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Requirements Analysis and
Specifications Document

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PowerEnjoy

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CONTENTS

1	Introduction	4
1.1	Purpose	4
1.2	System	4
1.3	Scope	4
1.3.1	Goals	6
1.3.2	Applications	6
1.4	Reference Documents	7
1.5	Glossary	7
1.5.1	Actors	7
1.5.2	Other definitions	8
1.6	Document overview	9
2	Overall Description	10
2.1	Software overview	10
2.2	User characteristics	11
2.3	Domain assumptions	11
2.3.1	General Domain Assumptions	11
2.3.2	User Assumptions	12
2.3.3	Vehicle Assumptions	12
2.4	Constraints	12
2.4.1	Software Limitations	12
2.4.2	Hardware limitations	13
2.4.3	Concurrency	14
2.4.4	Regulatory Policies	14
2.5	Functional Requirements	14
2.6	Non functional Requirements	15
2.7	Future implementation	16
3	Specific Requirements	17
3.1	External Interface Requirements	17
3.1.1	Mobile Application	17
3.1.2	Web Application	22

3.1.3	On-Board Application (Touch)	24
3.2	Scenarios	26
3.2.1	Scenario 1:User sign-up	26
3.2.2	Scenario 2: Log in	27
3.2.3	Scenario 3: Reserve a car	27
3.2.4	Scenario 4: Unable to reach car in time	27
3.2.5	Scenario 5: Car problems	27
3.2.6	Scenario 6: Share ride with passengers	27
3.2.7	Scenario 7: Drive with Money Saving Option	27
3.2.8	Scenario 8: Leaving a car with battery level <50%	28
3.2.9	Scenario 9: Charge car	28
3.2.10	Scenario 10: Out of safe area parking	28
3.2.11	Scenario 11: Bad parking position	28

1. INTRODUCTION

1.1 Purpose

The aim of this document is to give an overview of the requirements and specifications of system to be developed. The goal of the document is to describe in detail all functional and non-functional requirements of the system, analyzing the needs of the customer and explaining common use case scenarios. It will set a baseline for project planning and cost estimation, giving a detailed insight to all stakeholders which include the PowerEnjoy Board , Investors and finally engineers (present and future) involved in development, testing and maintenance.

1.2 System

The to be developed software system provides a complete support to the new PowerEnjoy car-sharing service. It will allow users to register ,log-in and use the car sharing service within the limits imposed by the below specifications.

1.3 Scope

The new PowerEnjoy software system will allow visitors to register and retrieve all necessary information of common domain (ToS , contact information...).

Once the visitor has successfully registered to the system and his/her driving license has been approved, he/she will be provided with a unique username-password combination. This enables an user to log into the system at any time , from any mobile device.

Once logged in, the user can search within a certain distance for vehicles based on his/her current location or based on an input address. Eventually the user chooses to reserve an available vehicle, which can be picked-up within a time span of one hour.

Should the user not pick-up the car within the one hour availability limit, then the system will tag the vehicle as available and charge the user a fee

of 1 Euro.

Should the user reach the car within the limit, he/she must be able to interact with the system in order to unlock the vehicle and grant the user access to the car. As soon as the engine ignites, the system starts charging the user for a given amount of money per minute. The current charge will be notified through a display inside the car.

The system stops charging the user as soon as the car is parked in a safe area and the user exits the car. At this point the system will automatically lock the car. Should the user stop in a non-safe area he/she won't be granted to end the transaction and will be charged until he/she parks in a safe area. The set of safe area parking spots is defined inside the system and must be available all the time to the user's knowledge through the on-board display.

