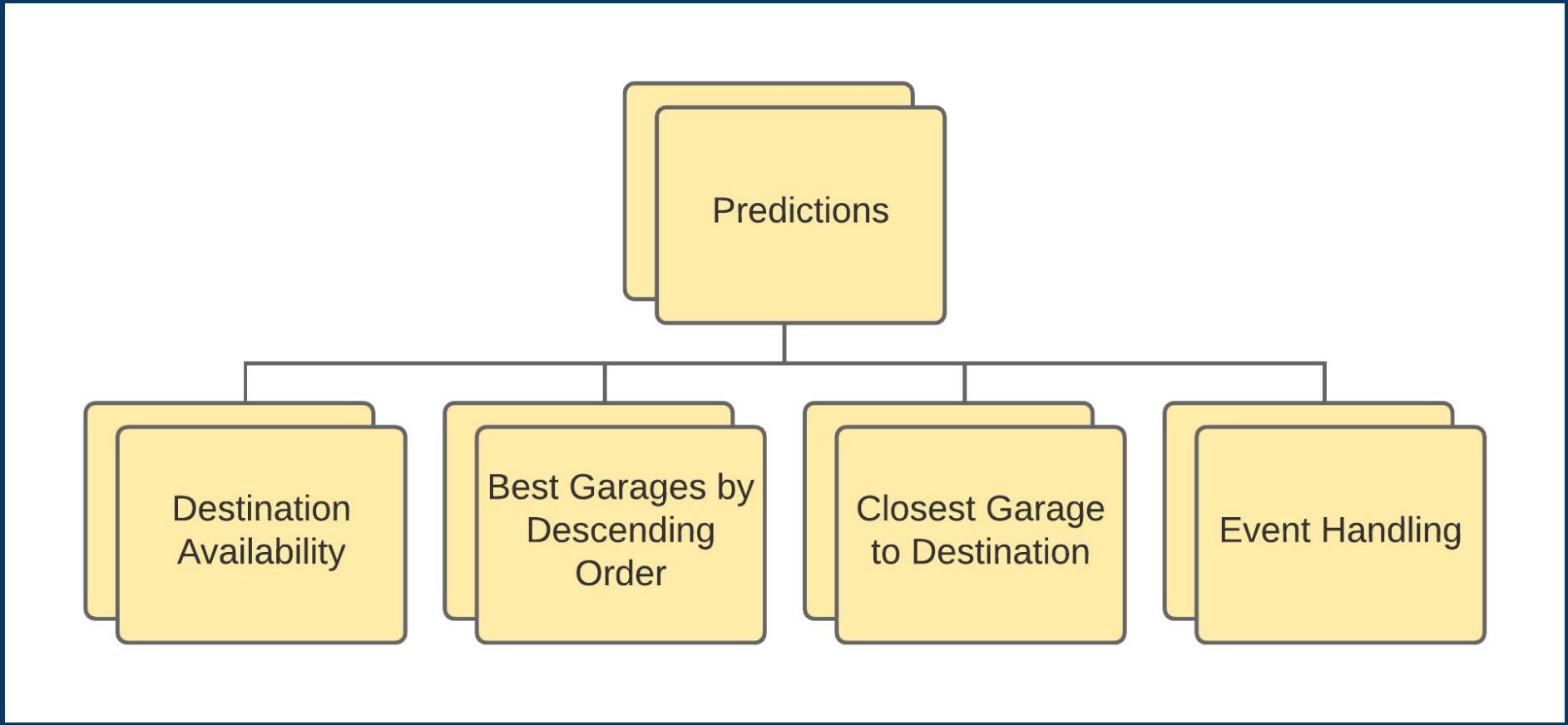
Driver Entry Rate = Number of Vehicles Arriving / Minute
Driver Exit Rate = Number of Vehicles Leaving / Minute
Garage Rate = Driver Entry Rate - Driver Exit Rate

Rush Hours:
7:45AM ~ 9:00AM (Students and Faculty Arriving)
12:00PM ~ 1:00PM (Lunch)
3:00PM ~ 4:30PM (Students and Faculty Leaving)

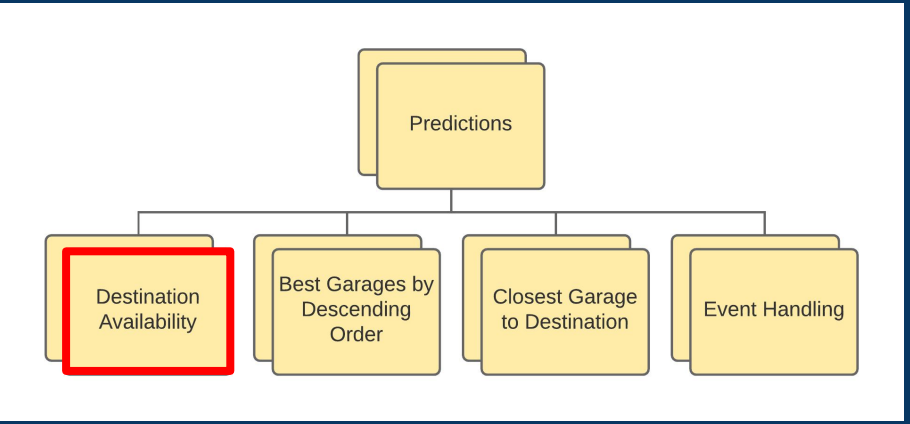
Operating Hours:
7:00AM ~ 10:00PM

- During rush hours (7:45AM ~ 8:30AM, 12:00), a 5-minute timeframe will be used.
- During the operating hours, a 15-minute timeframe will be used.
- Outside the operating hours, a 30-minute timeframe will be used.

Algorithms: Predictions



Algorithms: Destination Availability



Problem: At 8:12 am on Monday, a user wants to know how many vehicles there will be in a garage at 8:45 am. The current vehicle count is 20. The maximum capacity of the garage is 300.

