

PARK-NYC: APPLICATION UPGRADE

Deliverable 3 – Design Phase

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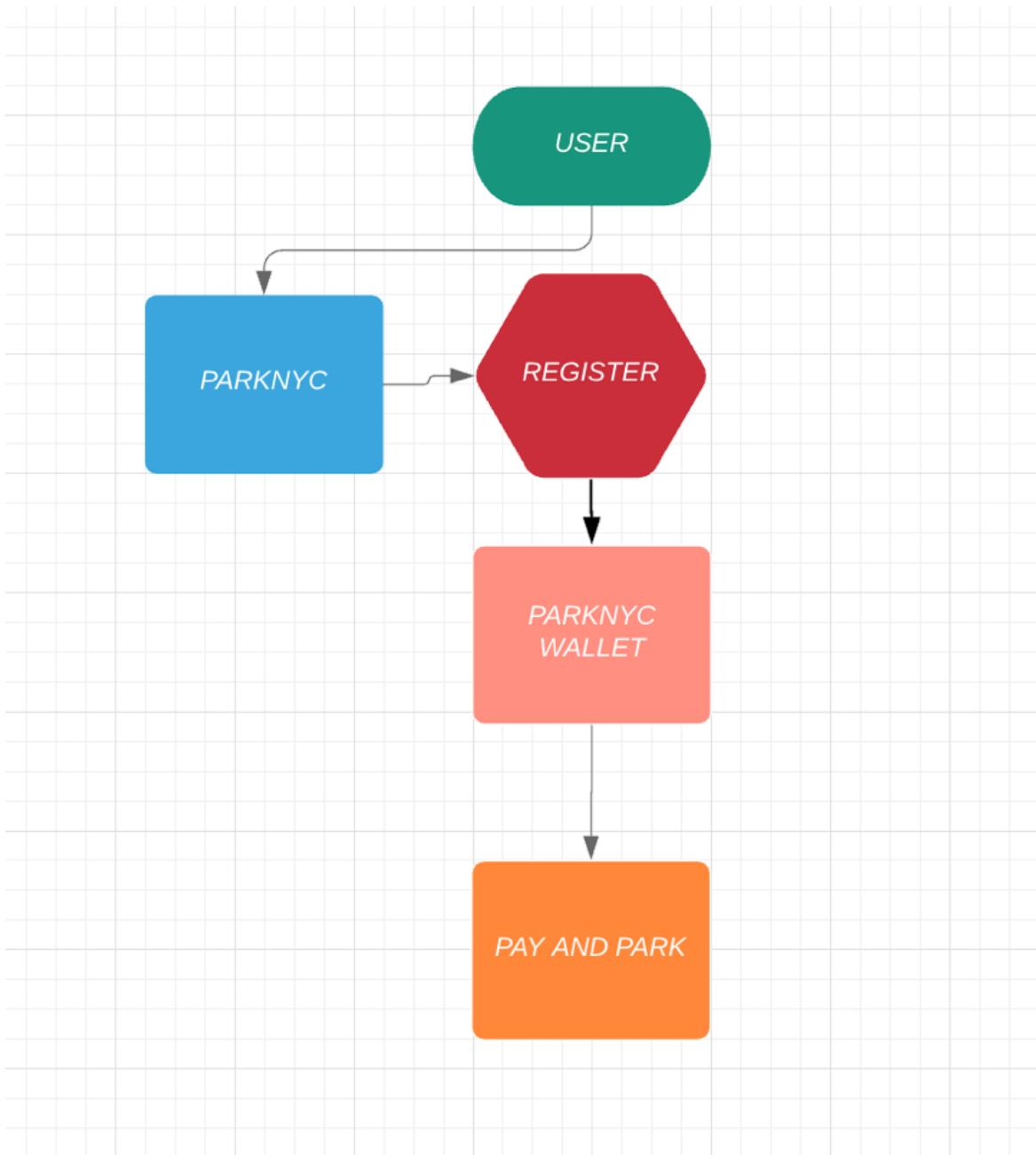
INTRODUCTION

- What is ParkNYC:

ParkNYC is an easy and convenient way to pay for on-street parking and municipal parking lots using a mobile phone or web browser. ParkNYC is governed by Department of Transportation, New York City. Using the ParkNYC app and website the users can pay for parking without using meters. Users don't have to carry coins or credit cards to pay for parking. By using the app, the need of placing the receipt on the dashboard of the car is eliminated. Users receive mobile alerts prior to time expiring for the parking. The application also provides the convenience of extending the parking time remotely. Users can also track their parking sessions and activities by using the app. This service manages to keep the park and pay experience convenient and hassle free for the users.

- How ParkNYC Works:

To use the app, the users have to first register their account on website <https://parknyc.parkmobile.us> or ParkNYC app. The app is available on the Appstore and Google Playstore. People using blackberry or windows devices can register and use the ParkNYC features via the website. After registering users can add up to 5 license plates for pay and park. To pay and park, user have to put the zone number and the app will show corresponding charges to park the vehicle in that zone. After this, the user has to select a license plate and amount of time they want the parking for. Then, the app shows total parking charge for the session and user can pay using saved debit and credit cards. The user can also extend the parking time prior to expiration by opening active sessions in the app and paying for the extra time. Users can also pay for parking by using ParkNYC wallet which can be used to preload money upto 150\$. Users can also raise a compliant or refund request in parking sessions of the app if they have any trouble with their parking session. The app also provides help and support tab which can be accessed by user if they need any help or need to connect with authorities from ParkNYC. The system workflow is shown in the figure below 1.



ParkNYC System Workflow.

FUCNTIONALITY

- OLD SYSTEM:

- Pay for parking using phone without having to go to a meter through app or website.
- The old app has numerous bugs and it has not been updated from last 2 years. We are going to fix all those bugs.
- No need to carry coins or a credit card to pay for parking.
- No need to place a receipt on your dashboard or show proof for parking.
- Receive mobile notifications prior to parking time expiration.
- Extend the parking time remotely, up to the maximum time allowed by using the ParkNYC app or website.
- Track your parking activity and sessions in the app for monitoring purpose.

- NEW SYSTEM:

- Effectively find empty parking spots in New York by using ParkNYC.
- Reduce traffic congestion by minimalizing time taken by vehicle to find a parking spot.
- Estimate time and place for empty parking slots so the users can plan ahead of time, thereby reducing time to find a parking.
- Significantly reduce CO2 emissions by saving fuel as users do not have to drive more to find a parking spot.
- Integrate paying for parking, finding a parking spot and trip planner into a single application thereby eliminating redundancy of apps and provide a uniform experience to users.

System Request
Project Sponsor: ParkNYC
<p>Business need:</p> <ul style="list-style-type: none"> • This project strives to add new functionality to their existing ParkNYC users to allow efficient and faster parking solutions using the ParkNYC mobile application. • Upgrade the existing system with add-on functionality to have GUI with map locator which would facilitate their users to locate the nearest parking space based on their location in the city. • Shorten the time taken to find the parking space, the less emission of carbon dioxide, So, this system would be environment friendly. • Securely store the data of parked vehicles. • Ability to generate detailed usage reports based on parking trends in different zones to adjust parking rates.
<p>Business Requirements:</p> <ul style="list-style-type: none"> • Develop a new user-friendly interactive map to search available parking spaces. • Upgrade the existing database to store the additional information required to interactive maps by using Google API and report generation. • Develop internal web application to generate report for parking trends in different zones. • Use of image processing to identify the free parking spots available.
<p>Business value:</p> <ul style="list-style-type: none"> • ParkNYC would be the first company in NYC who has come up with this functionality. This would attract lot of customers as we are adding new features and revamping the system for their ease. • Intangible value - We expect that improved service should increase customer's satisfaction and should result in to improve brand recognition. • Tangible value – We estimate that – percent of monthly growth due to its internet presence.
<p>Special issues or constraints</p> <ul style="list-style-type: none"> • Issues pertaining to get an approval from Department of Transport for the new system.

Feasibility Assessment

- ***Technical Feasibility:***

- **Application Familiarity:**

The ParkNYC app is already a very popular app amongst New Yorkers. So, there would not be a huge learning curve for user to get acquainted with the additional features we add into the existing system. Hence, adding extra features into the app would not result into polarization of user into using meters for parking. Only an additional tab would be added to navigation bar at the bottom of the app without changing the existing UI of the app. This will facilitate us to provide uniform UI across the whole app, without hindering the familiarity of the app for the user.

This will provide us with significant boost as we don't have to promote our app or have to make new tutorials for the user to learn the app from the scratch. Adding features into existing system without changing the UI of the app gives us significant advantage over private parking competitors who don't have an existing system. The already existing userbase will also help our app by easing the process of familiarity and added features. Due to above reasons, we won't have any problem adding features into the app and familiarize users with it.

- **Technological Familiarity:**

Most of the users are acquainted with how our parking app works. We are going to add a feature which will show map of empty parking spots and will direct users to the spot using navigation. This added functionality won't be an issue as the user having a smartphone is already familiar with how to use navigation maps due to ubiquitous navigation systems like Google Maps, Waze and Apple maps.

- **Combability:**

The existing system and technology of the app won't be affected due addition of purposed functionality. The new features will be built on the technology, which is compatible with already existing technology, so it be easier for the system to update and integrate to the new addition of features. This will ensure that our transition into new system is hassle free and smooth.

- **Project Scope:**

The project should be first implemented on pilot basis in the Downtown Manhattan area which is one of the most densely populated area in terms of vehicle and parking. This will give us a huge scope of improvement when we implement this project in entire NYC. Also, doing this will ensure us that we do not take greater risk for such a complex and intricate project.

- ***Economic Feasibility:***

- **Development Costs:**

- The cost for website/app creation for admin report generation.
- Integration cost for map implementation.
- The cost for data integration will be high.
- The actual main cost would be of purchase of new equipment specially the cost of cameras.

- **Operating Costs:**

- The continuous cost of website operations and maintenance of website and ParkNYC application.
- The cost of database maintenance of application and of cameras.
- The cost of storing the huge data and recordings of camera.
- The cost of labor for maintenance of cameras.

- **Annual Benefit:**
 - An estimate of 10% (\$1,067,753) annual growth is expected in the business once the application and website upgraded with our new features.
- **Intangible Benefits:**
 - More use of our application as a map which bring more customers.
 - The satisfaction of customers will increase.
 - The quality satisfaction of customers will increase as it will save their time and money.
 - The brand value will increase.
 - Less traffic because of less people needing to drive for finding parking space.
 - When people will not drive extra to find parking space, it will save fuel which will be good for climate automatically.
- ***Organizational Feasibility:***
- **Strategic Alignment:**

The goal of ParkNYC is to ease the parking experience and make parking convenient for the users. The added feature of finding a parking spot via the ParkNYC app aligns with the goal of the organization. The added features will reduce the carbon emissions by vehicles and lead to fuel saving. It will also reduce the traffic congestion caused due to vehicles searching for parking spots. This aligns with the organization's goal of safe, efficient, and environmentally responsible movement of people and goods in the City of New York and to maintain and enhance the transportation infrastructure crucial to the economic vitality and quality of life of our primary customers, City residents.

- **Project Manager:**

The duty of the project manager is ensuring the project is on track and all deadlines are met. They have to make sure that project goes as planned and keep track of tasks assigned to fellow subordinates. They also have to ensure that all resources are used carefully utilized, give updates to their employees about project progress and make crucial decisions when an unwanted situation arises. They have to report to CTO of the DOT, NYC regarding all the project developments and updates.