In addition to the functionality above, the system should incentivize the virtuous behaviours of the users with some bonuses:

- If the user shares a ride with at least two other passengers , the system will detect them and will apply a discount of 10% the last ride.
- If the user parks the car in a safe area and the battery charge level is more than 50% , the system will apply a discount of 20% on the last ride.
- If the user parks the car in a safe area provided with a PowerEnjoy charging station and takes care of the recharging ,the system will apply a discount of 30 % on the last ride.
- If the user parks the car in a safe area with a battery charge level less than 20% or the distance to the next power grid is greater than 3 KM, the system will add a fee of 30% of the last ride to compensate for the cost required to recharge the car on-site.
- If the user enables money saving option, he/ she can input the final destination and the system provides information about the station where to leave the car to get a discount. This station is determined to ensure a uniform distribution of the cars in the city and depends both on the destination of the user and on the availability of power plugs at the selected station.

1.3.1 Goals

The PowerEnjoy software system needs to be:

- **[G1] : Practical**

It wants to give the users a better connectivity among places in the participant cities that common public transport often can't offer.

- **[G2] : Convenient**

The service needs to be convenient: it's less expensive than taking a taxi. It's an eco-friendly solution : car-sharing reduces the number of vehicles circulating in the cities and doesn't pollute thanks to electric engines.

- **[G3] : User friendly**

The system needs to be as user friendly as possible in order to be used easily by everyone through their own intuitive knowledge.

- **[G4] : Fast**

The system needs to be fast and responsive even during high peaks of activity.

- **[G5] : Available**

The system needs to be available at every time and on the largest possible number of devices (mobile and not) with an internet connection.

1.3.2 Applications

To achieve the above mentioned goals to following software tools need to be developed:

- **Mobile Application:** to be developed for all major operating systems (iOS, Android , Windows Phone). The mobile software must allow the user to perform all the tasks in the *Scope section* (1.3).

- **Web Application:** must be compatible with all major browser applications. The user must be allowed to perform all tasks in the *Scope section* (1.3).

- **On board car application:** this application needs to handle user interaction such as displaying general car information (charge, fee, tire pressure...), letting the user validate his/her identity through a pin code and report about the status of the vehicle. Furthermore it must control if the vehicle is parked in a safe area.
- **Back-End Application:** this application handles all search and reservation requests, payment transactions and car communications. It is also an essential tool for customer support operators.

1.4 Reference Documents

- IEEE Std 830-1998: IEEE Recommended Practice for Software Requirements Specifications
- Project description: Assignments AA 2016-2017.pdf
- Alloy Language Reference : <http://alloy.mit.edu/alloy/documentation/book-chapters/alloy-language-reference.pdf>
- UML Language Reference : https://www.utdallas.edu/~chung/Fujitsu/UML_2.0/Rumbaugh--UML_2.0_Reference_CD.pdf

1.5 Glossary

1.5.1 Actors

- *Visitor:* a visitor is defined as a person who is not logged into the system.
- *Registered User:* is defined as customer who is logged into the system.
- *Car:* is defined as the mean of transport to be used by a registered user.
- *Support operator:* The support operator is an employee who is trained and has a full grasp of the different software application.

1.5.2 Other definitions

- *Valid Payment*: as payment we accept only Credit Cards (Visa, MasterCard and American Express).
The payment method must be valid : the card must not be expired nor blocked. The validity will be checked immediately during registration phase.
- *Valid Drivers License*: the user must provide a valid european drivers license. The license must be valid: it must not be expired or suspended. The validity will be checked immediately during registration phase.
- *Safe Area* : a safe area is any part of the city where the user is allowed to park. Safe areas are pre-defined and installed into the cars' on board systems. If a user parks the car in an area which is *not* safe , he/she will not be able to end the ride and will be charged until he/she parks in a safe area.
- *Money Saving Option*: when a user starts a ride he/she can enable this mode on the onboard display: he/ she can input the final destination and the system provides information about the station where to leave the car to get a discount.
- *Reserved Car*: is a vehicle currently used by a user. Reserved cars are not visible as results of a search query.
- *Time left to unlock*: as soon as a user reserves a car, he/she has one hour to unlock it. The time left is displayed on top of the user's mobile/web application.
- *Charging Station*: all PowerEnjoy's cars are provided with an electric engine. A charging station is a location where the user can park and recharge the car. All charging stations are listed in the on- board system.
- *Battery level* : the current state of the battery charge is indicated by the battery level.
- *Passenger* : is a person (not necessarily registered) who shares a ride with a registered driver. A passenger cannot drive but his presence will be detected by the system.