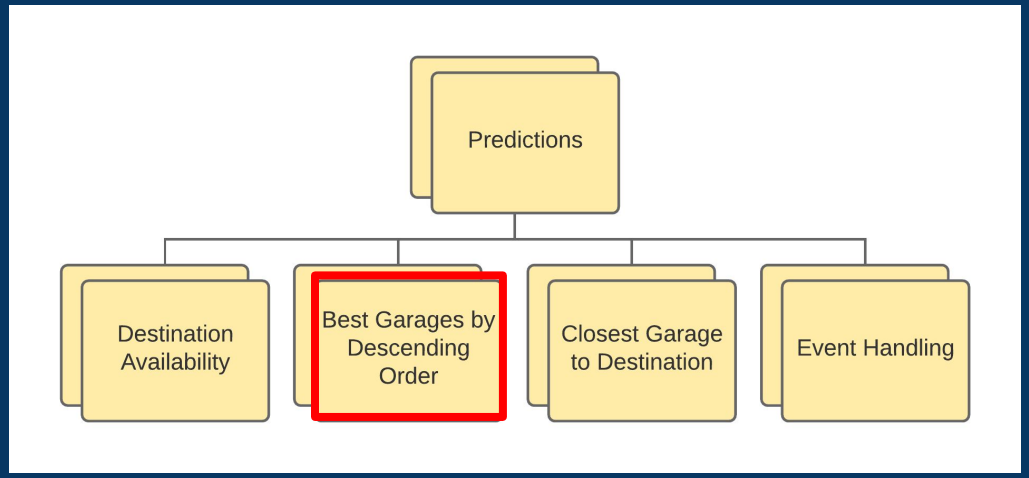
Algorithm

1st Monday at 8:45am = 75% occupancy
2nd Monday at 8:45am = 73% occupancy
3rd Monday at 8:45am = 72% occupancy
4th Monday at 8:45am = 77% occupancy
5th Monday at 8:45am = 73% occupancy

Sum of Previous Sample Occupancies / Sample Count = Projected Occupancy

(75 + 73 + 72 + 77 + 73) / 5 = 74% Projected Occupancy for 6th Monday at 8:45am

Algorithms: Best Garages by Descending Order



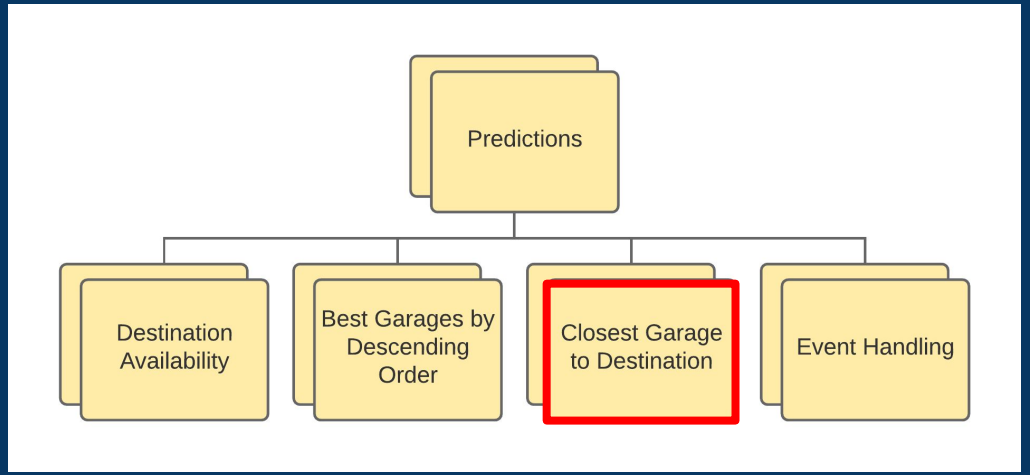
- Definition of “Best”: A garage must have minimum available parking spaces and closest to the destination.
- User is allowed to specify their desired minimum number of available spaces that a garage must have.

Algorithm

1. Calculate the predicted number of available spaces after X minutes for all garages.
2. Identify the garages that have at least the minimum number of available spaces specified by the user.
3. Using Google Map API, sort the list of garages by walking distance (in minutes) to the destination building from shortest to longest.

The first garage in the sorted list would be the best garage and each subsequent garage would be the next best.

Algorithms: Closest Garage to Destination



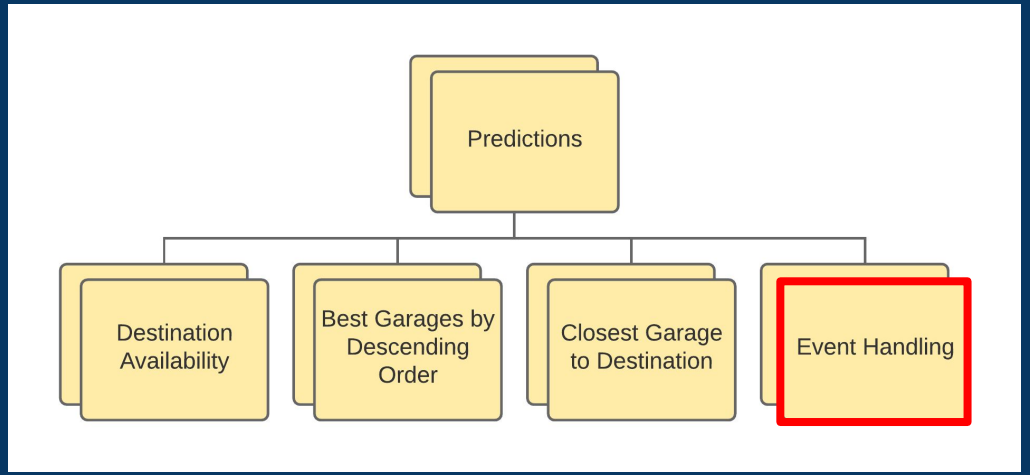
Definition: A garage that is closest to the driver's destination building regardless of space availability

Why: Even when the closest garage is predicted to be at full capacity, some drivers would prefer to go to the closest garage and try to find last one open space or wait for someone to leave their space.

Algorithm

1. Using Google Map API, sort the list of garages by walking distance (in minutes) to the destination building from shortest to longest.
2. The first garage in the list is the closest garage to the destination.