- **Senior Management:**

The senior management ensures that enough funding is provided to the project and there is no hindrance to project work due to financial reasons. They also have to take regular updates from the project manager regarding project development and any issues related to it. They should assist the project manager by promoting the new system in the organization. They should also promote the new features of the new system to existing and potential users.

- **Stakeholders:**

In this system, ParkNYC users are the stakeholders. They are going to use the newly developed ParkNYC app & website features. They should provide feedback using the app and website to the organization. There will also be an option to report issues and bugs via app to the developers. They can also suggest and request features by using the ParkNYC app to the parent organization DOT.

Cost Benefit Analysis

Project Work Plan

Phase 1: Planning Phase:

This is the first process of SDLC and the objective is to upgrade the current system with additional features. With these inputs, system request was developed which explains the business need and requirements. After the system request finalized, we conducted the feasibility study. So, the overall project planning steps we covered are project initiation, system request, feasibility study, project work plan and risk assessment. This is shown in fig 2

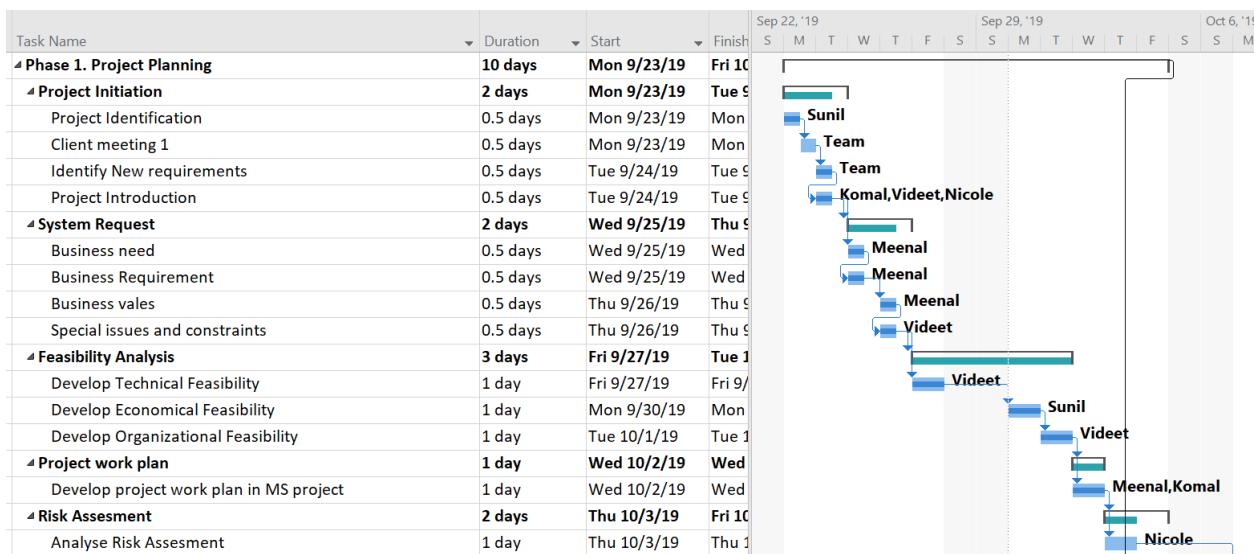


Figure 2

Phase 2: Project Analysis

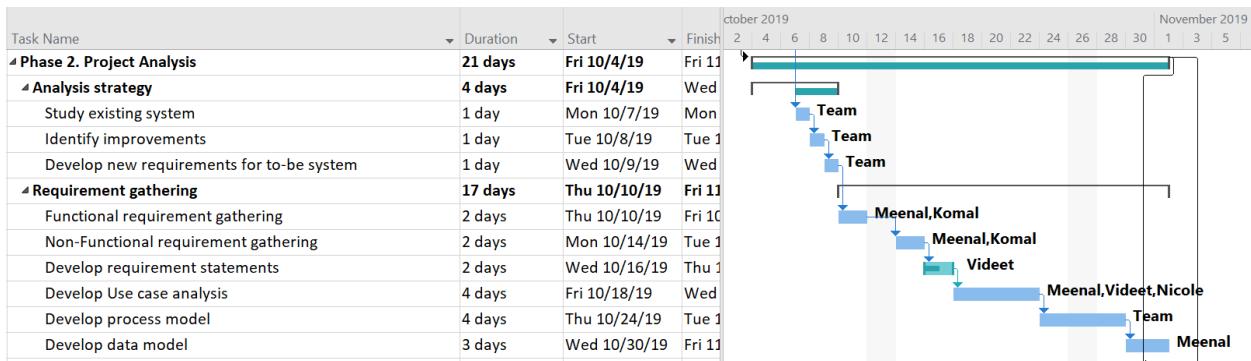


Figure 3

Phase 3: Project Design and Development

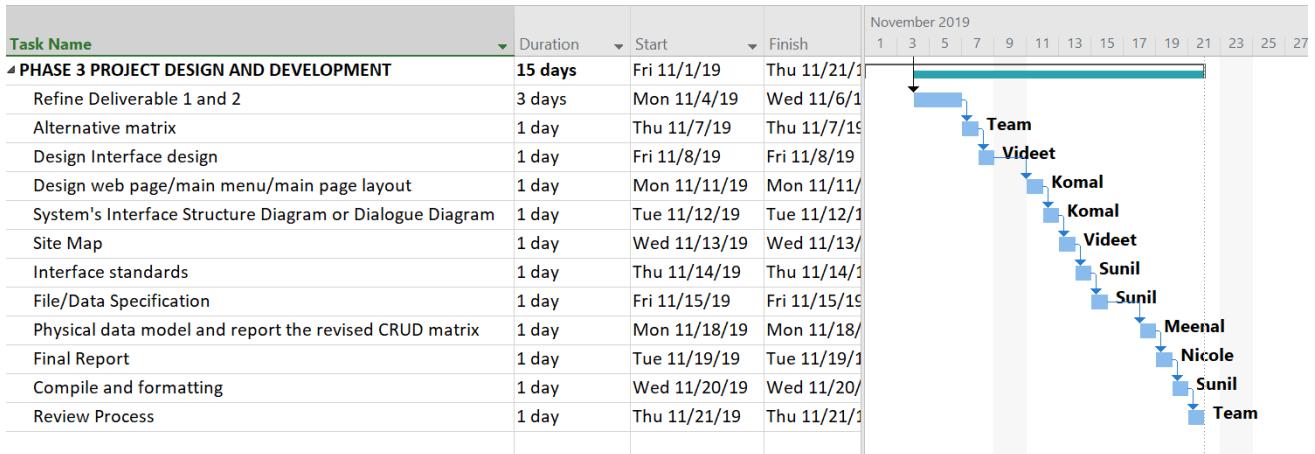


Figure 4

Risk Assessment

Risk 1:

The implementation of cameras may be susceptible to external damage. This can be due to property damage from extreme weather-like conditions and even vandalism.

- Likelihood of Risk:
 - High probability of risk
- Potential Impact:
 - Once cameras are installed routine maintenance will be required to keep the application running in all zones at all time to detect parking. For that reason, the ongoing cost of the cameras might impact the project.
- Ways to Address This Risk:
 - Investing in durable cameras that can withstand extreme weather-like forces. Also positioning on the camera on the light post so that it is not as visible for vandalism to occur.

Risk 2:

As stated in the technical feasibility portion, most user's will be well acquainted with the new and improved ParkNYC application; however, if not promoted in the right manner, ParkNYC might risk having less users use its application due to them not knowing about the update.

- Likelihood of Risk:

- High probability of risk
- Potential Impact:
 - Less users using the new feature implemented in the ParkNYC application would be a waste of capital to make the lives of New Yorker's much easier.
- Ways to Address This Risk:
 - Investing in a marketing campaign for the ParkNYC application with the additional features should be promoted throughout subway stations, trains, and social media.

Risk 3:

Though ParkNYC is owned by the Department of Transportation, it is powered by Park Mobile. Park Mobile is a business in which Park Mobile utilizes their unique software application and has implemented it within the ParkNYC application. Nevertheless, adding features like the sensory cameras would put the DOT at risk due to privacy issues. The risk of outsourcing such an application would provide a security issue to the Department of Transportation.

- Likelihood of Risk:
 - High probability of risk
- Potential Impact on The Project:
 - This risk is going to be hard to avoid being that individuals can act on their own will rather than follow disclosures in a contract.
- Ways to Address This Risk:

- Nevertheless, the DOT must be very transparent in the renewal of their ParkNYC contract with Park Mobile. With these additional features, the DOT must maintain strict guidelines that protect the privacy and security of New Yorkers.

Functional Requirements

1. *User Registration*

- 1.1. The system will allow user to create a username and password
- 1.2. The system will allow user to enter their card information
- 1.3. The system will allow vendor to input account information like email, contact number, address, and car license Number.
- 1.4. The system will allow user to edit any account information

2. *Search Parking Spot*

- 2.1 The system will allow user to search parking spaces.
- 2.2 The system will display current available parking space.
- 2.3 The system will notify distance in miles.

3. *Heatmap Information*

- 3.1 System will allow user to view heatmap i.e. color coded information for most trafficked parking areas.

4. *Feedback Functionality*

- 4.1 System will allow user to share their experience.
- 4.2 System will allow user to rate the application.

Non-Functional requirements

1. *Operation*

- 1.1. The system will run on Android, iOS devices
- 1.2. The system should be able to integrate with the existing Park NYC application system.
- 1.3. The system should be compatible with all browsers.

2. *Performance*

- 2.1. The interaction between the user and the system should not exceed 3 sec.
- 2.2. The system should be available 24 hours a day, 365 days a year.
- 2.3. The system supports thousands of users simultaneously.

3. *Security*

- 3.1. The system should keep each users' information protected.
- 3.2. The system should be able to prevent hacks of customer credit card information.
- 3. The system should be able to recover all information after any viruses or attacks.

4. *Cultural*

- 4.1. The system will match the language used on phone settings.