- *On-board application*: is the software installed on every car. The user can interact with it through a touch screen display.
- *Mobile application*: is the downloadable software that can be installed on major mobile devices.
- *Web application*: is the online software that is accessible through all common web browsers.
- *Back-End application*: is the part of the system that manages queries ,data and user-system interaction.
- *Ride*: a ride is a time span starting from the moment the user turns the car on and ends when the user parks it in a safe area after the car has automatically locked the doors.
- *Payment History* : a chronological list of all payments and rides made by a given user.
- *Available car* : a car that is not reserved or charging. These cars are shown as result of search queries and can be reserved by users.

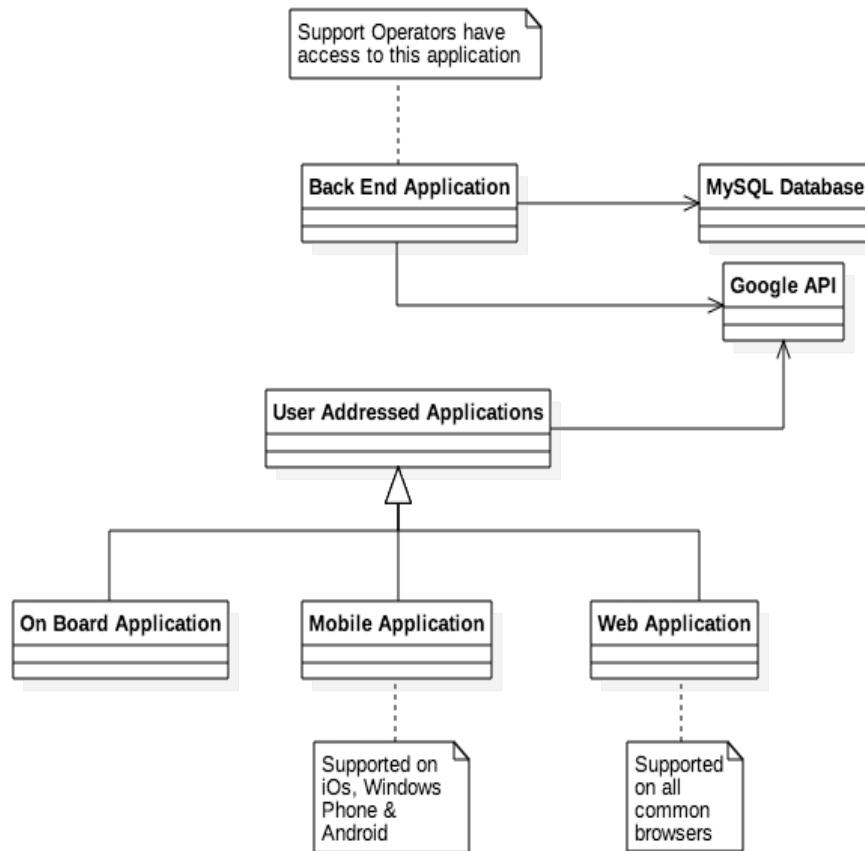
1.6 Document overview

1. **Introduction**: this section gives a general description of the software and its characteristics
2. **Overall description**: this section gives a detailed overview of the document focusing on domain assumptions, requirements (functional and not) and the characteristics of different types of interacting users.
3. **Specifications**: this section gives a deep insight about the system's main functionality, analyzing scenarios with their relative use-cases and includes an extensive alloy model. Event flows are model using sequence and state diagrams.