Algorithms: Event Handling



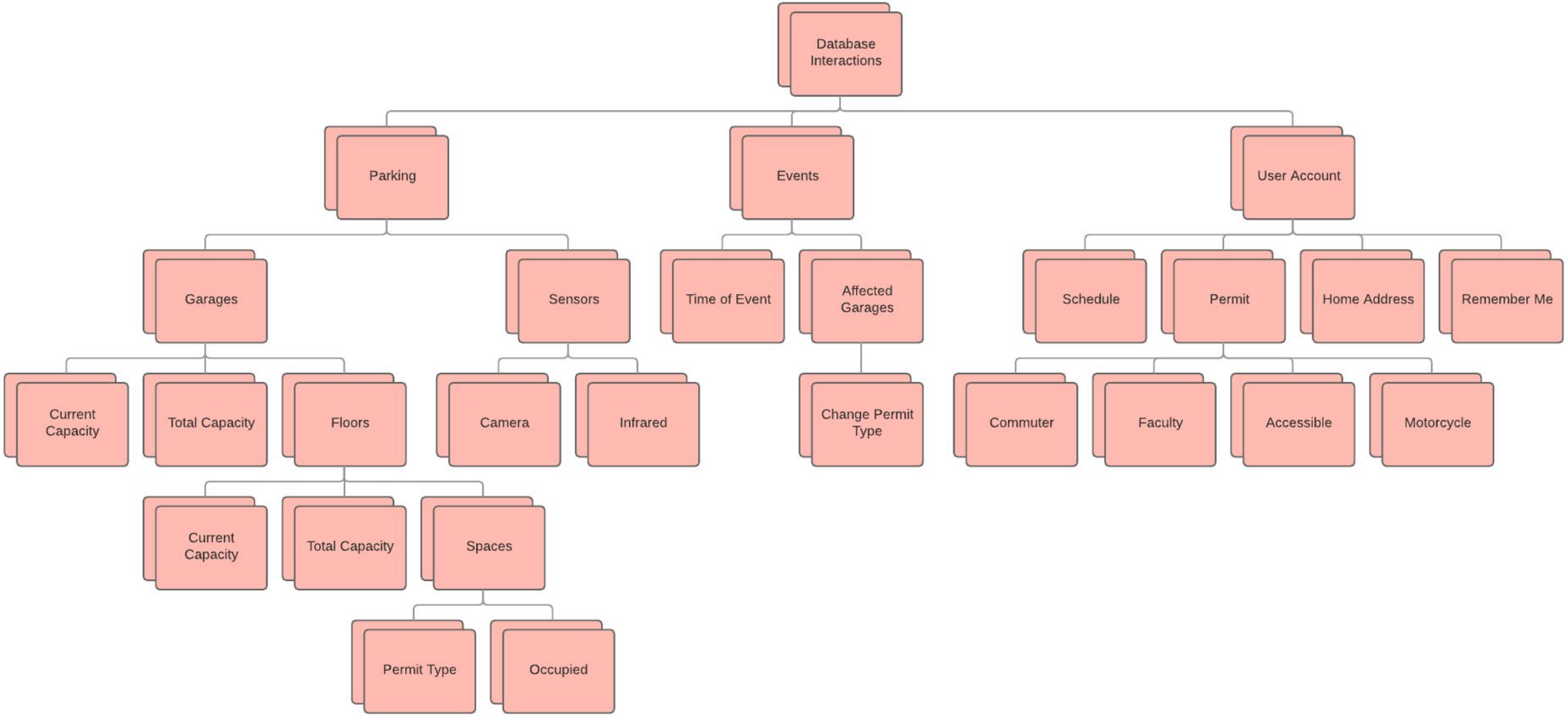
The algorithm for handling events is simple. However, it depends on the ODU parking staff to export the event schedule to ParkODU.

When predicting space availability, any garages closed due to events will be marked as “closed”.

If the event schedules are imported ahead of time, ParkODU can send a pop-up notification to all client Apps.

Database

Database


Database Interactions
Parking
Events
User Account
Garages
Sensors
Time of Event
Affected Garages
Schedule
Permit
Home Address
Remember Me
Current Capacity
Total Capacity
Floors
Camera
Infrared
Change Permit Type
Commuter
Faculty
Accessible
Motorcycle
Current Capacity
Total Capacity
Spaces
Permit Type
Occupied

Database: Parking Garages

garage document

```
{
        garage_id: "f27739d06525488eb65b1e28ea8ed746",
        name: "Parking Garage A",
        address: {
                street: "4700 Elkhorn Ave",
                city: "Norfolk",
                state: "Virginia",
                zip: "23462"
        }
        geo_location_lat: “47”,
        geo_location_long: “82”,
        total_capacity: “450”,
        current_capacity: “323”,
        is_open: “true”
}
```

sensor document

```
{
        space_id: "91495749cdf0405399430bffbe932100",
        floor_id: “f6ee4d41d2db46e7940d642639a36e88”,
        garage_id: "f27739d06525488eb65b1e28ea8ed746",
        sensor_id: ”349bd90fc7d84d0ab07cf22a38757382”,
        type: “infrared”,
        occupied: "false",
        state: “running”
}
```

space document

```
{
        space_id: "91495749cdf0405399430bffbe932100",
        floor_id: “f6ee4d41d2db46e7940d642639a36e88”,
        garage_id: "f27739d06525488eb65b1e28ea8ed746",
        space_number: “13”,
        space_type: “regular”,
        type: “infrared”,
        occupied: "false",
        permit_type: “commuter”,
        space_state: “running”,
        is_open: “true”
}
```

floor document

```
{
        floor_id: “f6ee4d41d2db46e7940d642639a36e88”,
        garage_id: "f27739d06525488eb65b1e28ea8ed746",
        level: “1”,
        current_capacity: “50”,
        total_capacity: “112”,
        is_open: “true”
}
```