Use Case Analysis

Use Case 1: Search for Available Parking

Use Case Name: Search for Available Parking	ID: UC001	Priority: High
Brief Description: User needs to search for empty parking spot. The system displays nearest vacant parking spots based on user's current location.		
Actor: User		
Trigger: User needs to search parking lot.		
Type <input type="checkbox"/> External <input type="checkbox"/> Temporal		
Preconditions: <ul style="list-style-type: none"> 1. User's login is successful 2. User's card is authenticated. 3. User needs to connect internet. 		
Normal Course <ul style="list-style-type: none"> 1. User enters a landmark keyword to search available parking spaces. <ul style="list-style-type: none"> 1.1 System displays current available parking spaces available 1.2 System notifies distance in miles for available parking spaces. 2. User selects prospective parking spaces. 3. System stores recent search history in database. 	Information for Steps <ul style="list-style-type: none"> <input type="checkbox"/> Enter landmark <input type="checkbox"/> Current parking spot availability information <input type="checkbox"/> Distance information <input type="checkbox"/> Enter parking space information <input type="checkbox"/> Updates search history 	
Alternative Course(s): <ul style="list-style-type: none"> 1.1 Traffic flow in the desired location is too high and the parking spaces fill rapidly. (step 1.1) 	<ul style="list-style-type: none"> <input type="checkbox"/> Suggest different locations 	

<p>1) The system asks the user if he wants to continue search with the same location or change the desired location or to exit.</p> <p>2a) The user continues search with the same location.</p> <p>4a) The system continues to display the current parking spaces availability in desired location.</p> <p>3b) The user changes the desired location.</p> <p>4b) The system starts normal course again.</p>	<input type="checkbox"/> Current parking space information <input type="checkbox"/> Change desired location																								
Postconditions: <ol style="list-style-type: none"> ParkNYC account shows available parking spots located on map as per the search criteria. 																									
Exceptions : E1. If user does not have internet connection. <ol style="list-style-type: none"> The system displays an error message “No internet connection”. The system terminates the use case. 																									
Summary: <table border="1"> <thead> <tr> <th>Inputs</th> <th>Source</th> <th>Outputs</th> <th>Destination</th> </tr> </thead> <tbody> <tr> <td>Enter landmark</td><td>User</td><td>Current parking spot availability</td><td>User</td></tr> <tr> <td>Enter parking space information</td><td>User</td><td>information Distance information</td><td>User</td></tr> <tr> <td>Change desired location</td><td>User</td><td>Updates search history</td><td>User’s database</td></tr> <tr> <td></td><td></td><td>Suggest different locations</td><td>User</td></tr> <tr> <td></td><td></td><td>Current parking space information</td><td>User</td></tr> </tbody> </table>		Inputs	Source	Outputs	Destination	Enter landmark	User	Current parking spot availability	User	Enter parking space information	User	information Distance information	User	Change desired location	User	Updates search history	User’s database			Suggest different locations	User			Current parking space information	User
Inputs	Source	Outputs	Destination																						
Enter landmark	User	Current parking spot availability	User																						
Enter parking space information	User	information Distance information	User																						
Change desired location	User	Updates search history	User’s database																						
		Suggest different locations	User																						
		Current parking space information	User																						

Use Case 2: Refill Account Balance

Use Case – Fully Dressed Format

Use Case Name: Refill Account Balance	ID: UC002	Priority: High
Brief Description: User needs to upload money from their debit/ credit card to their ParkNYC account in order to be able to pay for parking.		
Actor: User		
Trigger: User needs to upload funds to their ParkNYC account in order to pay for parking.		
Type <input checked="" type="checkbox"/> External <input type="checkbox"/> Temporal		
Preconditions: 1) User's login is successful 2) User's card on file is authenticated 3) Credit/ debit card funds sufficient over minimum \$25 upload 4) User downloaded application 5) User must have access to WiFi or active cellular network services.		
Normal Course	Information for Steps 1. User requests current balance 1.1 Systems displays current balance 2. User requests to add funds to ParkNYC Wallet 2.1 User is prompted to add between \$25 and \$150 to ParkNYC Wallet 3. User inputs specified amount to be added 4. User selects prospective card 4.1 System adds funds to user's ParkNYC Wallet 4.2 System validates user card information 4.3 System stores transaction history in datastore	
	çCurrent Balance Request èCurrent Balance Status çReload Request èPossible Amount Options çSelect Amount çSelect Card èFunds Update èCard Validation èPayment Processing	

<p>Alternative Course(s):</p> <p>1.1 User card on file expired</p> <ol style="list-style-type: none"> 1. Systems notifies customer card on file needs to be updated. 2. User inputs card information. 3. System interacts with banking institution system to verify user information. <ol style="list-style-type: none"> 3.1 User identity verified 4. System interacts with card validator system to authenticate card and user information. <ol style="list-style-type: none"> 4.1 System displays error message: Card unable to be validated 4.2 System displays error message: Incorrect CVC input by user 4.3 System prompts user to re-enter information 5. User inputs CVC (second time) <ol style="list-style-type: none"> 5.1 System notifies user of incorrect CVC input 5.2 System blocks card and refers user to their banking institution 5.3 System prompts user to use a different card 	<p><input type="checkbox"/>User Alert Message</p> <p>çCard Information</p> <p>èUser Validation Status</p> <p>èCard Validation Status</p> <p>èUser Error Alert Message</p> <p>èUser Error Alert Message</p> <p>èCard Information</p> <p>çUser Error Alert Message</p> <p>èCard Blocking Activated</p> <p>èAlternative Payment Method</p>
<p>Postconditions:</p> <ol style="list-style-type: none"> 1. Funds are added to user's ParkNYC Wallet. 2. System stores transaction. 3. Card Information is stored in system. 4. Card is blocked. 	

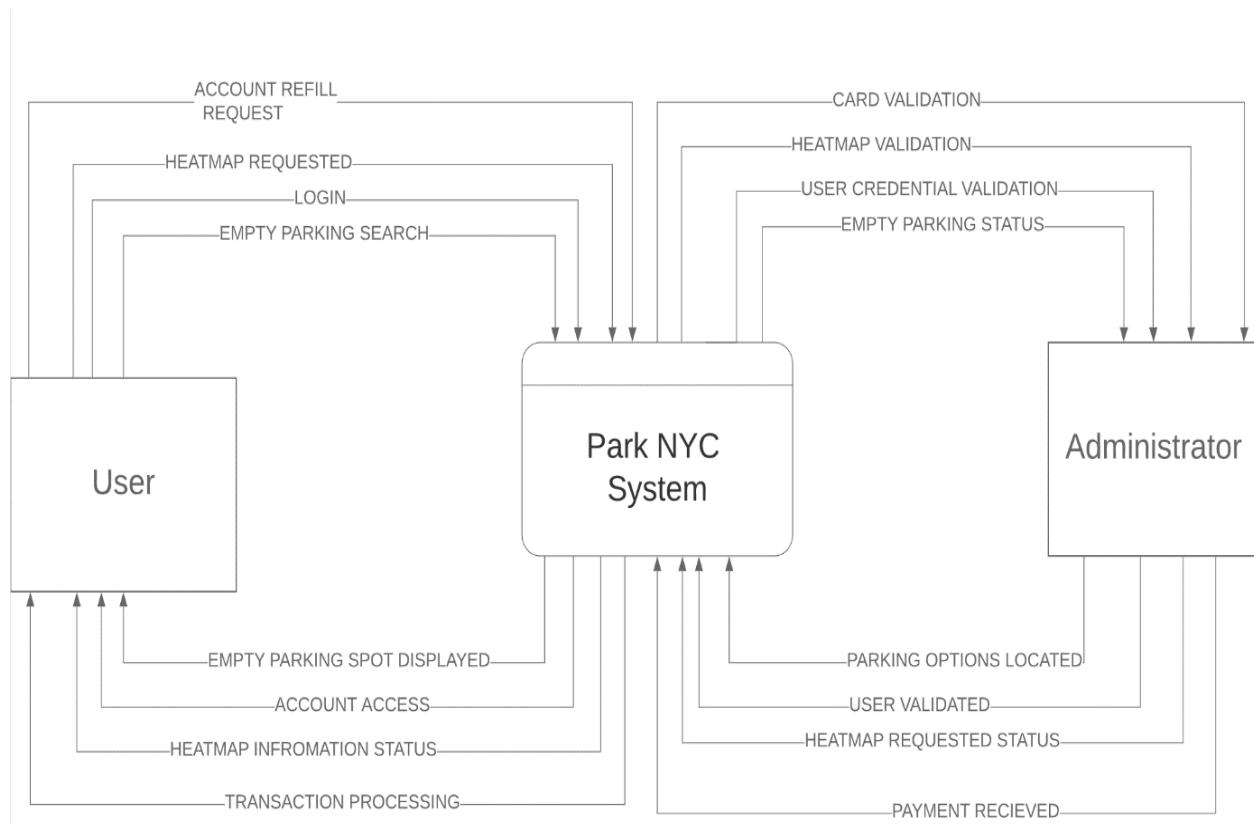
Exceptions:			
E1: User's card balance does not fulfill the \$25 minimum requirement			
Inputs	Source	Outputs	
Source			
Current Balance Request	User	Current Balance Status	ParkNYC System
Funds Reload Request	User	Possible Amount Options	ParkNYC System
Card Information	User	Card Validation	Payment
Card Selection	User	Status	
		Current Balance Adjustment	ParkNYC System
		User Alert Message	Payment
		User Error Alert Message	Payment
		Card Blocking	Payment
		Activated	Payment
		Information Stored	Payment
		Alternative Payment	Payment

Use Case 3: Viewing Parking Zone Heatmap

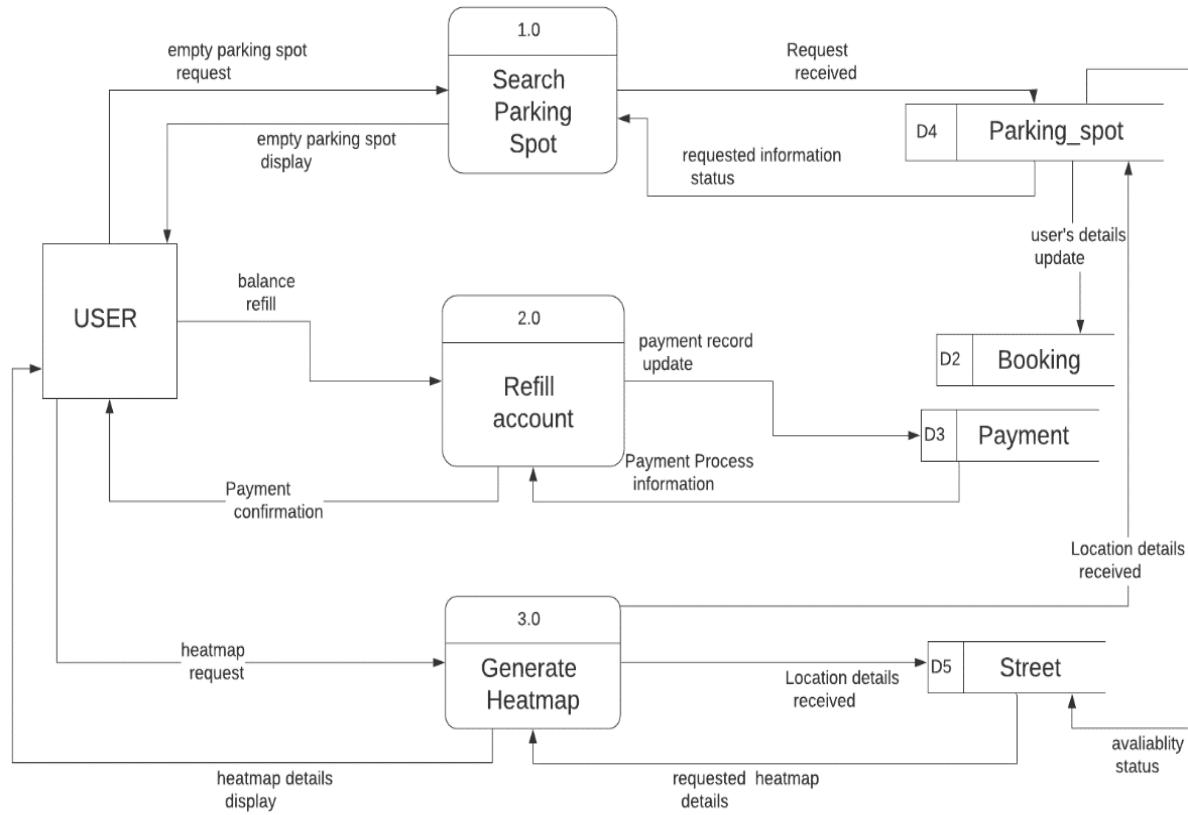
Use Case Name: View Parking Zone Heatmap	ID: UC003	Priority: Medium
Brief Description: User needs a view of Heatmap to have a general overview of crowded parking zones.		
Actor: User		
Trigger: User requests view heatmap in the ParkNYC application.		
Type <input type="checkbox"/> External <input type="checkbox"/> Temporal		
Preconditions:		
<ol style="list-style-type: none"> 1. User's login is successful 2. User's card is authenticated. 3. User needs to connect internet. 		
Normal Course <ol style="list-style-type: none"> 1. User requests to view the heatmap which has color-coded functionality highlights the most trafficked parking areas. 2. Park NYC processes the request and provides the live update of the heatmap to the user 		Information for Steps <input type="checkbox"/> Requests to view heatmap <input type="checkbox"/> Display the heatmap information.
Postconditions: The user gets a live feed of the Parking zone Heatmap.		
Exceptions:		
E1. If user does not have internet connection. <ol style="list-style-type: none"> 1. The system displays an error message "No internet connection". E2. ParkNYC server is down. <ol style="list-style-type: none"> 1. User gets notified about system outage and an error message regarding the same is displayed on the app screen. 		