2. OVERALL DESCRIPTION

The overview section highlights all the main functionality and constraints of the PowerEnjoy software.

2.1 Software overview



2.2 User characteristics

Specifies the characteristics of the different actors mentioned in *Actors section* (1.5.1)

- **Visitor:** A visitor can see only the log-in page with a registration form and some common information ,such as the company's customer office contact information and terms of service. There are no constraints about visitors : every person can access the main site and try to register.
- **User:** a want-to-be user must match the following requirements:
 - the user has to be **at least 18** years old
 - the user must have a **valid** driving license ¹
 - the user must enter a **valid** payment method
- **Car:** is property of the PowerEnjoy Company. A car must be able to communicate to with the system all the time. If a car is available (i.e currently not reserved by a registered user) then its current location must be stored in the system so to be shown on all users' devices. As soon as the engine ignition starts , the car's system must time the vehicle's usage in order to charge the user the right amount of money. Once the user has parked the car inside a safe area and has exited, the car informs the system about the fee to charge ,locks the doors automatically and finally informs the system that it is available again.
- **Support Operator:** his job is to offer costumer support concerning software issues and help out in case of emergency.
Contrary to a user, he has access to the back-end software which enables him to overview the system status.

2.3 Domain assumptions

2.3.1 General Domain Assumptions

We hold the assumption that the system will be deployed in large metropolitan cities with a maximum of 3M inhabitants.

¹ For more check out the *Glossary*

We assume that the mean highest peak of activity is around dinner time on Fridays and Saturdays. We assume that during the peak the system will be used by around 50k people , 80% of which gain access to the system through the Mobile Application, while the remaining 20% through the Web Application.

We assume that the fleet of vehicles will be proportional to the number of inhabitants, reaching a peek of 300 vehicles in the biggest area.

2.3.2 User Assumptions

We assume that all users are provided with an enabled internet connection equipped with GPS tracking which is the only way to search, reserve and unlock a car. We assume that all active users carry their driving license with them and drive following the traffic code².

2.3.3 Vehicle Assumptions

* chiedere se e' bisogna inserire assunsiozioni sulla carica delle macchine etc...*

2.4 Constraints

2.4.1 Software Limitations

The Mobile and Web Application can not exceed 50MB of RAM usage.

The On-Board application can not exceed 75MB of RAM usage.

The Back-End application cannot exceed 100GB of RAM usage.

²http://www.mit.gov.it/mit/site.php?p=normativa&o=vd&id=1&id_cat=&id_dett=0

2.4.2 Hardware limitations

The Mobile Application must be available for the following mobile operating systems:

- iOS version 7.0 or higher.
- Android version 4.0 or higher.
- Windows Phone 8 or higher.

The applications must interface with Google Maps API³ and follow the design guidelines provided by each platform^{4 5}.

The Web Application must be developed in order to be correctly used by the following web browsers⁶:

- Mozilla Firefox
- Google Chrome
- Safari
- Microsoft Edge
- Opera

The on-board software system must be equipped with a GPS Module and interface Google Maps API. The following safety regulations must be followed:

- **Night mode:** an automatic night mode must be implemented. This will avoid that drivers get blinded by excessive brightness of the display.
- **Safe - area parking recognition:** the system must recognize whether the vehicle is parked in a safe-area or not.
- **Additional passenger recognition:** the system must recognize passenger. This feature is crucial for bonus credit distribution to the driver.

³<https://developers.google.com/maps/documentation/javascript/>

⁴<https://developer.android.com/design/index.html>

⁵<https://developer.apple.com/design/>

⁶<http://www.w3schools.com/browsers/default.asp>

2.4.3 Concurrency

The back-end application must be able to handle correctly multiple user requests without creating conflicts : if two users desire to reserve the same car simultaneously ,only one can be granted a reservation.