Database: Events

event document

```
{
        event_id: "f27739d06525488eb65b1e28ea8ed465",
        name: "Football Game",
        start_date: “12/04/17”,
        start_time: “7:00AM”,
        end_date: “12/06/17”,
        end_time: “8:00PM”,
        affected_garages: [],
        affected_floors: [],
        affected_spaces: []
}
```

affected_location document

```
{
        location_id: “f27739d06525488eb65b1e28ea8ed746”,
        location_type: “garage”,
}
```

Database: User Account

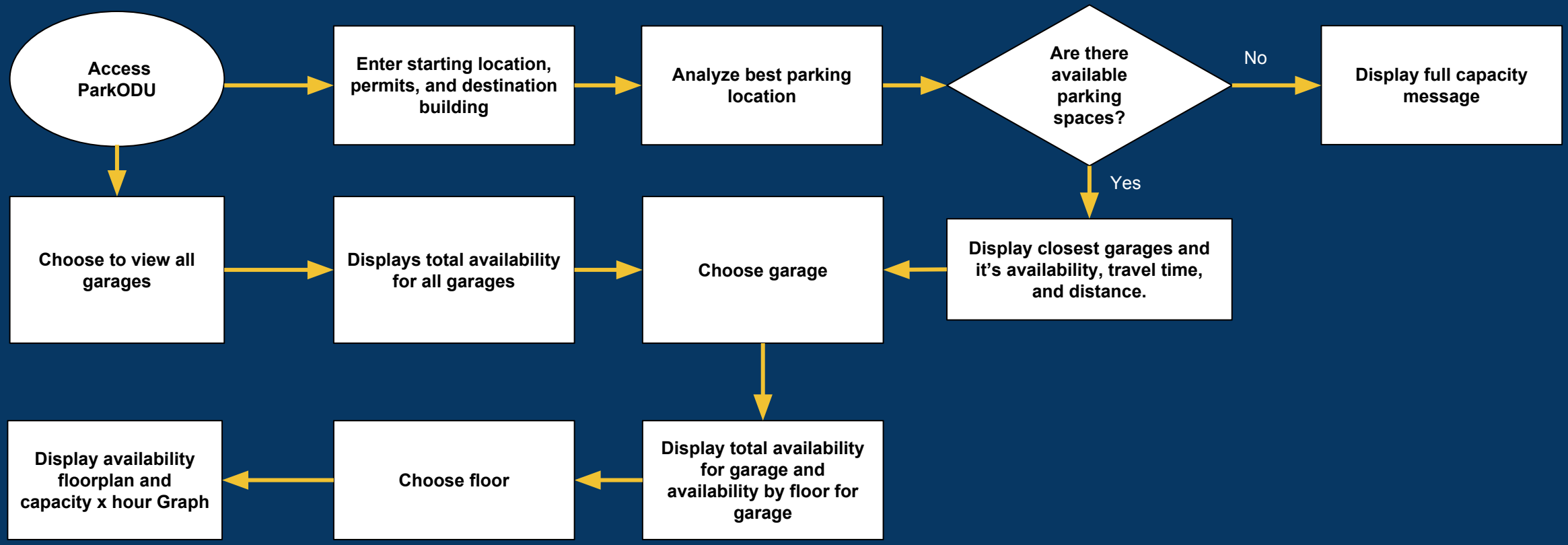
user document

```
{
        user_id: "f27739d06525488eb65b1e28ea8ed744",
        name: {
                first: “John”,
                last: “Doe”
        },
        address: {
                street: "4700 Main St.",
                city: "Norfolk",
                state: "Virginia",
                zip: "23462"
        },
        permit_type: “Commuter”,
        space_type: “Accessible”,
        remember_me: “true”,
        schedules: []
}
```

schedule document

```
{
        schedule_id: “aee4d41d2db46e7940d642639a36e88”,
        year: “2017”,
        semester: “Fall”,
        days: [
                “Monday”,
                “Thursday”
        ],
        start_time: “9:00AM”,
        end_time: “10:45AM”,
        building: “Batten Arts”
}
```

Use ParkODU Flowchart



Technical Risks

(T1) Web Connection Failure

(T2) Database/Web Application Failure

(T3) Software Bugs

(T4) Hardware Failure

(T5) Failure to Notify User of an Event

(T6) Lack of Technical Knowledge

(T7) Incompatible Input Format

(T8) Inability to Scale Under Load

Customer Risks

(C1) University Implements a Better Solution

(C2) University Does Not Allow Access to Network

(C3) Customer Unable to Maintain Servers/Hardware

(C4) University Replaces All Garages and Lots with Other Buildings

(C5) Customer Unwilling to Purchase Hardware

(C6) Parking Lot Replaced by Parking Garage

(C7) Customer Purchases Partially Compatible Technology

User Risks

(U1) User is Distracted While Using the Application

(U2) No Internet Device

(U3) User Cannot Find a Parking Spot

Probability

Risk Analysis Matrix		Very Low	Low	Medium	High	Very High
		1	2	3	4	5
Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
High	4			T4,C3	U1	
Medium	3	C2		T6,C7,T7		
Low	2		C6			
Very Low	1					

Impact

Red : Severe
Yellow : Medium
Green : Low

“T” : Technical Risks
“C” : Customer Risks
“U” : User Risks

Technical Risks

T1: Web Connection Failure

Description

Application server fails to connect to the Web.

Mitigation

Test the connection and ensure communication is regained.

Probability: 2
Impact: 5

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

T2: Database/Web Application Failure

Description

Database/Web App failure may occur due to network settings being offline or unavailable.

Mitigation

Verify the database and software communication through testing.

Establish dedicated clustered server environments for both database and web application server clusters to reduce possible downtime of ParkODU.

Probability: 2
Impact: 5

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

T3: Software Bugs

Description

Software development opens up the possibility for bugs that may reduce functionality of the Web application.

Mitigation

Software updates and debugging techniques will be administered routinely.

User Interface/User Experience (UI/UX) Testing

Regression testing and continuous integration

Probability: 1
Impact: 5

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

T4: Hardware Failure

Description

Hardware including IR sensors, Garage Signage (optional), may not be functioning or require repair.

Mitigation

Mark spot as hardware malfunction and send a service request to maintenance.

Probability: 3
Impact: 4

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

T5: Failure to Notify User of an Event

Description

ParkODU is not updated with event schedules that may affect garage availability.