Summary:

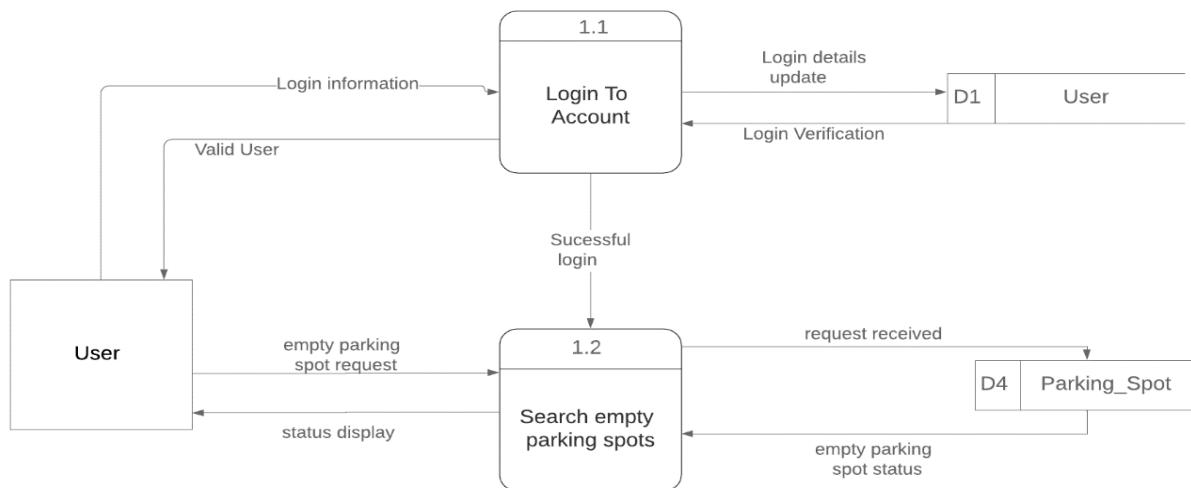
Inputs	Source	Outputs	Destination
Requests to view heatmap	User	Display the heatmap information	Street database

Data Flow Diagrams (DFD)**Context Level DFD:**

Level 0 DFD:

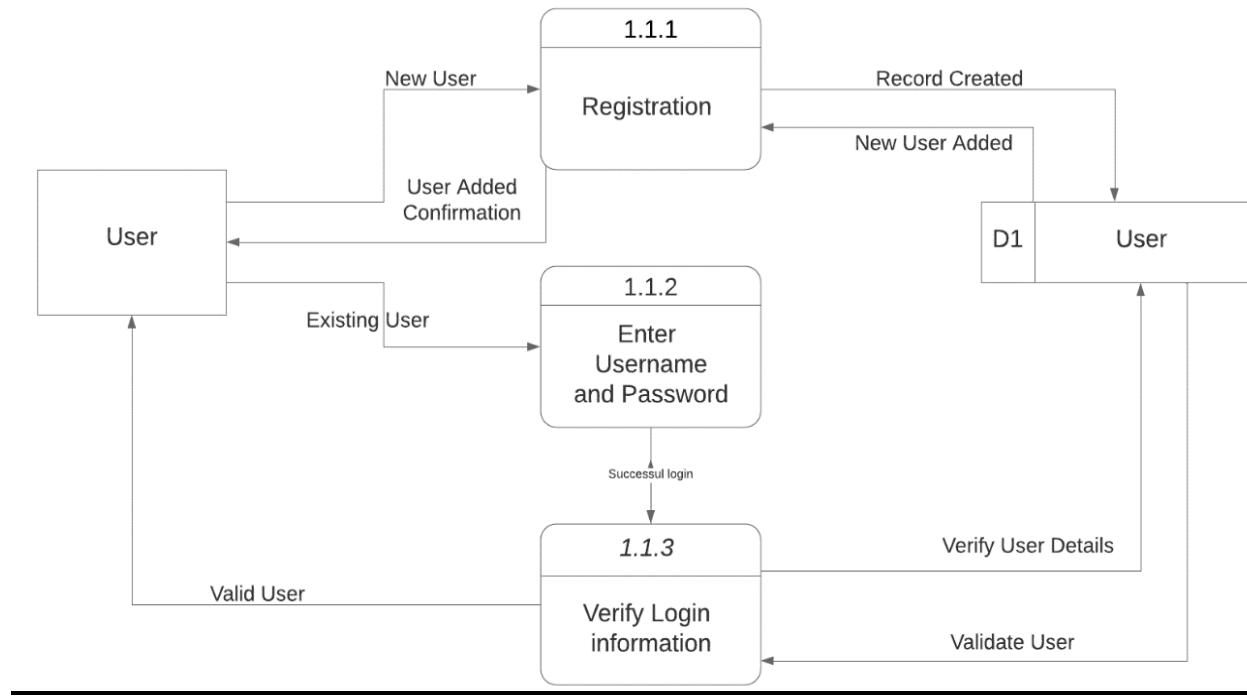


Search for Available Parking Use Case DFD Level 1:

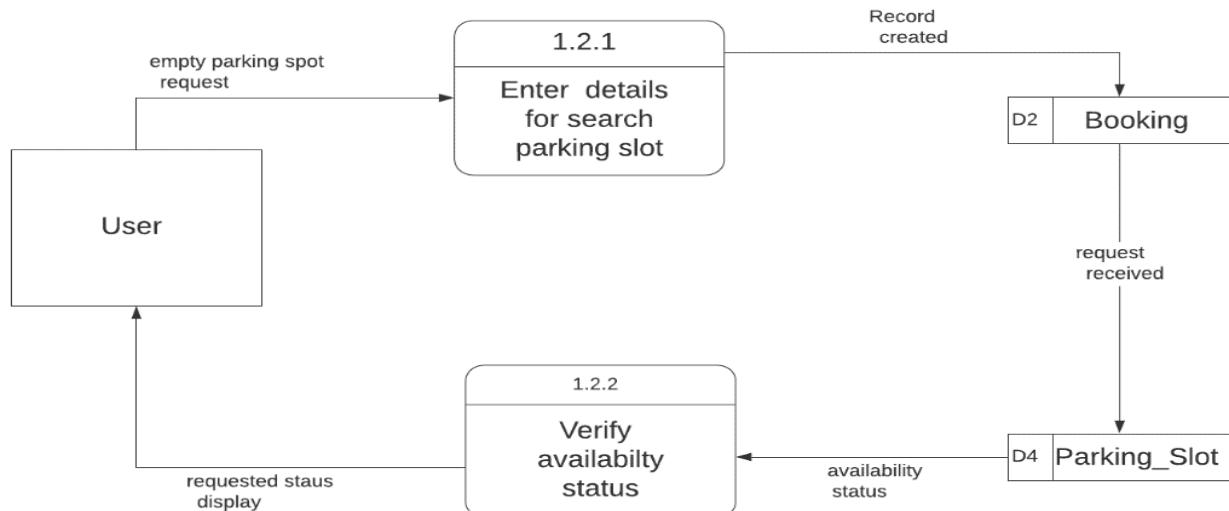


Use Case 1 DFD Level 2

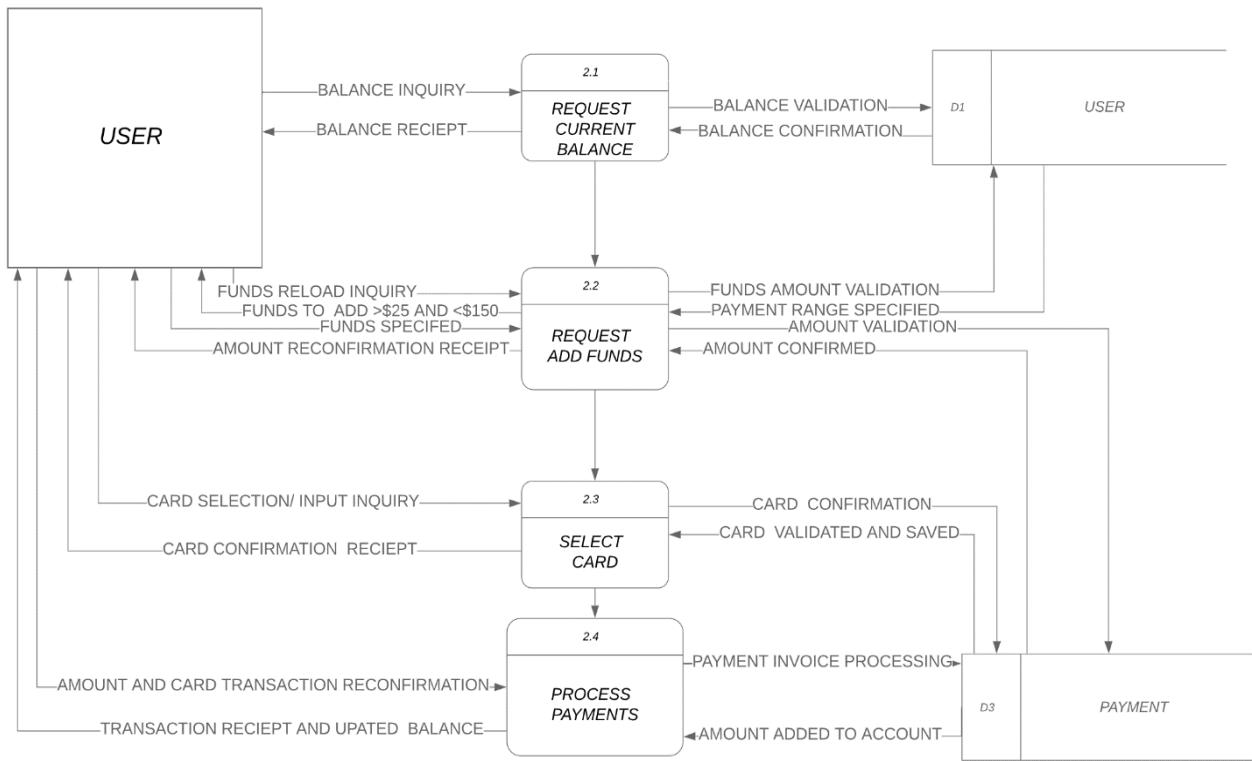
Login validation



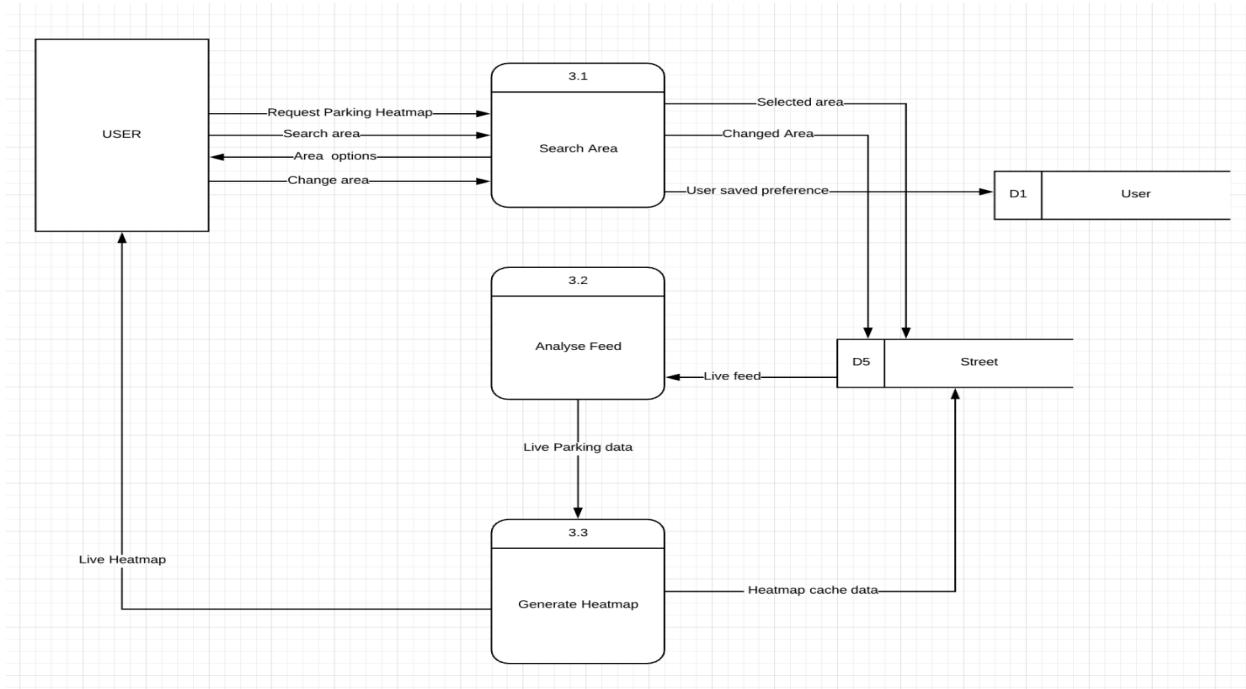
Search Parking Information:



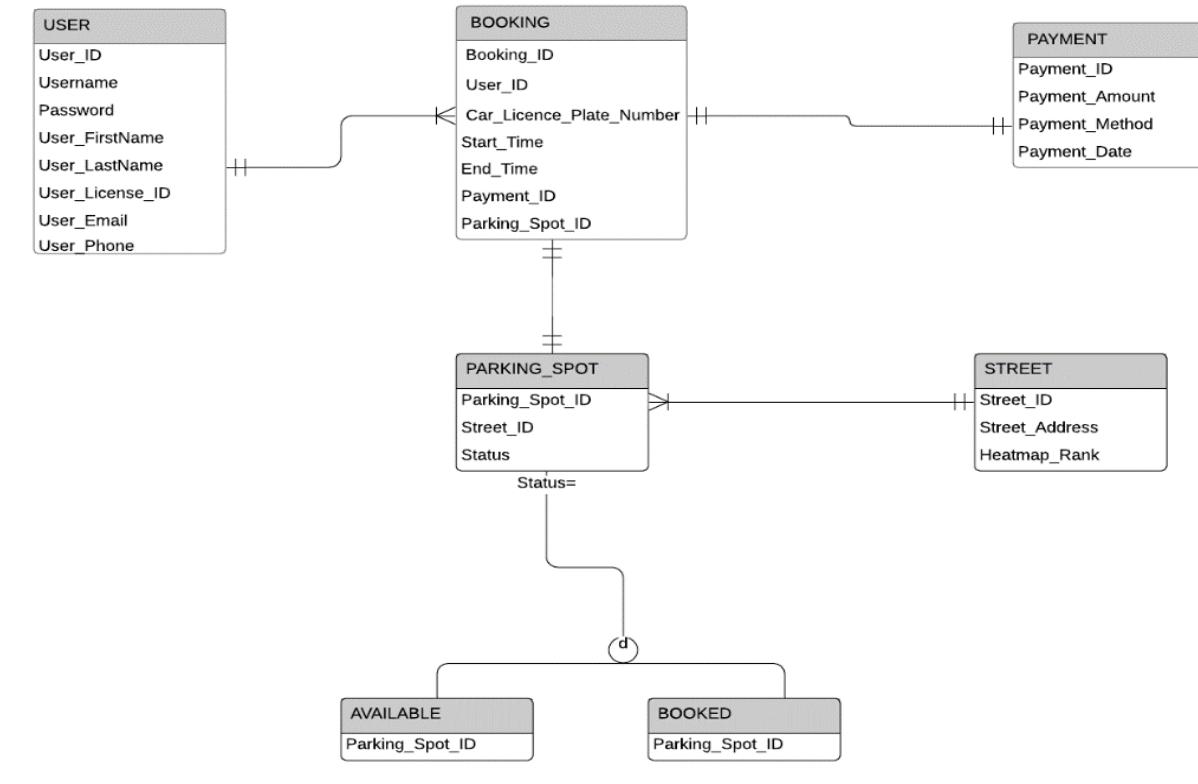
Use case 2 DFD Level 1:



Use Case 3 DFD Level 1:



Entity Relationship Diagram



Interviews

Interview Questions

Open ended

- What are the critical objectives in the existing application?
 - As-is system
 - Be able to provide NYC citizens an easy way to pay for public parking through a mobile application in a reliable and less inconvenient manner. The goal is to improve user experience and allow used to park in the city more efficiently.
 - To save time when looking for parking and therefore improving the parking situation.
 - To encourage citizens to use a mobile app instead of physically paying for their parking. This would eventually reduce the existence of physical barriers in the streets of New York City.
 - To give users a map interface to aid users in finding specific zones for public parking and to track their vehicles and the zones where they parked

- Describe the monitoring process that is available in an existing project.
 - Monitoring processes during the planning phase such as quarterly updating timelines and dividing the project into feasible phases that can be delivered as per the business requirements.
 - Making sure the team produces detailed documentation of the requirements for each phase without going out of scope. Making sure that the development team is involved to size the effort of each phase at the functional level.
 - Overseeing resource allocation and making sure enough tasks are allocated to meet the timeline
 - Meeting with stakeholders on a weekly basis and making sure they are fully involved in the development process and critical decision making.
 - Making sure that all tasks are measured from the requirements to the maintenance phase.

- What are the biggest frustrations you've experienced during the integration?
 - During integration some of the main frustrations are mapping issues, performance, efficiency issues, legacy data, security, and keeping up with the latest technology.
- Do you have any innovative strategies which you would like to employ to attract new customers?
 - Attracting more users to use the application by reducing the amount of private information (car model, credit card, phone number, email, ect.) requested to start using the parking services.
 - Improving the user experience by making the application more user friendly, and allowing the user to navigate through the application in a more flexible manner
 - Upgrading and improving the map interface so that less tech savvy users are not intimidated by the application. Making the map easier to visualize with less iconic clutter and more accurate geography.
 - Improving the responsiveness of the application in throughout all devices of sizes.
- What was the business need for ParkNYC?
 - To encourage drivers to download the application on their phone and make all payments through the application.
 - Making it easier to park in NYC with the help of zones and reducing the risk of getting a fine.
- What issue did ParkNYC resolve as a result?
 - ParkNYC has made it easier for driver's to park and pay on the go using a mobile application that allows you to track the duration and location of your parking from anywhere in the city.
- Do you feel ParkNYC has a significant impact on NYC parking. If yes, how so?
 - I believe ParkNYC on the city because alleviated drivers with their parking experience therefore improving unnecessary traffic jams throughout the city. It

has made it easier for users to avoid getting fines even though it is up to the driver's supervision to track their time and zones they parked in. It saves people's time and make the payment process of any zone throughout the city more seamless.

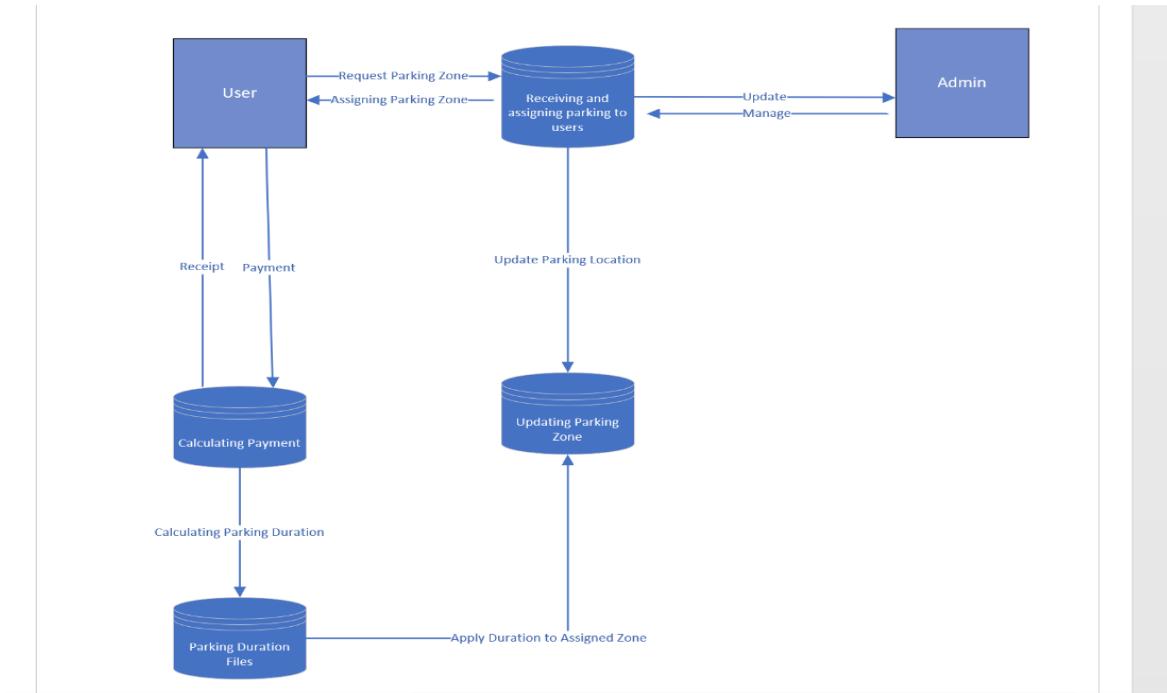
- Are there any additional improvements you would like to see in the future of the ParkNYC application?
 - The applications could offer a feature where the zone number is displayed and recommended based on the geographical area using the user's current location
 - These will help avoid making mistakes when entering an incorrect zone giving the users the option to add the payment information later in the process instead of entering all information at once. Adding more functions to facilitate navigation between interfaces. Upgrading the map to a more readable map with less icons.
- Are there any problems occurred during payable?
 - There were no issues when using the paying feature in the app because we did a lot usability/ UAT of all types.

Close Ended

- Priorities for improving the technological infrastructure.
- Mobile first strategy to reach out to the younger and older population who have not interacted with this type of technology because they're too used relying on computer websites.
- Focusing on network redesign strategy to reduce costs and cut operating cost around the end users computing environment.
- Improving the wireless connectivity strategy to allow for faster internet speeds and better reliability when it comes to connectivity
- Improve the identity and access management so that with the purpose of improving service delivery and offer better customer service.

Probe:

Please give an illustration on the data flow in an existing application.



Interview questions to customers:

1. What improvements for the application would you suggest?
 - What I've noticed is that though you can add money to the meter through the application, it still caps you out at two hours. It's inconvenient to have to add money manually at the parking meter if I stay at a location for over two hours.