2.4.4 Regulatory Policies

- **Privacy Policy:** Data should be collected and stored following the privacy policy guidelines provided by Mozilla Foundation https://developer.mozilla.org/en-US/Marketplace/PublishingPolicies_and_Guidelines/Privacy_policies
- Network connections must be encrypted.
- Data storage on PowerEnjoy databases must be encrypted

2.5 Functional Requirements

1. Mobile and Web Application

- [R1.1]: Allow a guest to register entering all relevant personal data and a valid driving license whose validity will be checked on the spot
- [R1.2]: Allow a registered user to log-in
- [R1.3]: Allow a registered user to update his personal information
- [R1.4]: Allow a registered user to search for an available vehicle given his position within a selected distance
- [R1.5]: Allow a registered user to search for an available vehicle given an input position within a selected distance
- [R1.6]: Allow a registered user to reserve a selected vehicle.
- [R1.7]: Allow a registered user to check his payment history
- [R1.8]: Allow a registered user to recover his account log-in information in a secure way
- [R1.9]: Allow a registered user to search for an available vehicle given an input position.

- [R1.10]: Allow a registered user to unlock *his/her* reserved car if the user is nearby.
- [R1.11]: **Chiedere per cancellazione prenotazioni**

2.On-Board Application

- [R2.1]: Allow a registered user to correctly identify himself/ herself by entering a user specific pin-code
- [R2.2]: Enable a registered user to keep track of the distance covered, time spent using the car ,the current owed fee and the remaining battery charge.

3.Back-End Application

- [R3.1]: .

2.6 Non functional Requirements

Some non functional requirements have been to be necessary in the to be developed system in order to provider a correct operation flow and an optimized UX.

- *User friendliness*: the Mobile/Web as well as the On-Board Application must be easily handled by the average web user with basic web knowledge.
- *Performance*: to supply a suitable service the system must be responsive even at peak activity times. To achieve this client-server transaction must be reduced to a minimum.
- *Reliability*: the PowerEnjoy service must be active 24h/24h . Maintenance must be performed without compromising functionality. At all the time , a user must be able to be charged the owed fee.
- *Data integrity and availability*: Data have to be always available and accessible.Data availability can be achieved by duplicating data on back-up servers. For instance the use of RAID, mirroring and backup could present a valid solution.

- *Maintainability*: the software should be implemented so as to be as modular as possible to allow future expansions and easy modifications
Google API are required but can be easily updated from time to time on all systems.
- *Security*: user accounts are provided with two factor authentication with a code sent to the user's mobile phone to add a secure connection method to the system. Sensible user information are stored using a hashing mechanism .
User data input should be filtered to avoid malicious modifications (i.e SQL Injections).
All connections should be encrypted and run on a secure HTTPS protocol with valid certificates that uses the secure TSL protocol to avoid Man in the Middle Attacks.

2.7 Future implementation

The system must be as scalable as possible: future implementations can require a deployment in very large metropolitan cities that exceed by far the maximum amount of planned users.

An important thing to keep in mind is that the nature of vehicles could change in the distant future : not only cars , but also electric powered motorcycles could be added to the PowerEnjoy vehicle fleet.This means that the on- board software should be as expandable as possible using for instance Hierarchy Design Patterns in the vehicle type definition.

3. SPECIFIC REQUIREMENTS

3.1 External Interface Requirements

This section is dedicated to illustrate the mockups of the user interfaces.