Mitigation

Ensure ParkODU is updated with upcoming events.

Create a ScheduledTask to poll the event calendar through rest endpoints.

Probability: 2
Impact: 5

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

T6: Lack of Technical Knowledge

Description

Minimal technical experience and/or programming familiarity needed to develop the application.

Mitigation

Individually improve programming knowledge and provide training to less experienced members in area of deficiency.

Probability: 3
Impact: 3

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

T7: Incompatible Input Format

Description

Formatting of input is not compatible with ParkODU.

Mitigation

Verify input formatting compatibility through testing.

Probability: 5
Impact: 3

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

T8: Inability to Scale Under Load

Description

As volume or customer count increases the database becomes slow or may fail.

Mitigation

Expanding computing resources to handle the exponential growth of work with the use of database scalability.

Establish dedicated clustered server environments for both database and web application server clusters.

Probability: 1
Impact: 5

Impact			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

Customer Risks

C1: University Implements a Better Solution

Description

The university implements a solution other than ParkODU.

Mitigation

Show the customer how ParkODU's benefits and features are superior to competing solutions.

Offer ParkODU as an open-source solution.

Probability: 1
Impact: 5

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

C2: University Does Not Allow Access to Network

Description

ODU ITS does not allow ParkODU to run on the university's network.

Mitigation

Some departments within the university run things on their own networks.

Customer determines hosting location.

Probability: 1
Impact: 2

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

C3: Customer Unable to Maintain Servers/Hardware

Description

Customer will be unable to maintain the hardware utilized by ParkODU.

Mitigation

Customer determines the most effective hardware solution with their implementation for ParkODU.

Probability: 3
Impact: 4

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

C4: University Replaces All Garages and Lots with Other Buildings

Description

All parking garages and lots are replaced by buildings

Mitigation

Parking will still be essential. The software will allow for reconfiguration as the university changes parking allocations.

Probability: 1
Impact: 5

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

C5: Customer Unwilling to Purchase Hardware

Description

Customer may not agree to purchase hardware.

Mitigation

Software will allow for multiple hardware implementations.

ParkODU will allow reconfiguration of parking spaces.

Probability: 3
Impact: 5

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

C6: Parking Lot Replaced by Parking Garage

Description

The University builds parking more parking garages in place of parking lots

Mitigation

Ability to add/edit/delete parking objects.

Probability: 2
Impact: 2

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

C7: Customer Purchases Partially Compatible Technology

Description

Customer purchases detection hardware that does not support a certain functionality, such as count by space.

Mitigation

The software can be reconfigured to support specific customer implementation.

Probability:3
Impact: 3

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

User Risks

U1: User is Distracted While Using the Application

Description

User is distracted while using ParkODU.

Mitigation

Provide safety notification.

Allow for ParkODU to auto-refresh in order to display current data without any additional user interaction.

Probability: 4
Impact: 4

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

U2: No Internet Device

Description

The end user does not have access to an internet device, such as a Smartphone or a computer, to use the mobile or web application.

Mitigation

User is able to view occupancy signage while on campus.

User can use public resources such as a public library computer to access ParkODU.

User can utilize ParkODU's historical prediction feature to print future projections.

Probability: 1
Impact: 5

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

U3: User Cannot Find a Parking Spot

Description

All parking that is being monitored by the application is full.

Mitigation

Inform the user parking is full and application will notify ODU Parking Services.

Provide ODU Parking Services contact information.

Probability: 1
Impact: 5

			Probability				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Impact	Very High	5	T3,T8, C1,C4,U2,U3	T1,T2,T5	C5		
	High	4			T4,C3	U1	
	Medium	3			T6,C7,T7		
	Low	2	C2	C6			
	Very Low	1					

User Roles

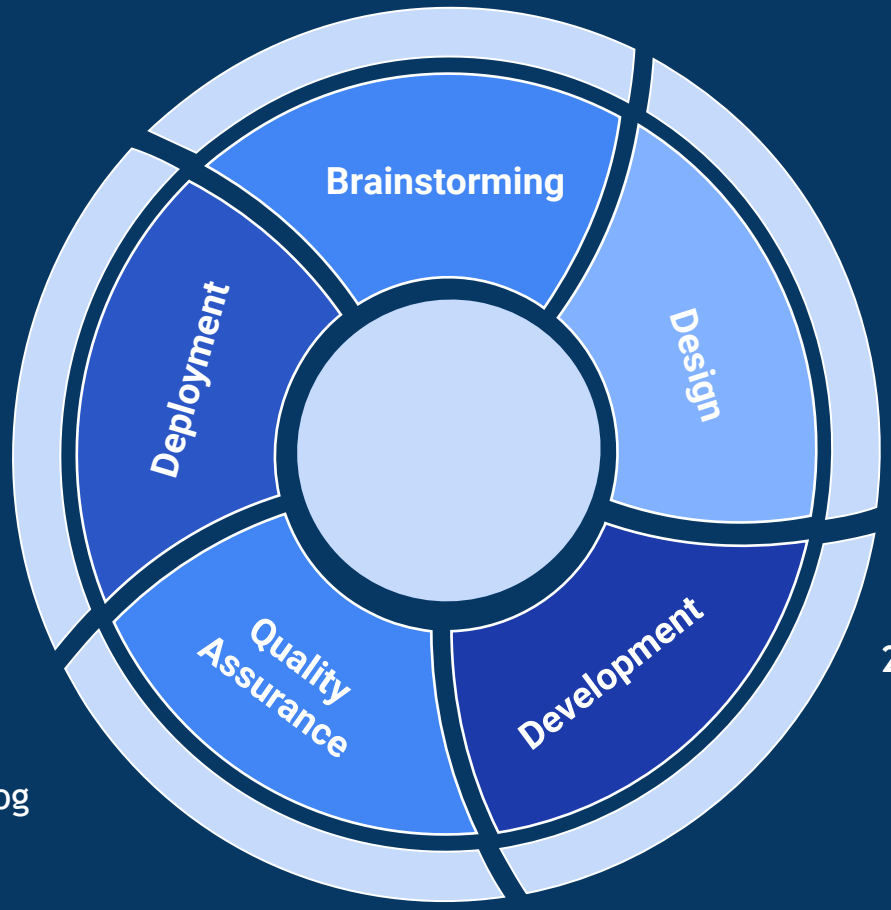
- Administrator - Access to administrative tools to add, edit, and delete garages, floors, and spaces

- User - Access to all other basic functionality

Development Model

1. Brainstorming
- Identify use cases
- Determine project feasibility
- The goal of ParkODU is to help students, faculty, and staff find parking easily
- Prioritize development tasks within scope - develop schedule to determine project estimation
- Establish and maintain plans that describe or reference the development activities and define responsibility for implementation
- Identify testing team

2. Design
- Develop initial vision - A mobile and web app that lays out what ParkODU will look like
- Develop user stories
- Develop prototype
- Obtain approval from the customer.