2. Do you find Park NYC application user-friendly?
 - Yes, it is simple and self-explanatory. The hardest thing might be trying to select a username.

3. Rate the application from scale 1 to 5, one being the highest.
 - If I had to rate this application, I would rate it a 4.5. This rating would be improved if the application didn't cap me out at 2 hours at a location.

4. Has an application crash occurred while in the mists of using it?
 - No. I have not experienced any application crash while using Park NYC.

5. With this application, did you experience high storage capacity?
 - I use this application all this time because I live in the Bronx, yet I never experienced it taking too much space or battery from my phone.

6. Will you use the application more frequently if a ‘find a parking’ feature was added?
 - Yes. It will save me so much time, especially when travelling to the city. I live in a congested area so it would save me time looking for parking and help me utilize a lot less gas.

7. How can we improve customer service?
 - I’ve never really had to reach out to customer service regarding the application.

CRUD Matrix

The CRUD (create, read, update, delete) matrix shows how data is used by the processes within the system. In the design phase, it helps analysts ensure that all of the data stores used by the processes have been created. This is a tangible way to link the processes from the process models and the data stores from the data model, ensuring that no data required by the processes has been omitted from the data model.

	Search for available parking	Refill account balance	View parking zone heatmap
USER			
User_ID	CRU	CRU	
Username	CRU	CRU	
Password	CRU	CRU	
User_FirstName	CRU	CRU	
User_LastName	CRU	CRU	

User_License_ID	CRU	CRU	
User_Email	CRU	CRU	
User_Phone	CRU	CRU	
PAYMENT			
Payment_ID		CR	
Payment_Amount		CR	
Payment_Method		CRU	
Payment_Date		CRU	
User_ID		CRU	
PARKING_SPOT			
Parking_Spot_ID	R		R
Street_ID	R		R
Status	R		R
STREET			
Street_ID	R		R
Street_Address	R		R
Heatmap_Rank			R
BOOKING			
Booking_ID	R		
User_ID	R		
Car_Licence_Plate_Number	CRU		
Start_Time	CRU		
End_Time	CRU		
Payment_ID	R		
Parking_Spot_ID	R		
AVAILABLE			
Parking_Spot_ID	R		R
BOOKED			
Parking_Spot_ID	R		R

Alternative Matrix

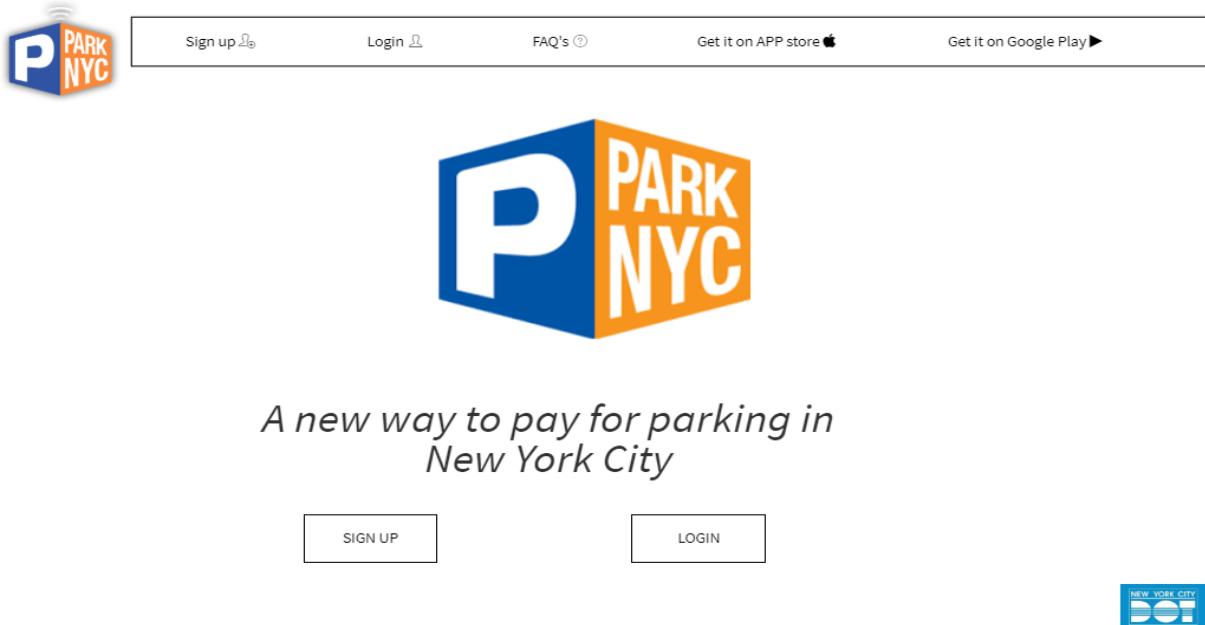
Evaluation Criteria	Relative Importance	Alternative 1	Score (1-5)	Weighted Score	Alternative 2	Score (1-5)	Weighted Score	Alternative 3	Score (1-5)	Weighted Score
Develop code in house			Outsource			Buy third party package				
Technical Issues										
Integration with Maps	10	Most effective integration	5	50	No high level expertise required	4	40	Less fluid integration	1	10
Image Processing for Live Feed	30	High possibility of failure if there is no inhouse expertise	3	90	More advanced AI and Deep learning knowledge	5	150	Very limited features	4	120
Camera and Sensor Engineering	30	High possibility of failure if there is no inhouse expertise	3	90	System may be harder to learn if coding is outsourced	5	150	Good alternative but our system requires some custom features	3	90
Economic Issues										
Cost	20	Most Expensive	2	40	Moderately expensive	3	60	Varies depending on package	3	60
Organizational Issues										
Customizable/dynamic	10	Yes	4	40	Somewhat	3	30	No	1	10
	100			310			430			290

System Specification

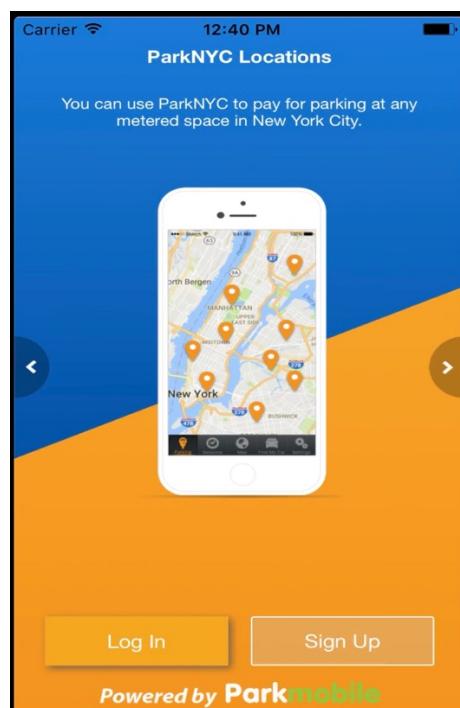
Interface Design:

Main Page:

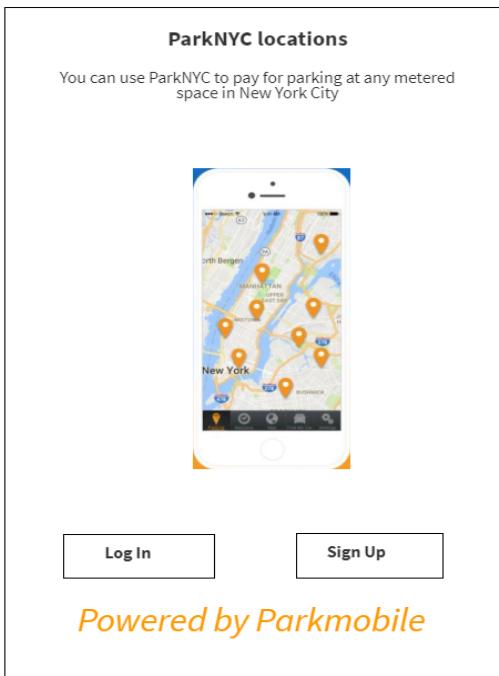
Website View



Mobile Application View

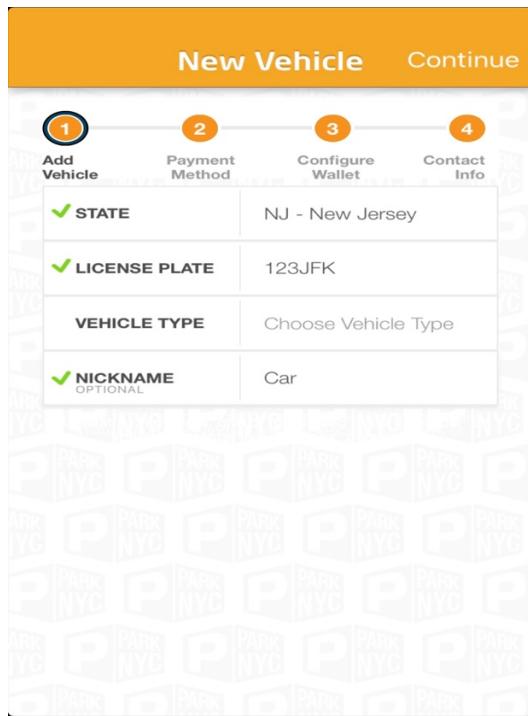


Login/Register Page:



Registration Process Page:

New Vehicle		Continue	
1 Add Vehicle	2 Payment Method	3 Configure Wallet	4 Contact Info
✓ STATE NJ - New Jersey			
✗ LICENSE PLATE 123 ABC			
VEHICLE TYPE Choose Vehicle Type			
NICKNAME OPTIONAL Sports Car			
At this time, your vehicle's license plate number can only include numbers and/or letters. Special characters or symbols are not accepted.			

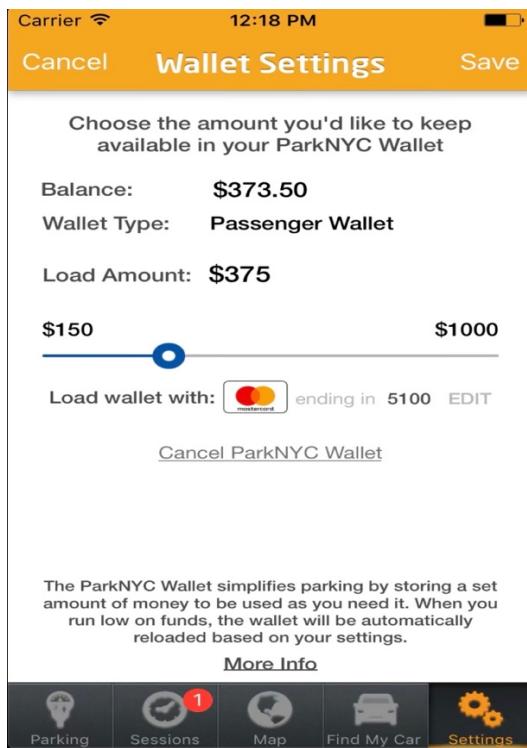


Setting Page:

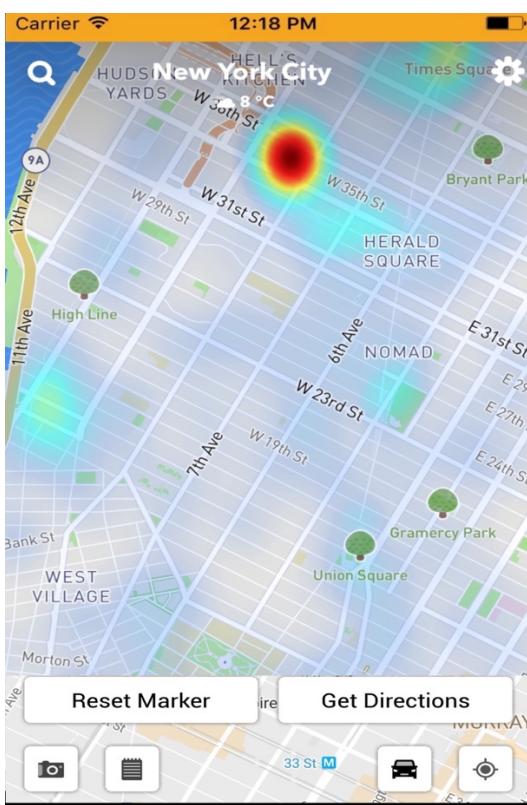
Scroll down and tap on one of the choices below to view or change your settings.