3.1.1 Mobile Application

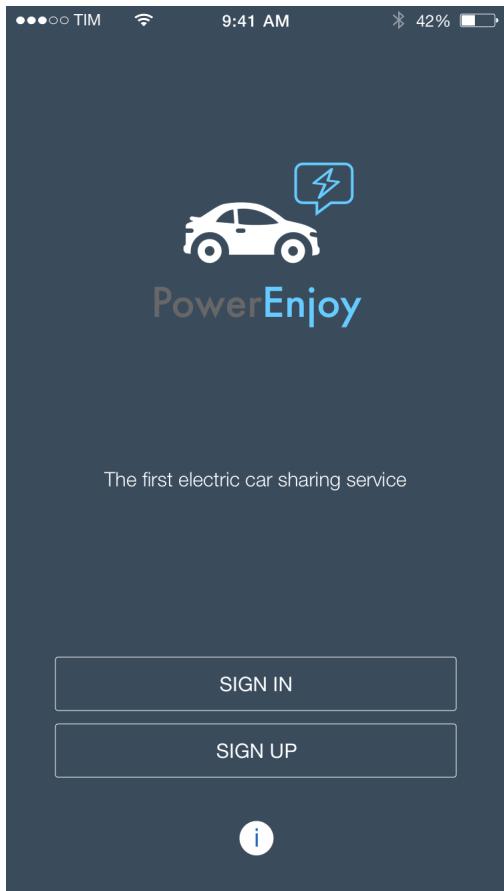


Figure 1: Confirm selection

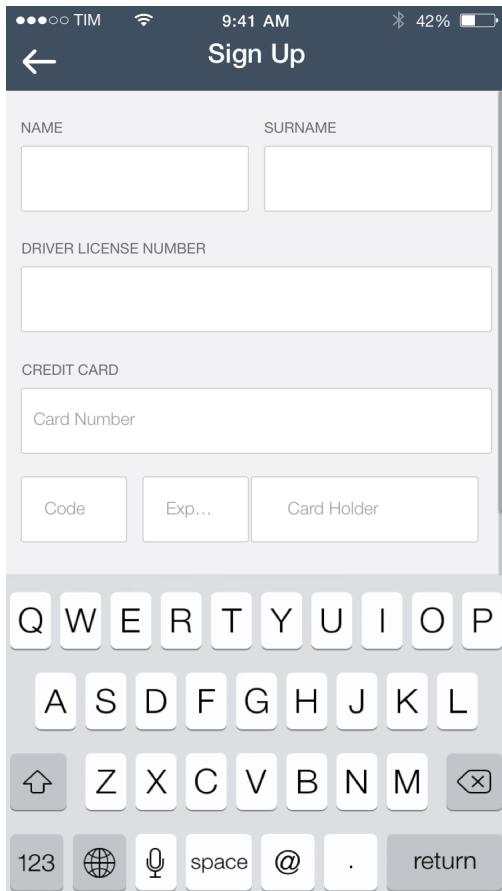


Figure 2: Time left to unlock