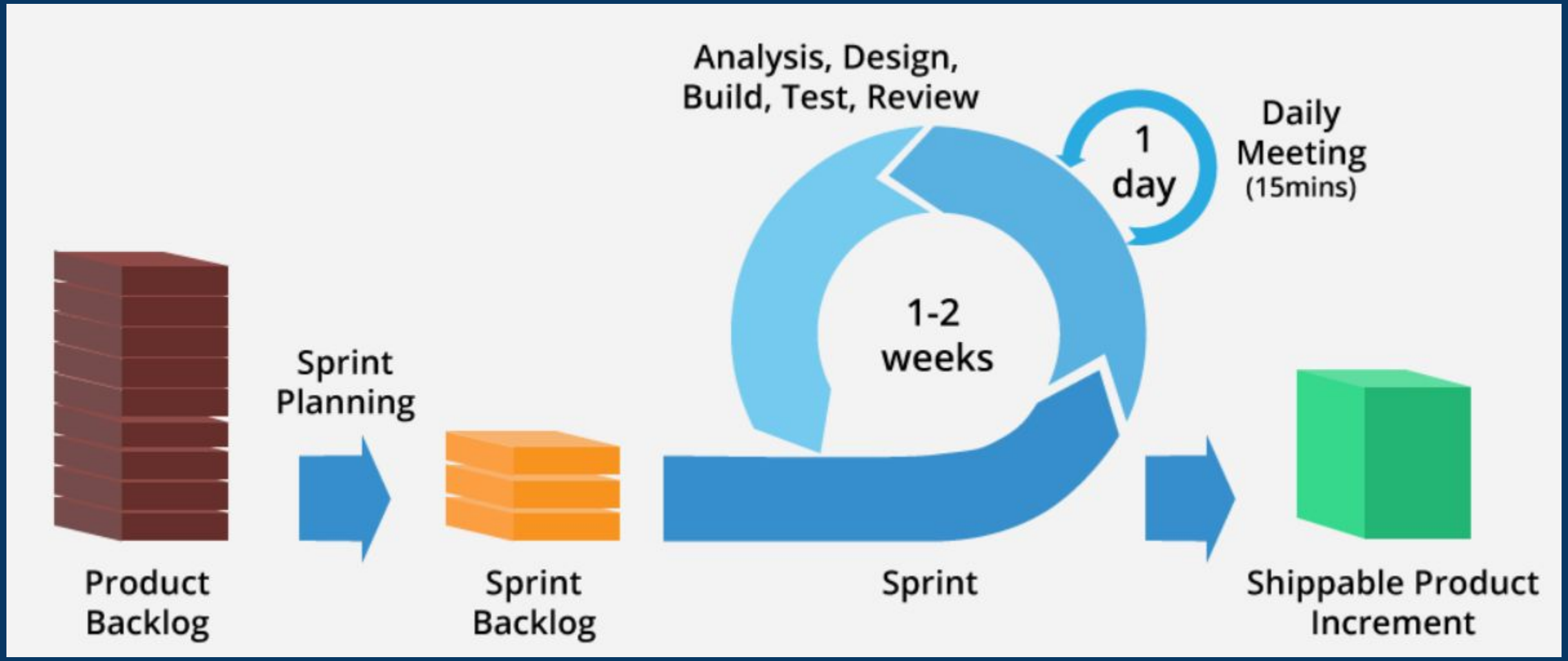


3. Development (Agile)
- Conduct sprint planning meeting
- Hold daily scrums (meetings)
- Implement user stories from sprint backlog
- Test software in increments (UI/UX and regression testing)
- Conduct sprint review meetings with stakeholders

4. Quality Assurance
- Generate reports to inspect and fix bugs
- Run all tests and clean up code

5. Deployment
- Final system testing
- Pilot the test release
- Deploy ParkODU into production
- Validate final software with customers
- Train end users and production staff
- Finalize documentation(maintenance/support)

Agile Software Development



F.4.

ParkODU

To summarize, the application will:

- Compute vacancies in each parking garage in real-time
- Analyze past parking data for future decisions
- Find parking nearest to the user’s building on campus
- Send notifications of available spaces to the user
- Inform user of campus events that will impact parking
- Provide navigation to the garage
- Suggest parking spaces according to their schedule

Conclusion

ParkODU offers a complete solution for selecting a parking spot at ODU.

Our application will resolve frustrations from not knowing what garages are available, the lack of signage for appropriate garages, and the limited parking during peak parking hours between 10:00AM to 2:00PM.