-  Help
 -  About
 -  Vehicles
 -  Favorite Zones
 -  ParkNYC Wallet Settings
 -  User Profile
 -  Notifications
 -  Parking History
 -  Payment History
 -  Sign Out
-  Parking
 Sessions
 Map
 Find My Car
 Settings

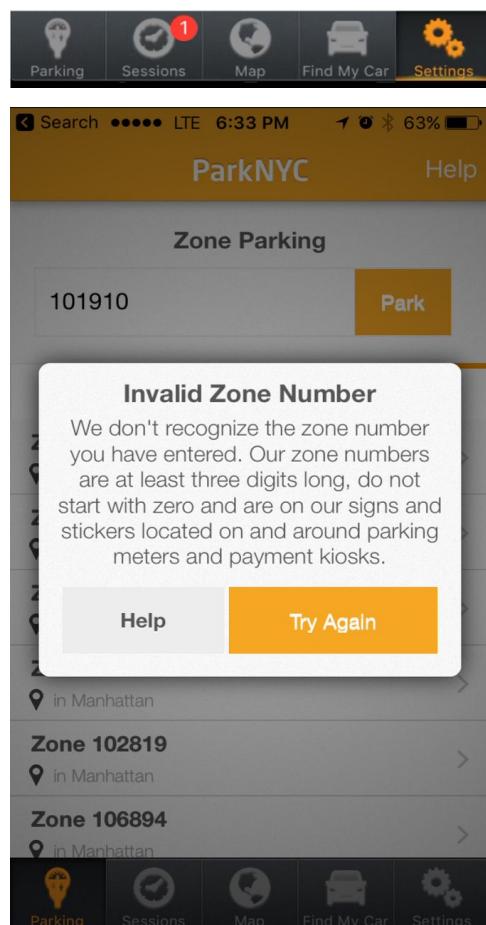
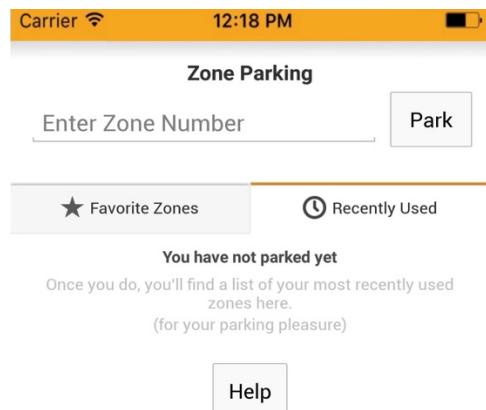
Wallet Setting Page:



Heatmap Page:



Parking Zone Process Page:



Parking Spot Booking Page:

Select Duration

Hours Minutes

0	15
1	30
2	45
3	...

Max Duration (7h 14m)

Cancel Continue

Active Session

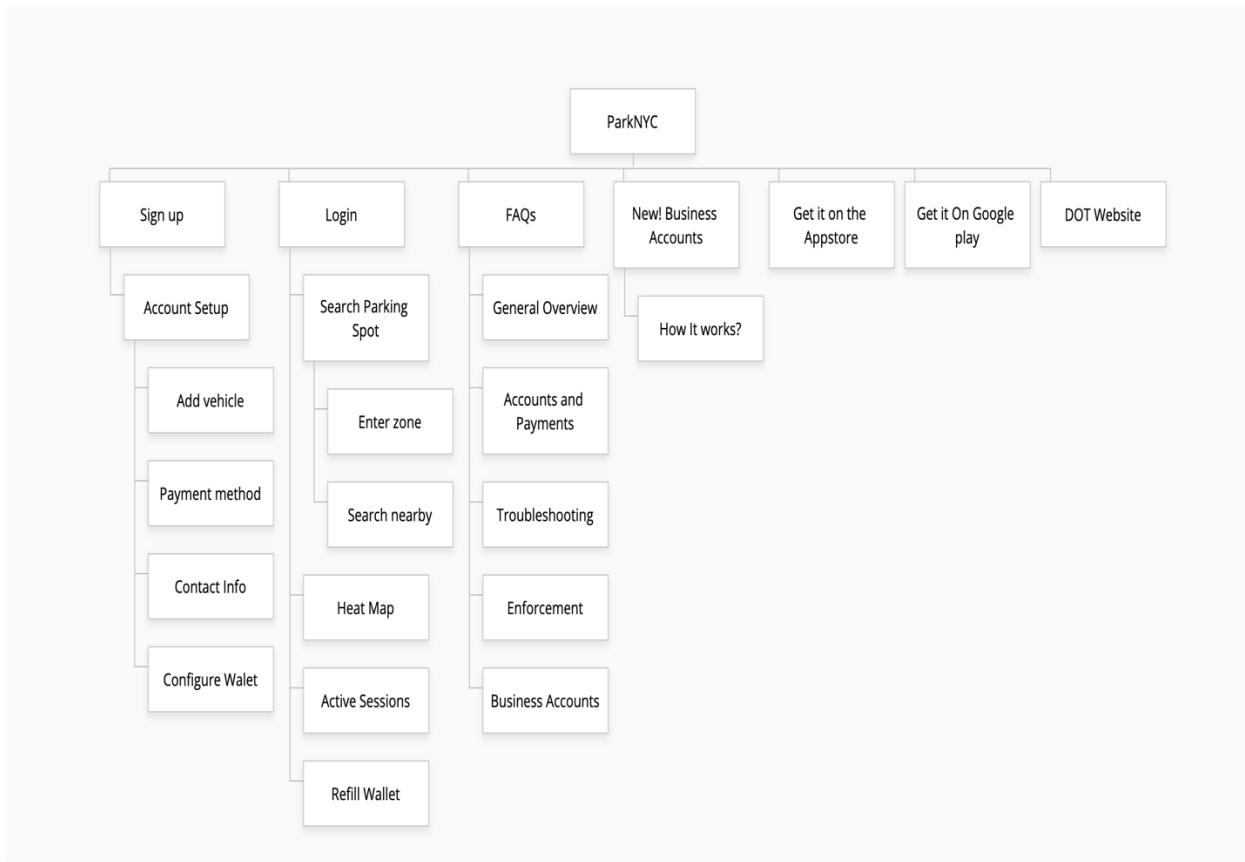
Time Left
00 h 13 m 28 s
Ends at 2:01 AM

Zone Number	Zone 108715 in New York City	
Passenger Vehicle	Rental Car (AK) 122DDD	
Total Cost	\$0.00	
Parking Reminder	5 min	Edit

Extend Parking

Parking Sessions Map Find My Car Settings

Website/Mobile Application Process Map



System's Interface Structure Diagram

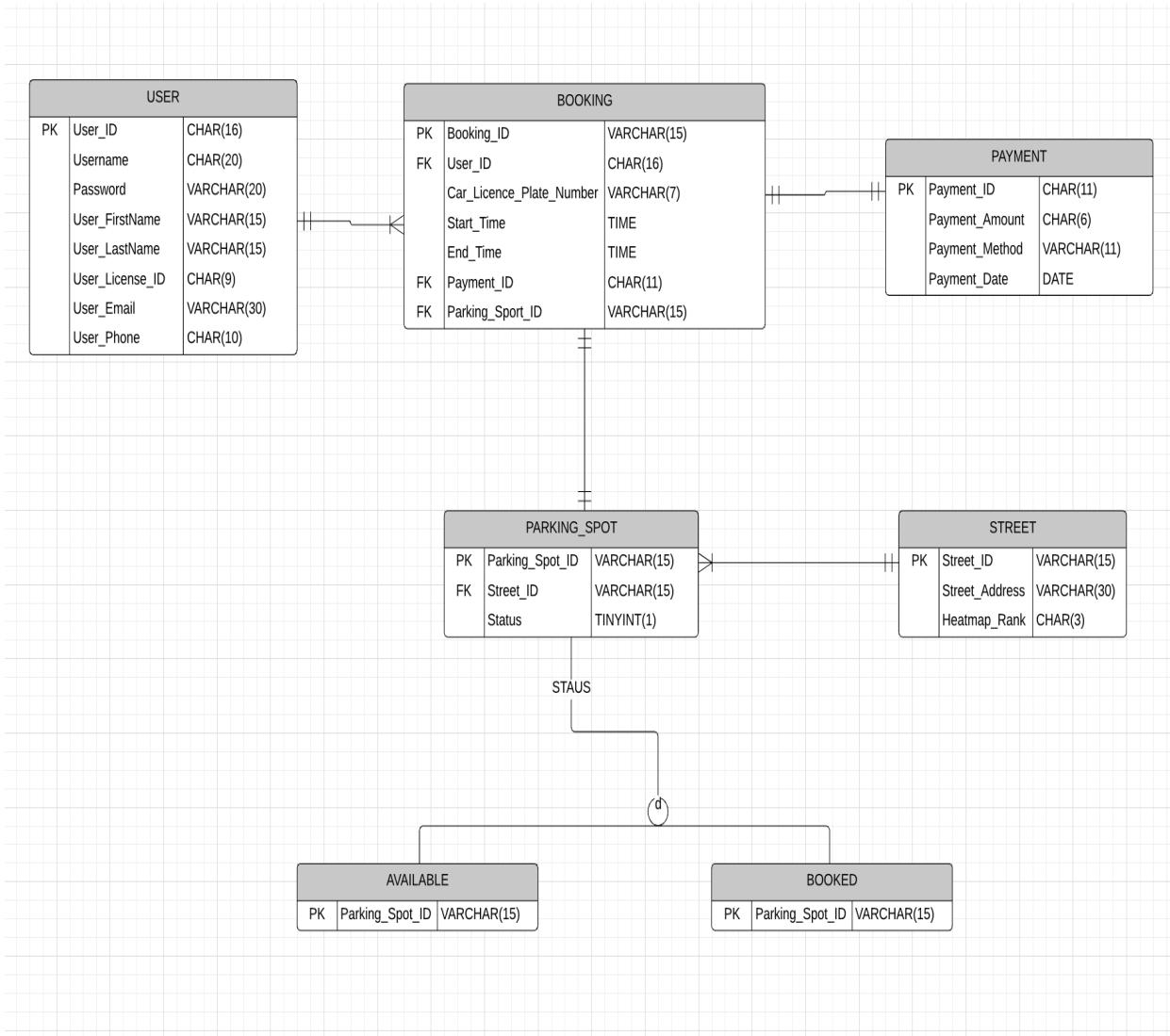


Interface structure diagram

Interface Standards

Interface Metaphor
An upgrade in ParkNYC application to track and find the empty parking space.
Interface Objects
<ul style="list-style-type: none"> • <i>Account:</i> user can login to their account using the application to perform their desired activity. • <i>Search Bar:</i> user can search for empty parking spots near them. • <i>Register:</i> Anyone who have vehicle can register. • <i>Homepage:</i> user can go back to the home page
Interface Action
<ul style="list-style-type: none"> • <i>My Account:</i> user will log in or register. • <i>Create Enrollment:</i> user can create enrollment. • <i>Manage Enrollment:</i> user can manage enrollment. • <i>Create Time:</i> user can create time to park vehicle. • <i>Manage Time:</i> user is allowed to increase time • <i>User Information:</i> user gets the information/history of their parking time.
Interface Icon:
<ul style="list-style-type: none"> • <i>Website:</i> ParkNYC icon will be used in all pages of website. • <i>Search:</i> Search box that allows user to search. • <i>Register:</i> user can register the more than one vehicle. • <i>Login:</i> user need to login into account.