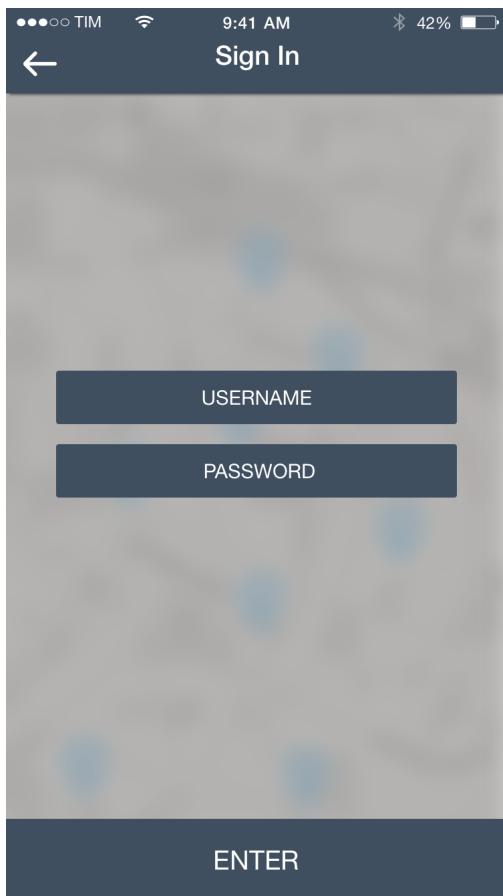


Figure 3: Sign In

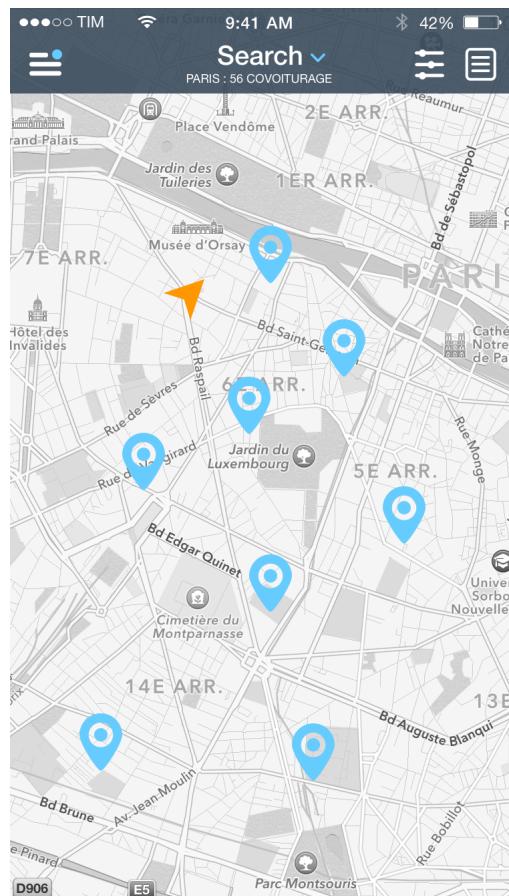


Figure 4: Search

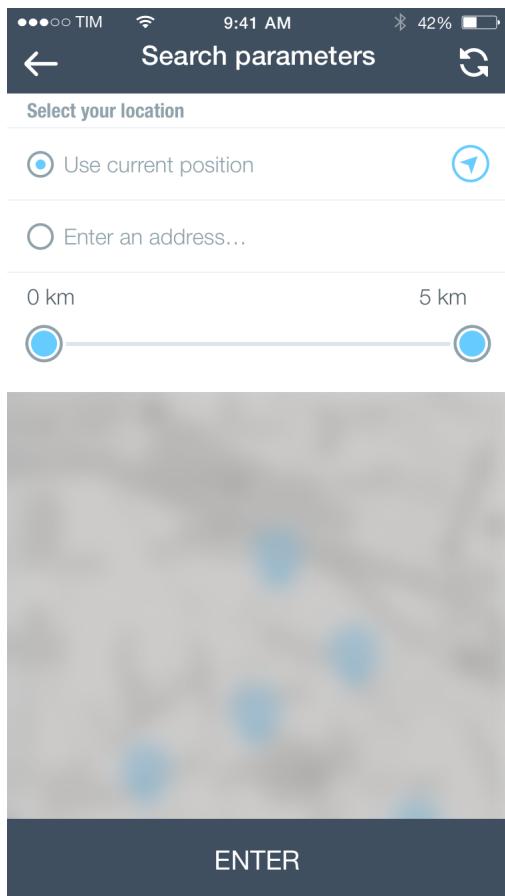


Figure 5: Address input

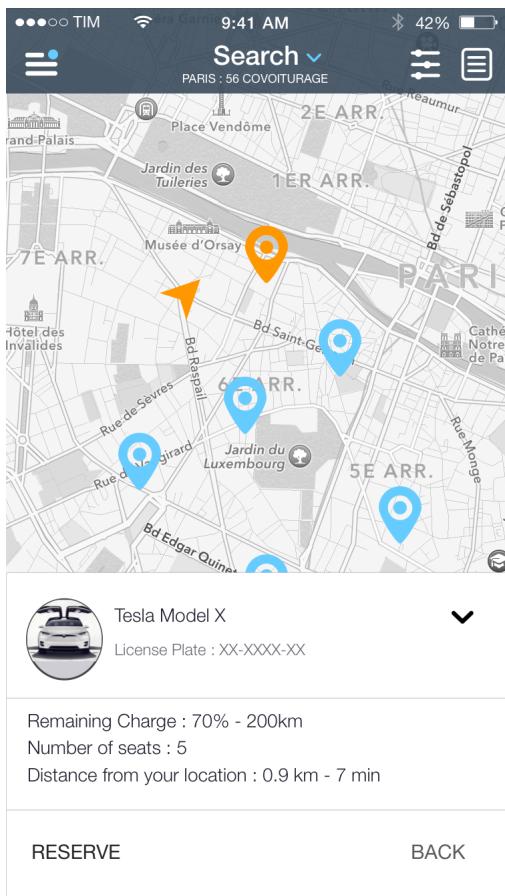