References

Dear Future ODU Students. (2017, August 28). Retrieved November 02, 2017, from https://www.theodysseyonline.com/dear-future-odu-students. (1)

The Problem at Hand - The Expansion of Parking At Old Dominion University. (n.d.). Retrieved November 02, 2017, from https://sites.google.com/a/odu.edu/the-expansion-of-parking-at-old-dominion-university/home/the-problem-at-hand. (2)

University Facts & Figures. Old Dominion University. Retrieved November 02, 2017, from https://www.odu.edu/about/facts-and-figures. Accessed November 1, 2017. (3)

Parking and Traffic Procedures. Old Dominion University. Retrieved November 02, 2017, from https://www.odu.edu/content/dam/odu/offices/parking-and-transportation-services/docs/parking-transportation-rules-and-regulations.pdf. (4)

Operating Budget and Plan. Old Dominion University. Retrieved November 02, 2017, from https://www.odu.edu/content/dam/odu/offices/budget-office/docs/opplan2017.pdf. (5)

How Much Does a Parking Garage Cost? Retrieved November 02, 2017, from http://www.parking.org/2016/01/19/tpp-2013-09-how-much-does-a-structure-cost/. (6)

References

Access Automation Car Park Count Systems. (n.d.). Retrieved October 10, 2017, from http://www.access-automation.co.uk/car-park-count-systems (7)

Burr, David W. “Is University Parking a Common Grievance?”. Parking Today Media. September 2011. http://www.parkingtoday.com/articledetails.php?id=1072. September 2017. (8)

Car counting solutions. (n.d.). Retrieved October 10, 2017, from http://www.puretechsystems.com/solutions-car-counting.html (9)

Solutions: vehicle counting. (n.d.). Retrieved October 10, 2017, from http://www.t2systems.com/solutions/vehicle-counting (10)

Vehicle counting & detection systems. (n.d.). Retrieved October 10, 2017, from https://www.swarco.com/stl/Products-Services/Parking-Solutions/Parking-guidance/Vehicle-counting-detection-systems (11)

Vehicle Counter. (2016, February 12). Retrieved October 10, 2017, from https://www.kiwisecurity.com/vehicle-counter/ (12)

References

F.1. Traffic Mess (2012, December 4). Retrieved October 23, 2017, from https://1funny.com/traffic-mess/

F.2. ODU 43rd Street Parking Garage. (n.d.). Retrieved October 23, 2017, from http://www.sbballard.com/portfolio/odu-43rd-street-parking-garage/

F.3. Providence Place mall enhances parking garage with $20M in improvements (2016, December 15). Retrieved October 30, 2017, from https://pbn.com/providence-place-mall-enhances-parking-garage-adds-more-pay-stations-improves-signage119194/

F.4. Agile [Digital image]. (2017, May 8). Retrieved November 29, 2017, from https://www.codingmart.com/uploads/post/image/57e0c0488ca7853c76dd986e/Agile_Development_Process.png

Glossary

Administrator - a special user with access to additional tools for user account and space management
Agile - a methodology that anticipates the need for flexibility and applies a level of pragmatism into the delivery of the finished product
Best Garage - the closest garage to the destination building with the specified minimum number of available spaces
Driver - anyone who drives and parks at ODU
Driver Entry Rate - the number of vehicles entering the garage each minute
Driver Exit Rate - the number of vehicles exiting the garage each minute
Event - an occasion which affects garage and/or space availability
Garage Rate - Driver Entry Rate - Driver Exit Rate (a positive number denotes that the garage is filling up)
Operating Hours - 7:00AM - 10:00PM
Permit - a physical decal that specifies in which spaces the vehicle is allowed to park
Predictions - a guess based on current and historical data about garage space availability
Real-time - current time
Reconfigurable - software-based creation, deletion, or editing of spaces, floors, and garages
Rush Hours - 7:45AM - 9:00AM, 12:00PM - 1:00PM, 3:00PM - 4:30PM
Sensor - any device which indicates to the software whether a space is occupied or not
Signage - signs that indicate the number of available spaces
Statistical Analysis - the ability to use sample data to form predictions
User - an entity using Park ODU
Vehicle Detection Technology - any device which indicates to the software that a vehicle has entered a specified area

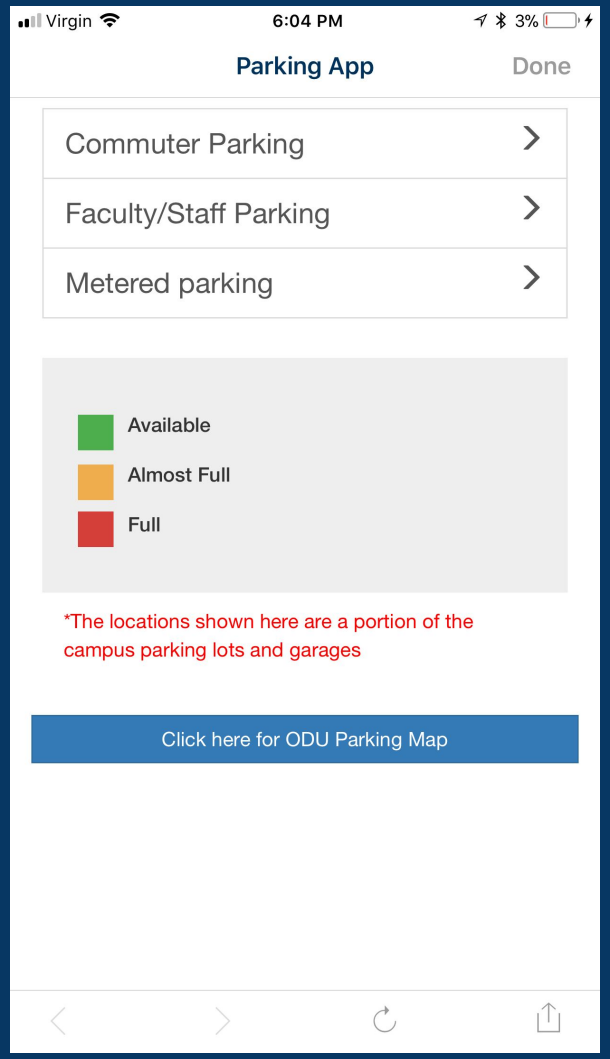
User Stories

- As a driver, I want to be able to see parking conditions.
- As a driver, I want to be able to find a parking spot by looking at the app.
- As a driver, I want to be able to import my class schedule.
- As a driver, I want to be able to see occupancy signage while on campus.
- As a driver, I want to be able to receive notifications for any events affecting parking.
- As a driver, I want to be able to use built-in navigation to get to my destination garage.
- As a driver, I want to be able to save my user preferences.
- As a driver, I want to be recommended the closest parking garage based on building destination.
- As a driver, I want to be able to see all the parking garages status regardless of recommended ones.