File Data Specification



CRUD Matrix

	Search for Available Parking	Refill Account Balance	View Parking Zone Heatmap
USER			
User_ID	CRU	CRU	
Username	CRU	CRU	
Password	CRU	CRU	
User_FirstName	CRU	CRU	
User_LastName	CRU	CRU	
User_Licence_ID	CRU	CRU	
User_Email	CRU	CRU	
User_Phone	CRU	CRU	
PAYMENT			
Payment_ID		CR	
Payment_Amount		CR	
Payment_Method		CRU	
Payment_Date		CRU	
User_ID		CRU	
PARKING_SPOT			
Parking_Spot_ID	R		R
Street_ID	R		R
Status	R		R
STREET			
Street_ID	R		R
Street_Address	R		R
Heatmap_Rank			R
BOOKING			
Booking_ID	R		
User_ID	R		
Car_Licence_Plate_Number	CRU		
Start_Time	CRU		
End_Time	CRU		
Payment_ID	R		
Parking_Spot_ID	R		
AVAILABLE			
Parking_Spot_ID	R		R
BOOKED			
Parking_Spot_ID	R		R

Executive Summary

New York City is one of the most congested cities in the United States. Ranking at # 1, the average New Yorker can expect to spend up to 107 hours a year searching for parking (McCoy, 2017). Finding parking alone contributes to 30% of traffic in the area. This doesn't allot for the cost in fuel and emissions wasted finding parking which totals over \$2,336 a year (McCoy, 2017). With such problematic issues in finding parking, New Yorkers are prone to tickets due to illegal parking in an already expensive city to live in. From 2012 to 2016 New York City saw a 6 percent rise in fines for parking violations totaling over a half million dollars ("New York City Fine Revenues Update", 2017). All in all, New Yorkers are faced with the daily brutal battle of finding parking and the Department of Transportation (DOT) has responded accordingly.

The DOT's mission is to create and "provide safe, efficient, and environmentally responsible movement of pedestrians, goods, and vehicular traffic on the streets...and improve mobility and reduce congestion throughout the City" ("About DOT", 2016). Nevertheless, in order to combat parking efforts, the DOT has decided to work with business Park Mobile to develop an application to address the growing concerns of New Yorkers. The introduction of DOT's ParkNYC application would make commuting convenient for the everyday New Yorker.

ParkNYC implements the same features as its originator Park Mobile. In the application you can find parking zones in proximity by using the embedded map, set up payment, reload parking meters up to two hours, view real time parking status, and even add a user's different cars. All the features have been implemented to save New Yorker's time and money; however, there have been some flaws in its development.

Though ParkNYC was a pivotal response to address the growing concerns of congestion and fines, parking and traffic remains a significant issue. Nevertheless, the application calls for a massive redesign to accommodate fellow New Yorkers. In order to address the overarching issue of parking and traffic, we have created components that implements both a parking and GPS heatmap feature.

The parking feature is a well needed component of the new system. Here users will be able to search for parking in advance of leaving their location. The way we implement the find parking feature is by putting camera sensors on light posts all over the city that span a couple

feet. The application can then reflect empty parking spots for a vehicle. However, cars come in all shapes and sizes which is why the application will allow users to select their car type like one would when requesting a Lyft or Uber (Sedan, Truck, Van etc.). Moreover, when on the topic of implementing our parking feature, it is impossible to not mention the advancement we have with the current map.

The current map in ParkNYC only reflects parking zones in which cars can park; however, it does not signify empty parking spaces. For that reason, in conjunction with the parking feature, the map will allow users to see possible empty parking spots. The built in GPS system will be able to locate and reroute users to empty parking spots, saving them time, money, and reducing traffic. The heatmap feature will also be implemented to forecast the traffic congestion. If the map happens to be red in a certain area you'd like to go, you can believe that area is congested, and you should probably take public transportation if possible. This feature in short will lessen the traffic congestion significantly across the city; therefore, contributing to the major sustainability efforts of the DOT.

New York City is in high demand of improvements to its issue of congestion and parking system. For that reason, improvements to the DOT's ParkNYC application is a necessity to the everyday commuting New Yorker and the DOT's mission. In addressing these concerns, the implementation of find parking feature and GPS heatmap feature would bring significant changes to the everyday commute of New Yorkers alike.

Project Lesson Learned

During the development of this comprehensive system we faced both successes and roadblocks as would any project. Some of successes can be seen in making an actual impact on New Yorkers as we address the many concerns of parking, tickets, and traffic. The complications that arose can be found in previous deliverables and include the Context Level Diagram, Process Model, Physical Model, and risk analysis.

The implementation of such a system will alleviate New York's parking, fine, and traffic problems. This would be a significant win for the city. Coming up with such an idea to solve the congestion problem in New York can impact other dense cities with its implementation and can

overall help sustain the environment in the long run. We believe this is a success because we brainstormed an impactful solution for a seemingly never-ending issue in New York City. However, with such success, we also faced times of confusion.

The most complicated part about this project was the development of the Context Diagram, Process Model, and the Physical Model. From the positioning of processes to the consistency of metadata, there were constant changes within our Use Cases, Data Flow Diagrams, and Entity Relationship Diagrams. If we could change anything about this project, it would be to first create a data dictionary beforehand based on terms that will be needed to describe processes, data flows, and datastores. Therefore, everything would be consistent while working collectively and alone. Hence, leading to less reconstruction of final drafts.

Analyzing the risk of a project can also be complicated. The future is unforeseeable, and for that reason it is difficult to analyze events that haven't yet occurred or seem to be a threat at the current moment. Nevertheless, these unforeseen issues might be alarming in the future as we would have to adjust the system to alleviate customer impact. Also, another issue that might be faced in the implementation of such a system, is that there is already a contract in place with Park Mobile. In order to do any future changes within the application this might be difficult until the contract is renewed with new requirements. For that reason, in the future the DOT might want to consider creating an in-house application, so it is not reliant on Park Mobile to make major changes as needed.

Overall this project has shaped our minds into understanding software development life cycle as applied to ParkNYC. Throughout the deliverables we were able to create, brainstorm, and integrate a compressive system with the Department of Transportation's requirements and mission in mind. Though this is said, we also found difficulty in keeping consistent layout and terms between the Context Level Diagram, Data Flow Diagrams, Entity Relationship Diagram, and risk analysis.

Appendices

Interview Results:

The interviewee representing the Department of Transportation was very keen on creating a better interface and user experience. It was stressed that the map feature should be less congested with icons and have more a tech savvy feature to it. He also suggested that users be able to still use the application without logging in, as it can be extensive process, especially if you're a New Yorker and on the go. It was also implied that application take use of parking zones in depth, as user's have issues with finding the correct zone. Nevertheless, users are prone to tickets, something this was application was made to combat against. Overall, the interviewee believes that ParkNYC was a great adjustment for the everyday commuting New Yorker and looks forward to seeing more changes soon.

The user interviewee overall believes that ParkNYC is very useful in her everyday commute within the Bronx. It's efficient and convenient because one doesn't need to leave their location to refill the meter. Though this is said, the interviewee does believe the application can do for some adjusting. For example, adjusting the two-hour time limit will make the application more ideal. Nevertheless, she looks forward to new developments within the application.

References

McCoy, K. (2017, July 12). Drivers spend an average of 17 hours a year searching for parking spots. Retrieved December 17, 2019, from USA TODAY website:
<https://www.usatoday.com/story/money/2017/07/12/parking-pain-causes-financial-and-personal-strain/467637001/>

New York City Fine Revenues Update. (2019). Retrieved December 15, 2019, from Nyc.gov website: <https://comptroller.nyc.gov/reports/new-york-city-fine-revenues-update/>

NYC DOT - About DOT. (2016). Retrieved December 15, 2019, from Nyc.gov website:
<https://www1.nyc.gov/html/dot/html/about/about.shtml>

Deliverable 1 Meetings

MEETING 1

Name of Attendees: Videet, Nicole, Sunil, Komal and Meenal.

Time & Date: 28 September 2019, from 3pm to 5:30pm.

Minutes: 180 Minutes.

Discussed points:

- Discussed the planning phase and new features for the existing system.
- Had an overview of what the existing system is lacking.
- Discussed the possible solutions for the problem and potential features.
- Had an overlook of existing market and the competitors.
- Group discussion on various types feasibilities like economic, organizational, etc.
- Discussed benefits of newly added features and the value it would add to the existing
- system.
- Assigned duties and task to various group members.

MEETING 2

Name of Attendees: Meenal, Komal, Videet, Nicole, Sunil

Time & Date: Sep-30-2019 3 pm to 5:30 pm

Minutes: 180 Minutes.

Discussed Points:

- We discussed about cost benefit analysis with identifying cost and benefit associated with this
- system.
- We came up with business need data integration system for image processing for image
- visualization and manipulation.
- Need for website admin.
- Keep track of individual's work progress.

Deliverable 2 Meetings

MEETING 1

Name of Attendees: Videet, Nicole, Sunil, Komal and Meenal.

Time & Date: 27 October 2019, from 1pm to 4:30 pm.

Minutes: 210 Minutes.

Discussed Points:

- Determine functional and non-functional requirements.
- Identifying major use cases.
- Discussing details of use cases.
- Work distribution.

MEETING 2 (Virtually)

Name of Attendees: Videet, Nicole, Sunil, Komal and Meenal.

Time & Date: 30 October 2019, from 9pm to 10pm.

Minutes: 60 Minutes.

Discussed Points:

- Discussed DFDs and reviewed use cases.
- Tracked progress of distributed work.

MEETING 3

Name of Attendees: Videet, Nicole, Sunil, Komal and Meenal.

Time & Date: 3rd November 2019, from 11am to 5pm.

Minutes: 360 minutes.

Discussed Points:

- Fine-tuned and reworked on the DFDs.
- Checked ERD.
- Compiled documents and interview.
- Reworked on some use cases.

Deliverable 3 Meetings***Meeting Minutes******MEETING 1***

Name of Attendees: Videet, Nicole, Sunil, Komal and Meenal.

Time & Date: 6th December 2019, from 5 pm to 6:30 pm.

Minutes: 90 Minutes.

Discussed Points:

- Identify user interface design.
- Discussion on ‘Web page/main menu/main page layout’
- Discussion on ‘File/data specification’
- Final Report writing.
- Work distribution.

MEETING 2

Name of Attendees: Videet, Nicole, Sunil, Komal and Meenal.

Time & Date: 13th December 2019, from 5:30 pm to 7:30 pm.

Minutes: 120 Minutes.

Discussed Points:

- Redefined Deliverable 2
- Draft Deliverable 3
- Discussion on Website and Mobile Application Layout

MEETING 3 (Virtually)

Name of Attendees: Videet, Nicole, Sunil, Komal and Meenal.

Time & Date: 15th December 2019, from 7 pm to 8:30 pm.

Minutes: 90 Minutes.

Discussed Points:

- Discussion on Confusions
- Final Report writing.

- Final Formation