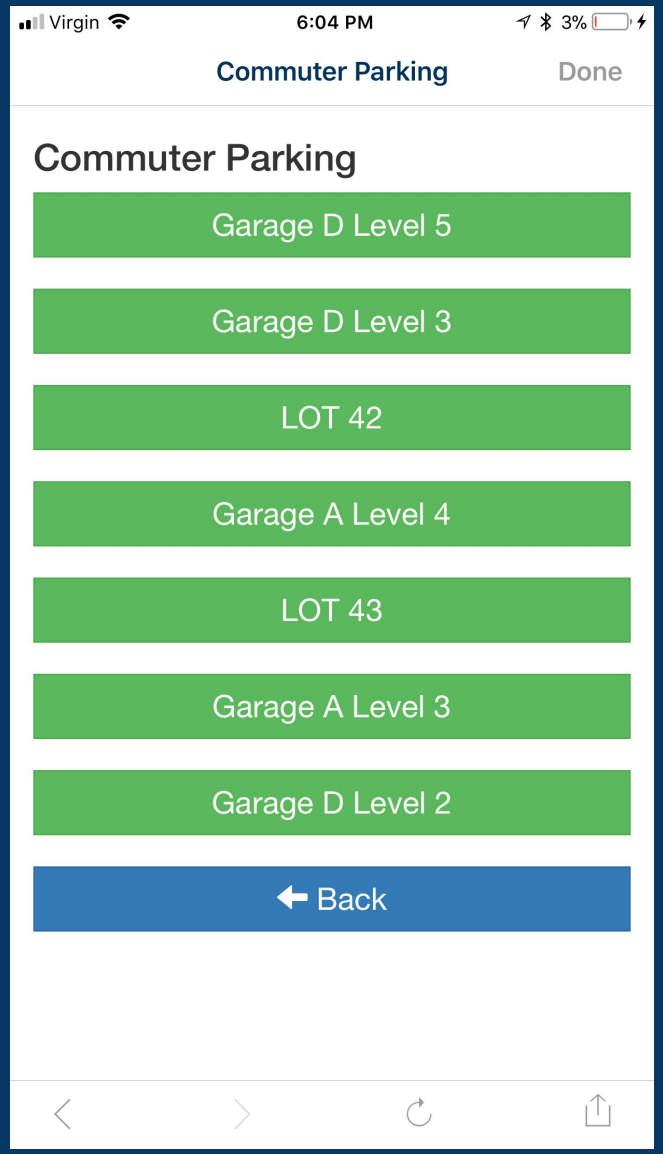
User Stories

- As an administrator, I want to be able to review past parking conditions for a particular parking garage.
- As an administrator, I want to be able to review current parking conditions for a particular parking garage.
- As an administrator, I want to be able to add event notifications.
- As an administrator, I want to be able to edit event notifications.
- As an administrator, I want to be able to remove event notifications.
- As an administrator, I want to be able to add other administrative accounts.
- As an administrator, I want to be able to edit other administrative accounts.
- As an administrator, I want to be able to remove other administrative accounts.
- As an administrator, I want to be able to add a Garage.
- As an administrator, I want to be able to edit a Garage.
- As an administrator, I want to be able to delete a Garage.
- As an administrator, I want to be able to add a Floor.
- As an administrator, I want to be able to edit a Floor.
- As an administrator, I want to be able to delete a Floor.
- As an administrator, I want to be able to add a Parking Space.
- As an administrator, I want to be able to edit a Parking Space.
- As an administrator, I want to be able to remove a Parking Space.

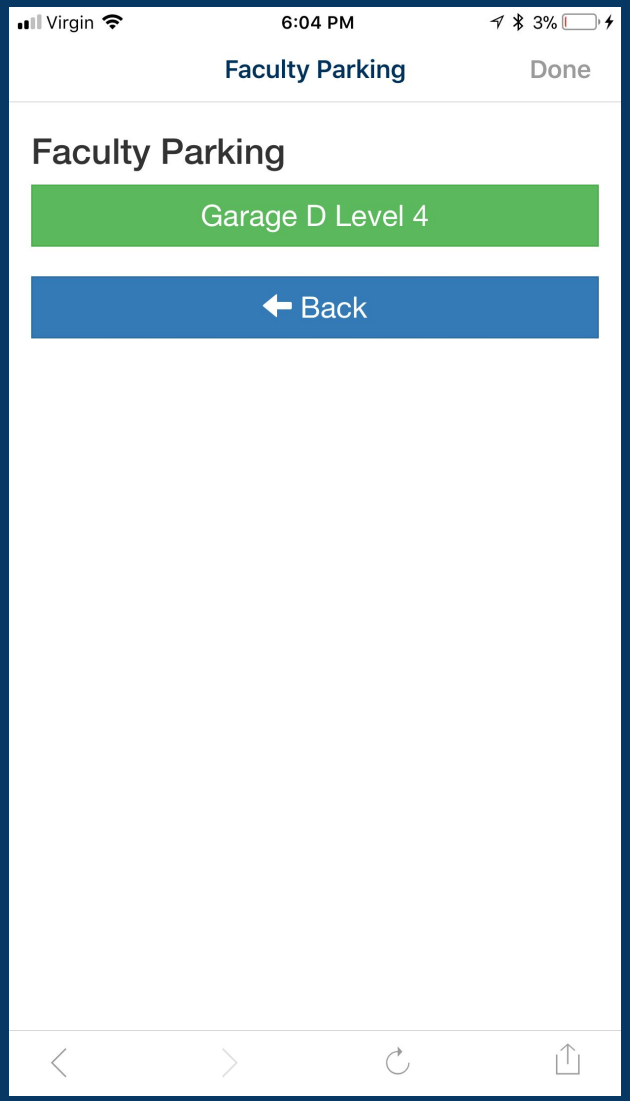
Appendix A: ODU Parking App - Main Page



Appendix B: ODU Parking App - Commuter Parking



Appendix C: ODU Parking App - Faculty Parking



Appendix D: ODU Parking App - Metered Parking