Figure 6: Car Selection

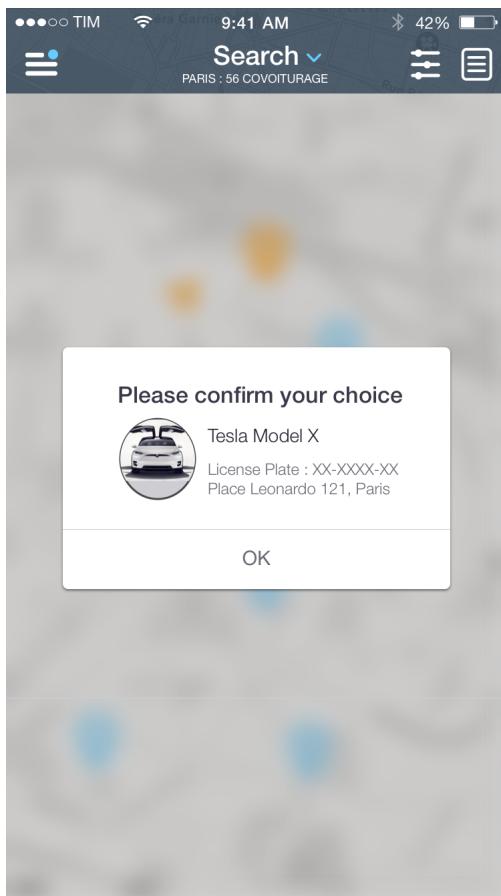


Figure 7: Confirm selection

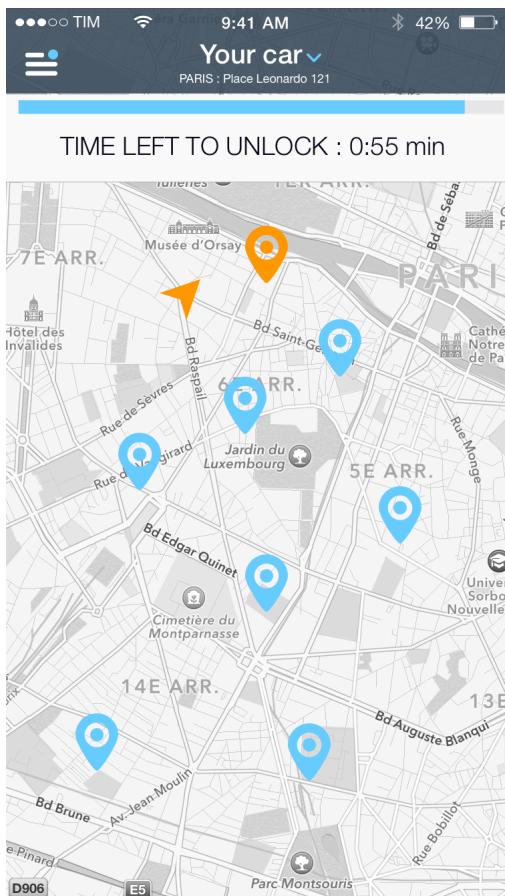


Figure 8: Time left to unlock

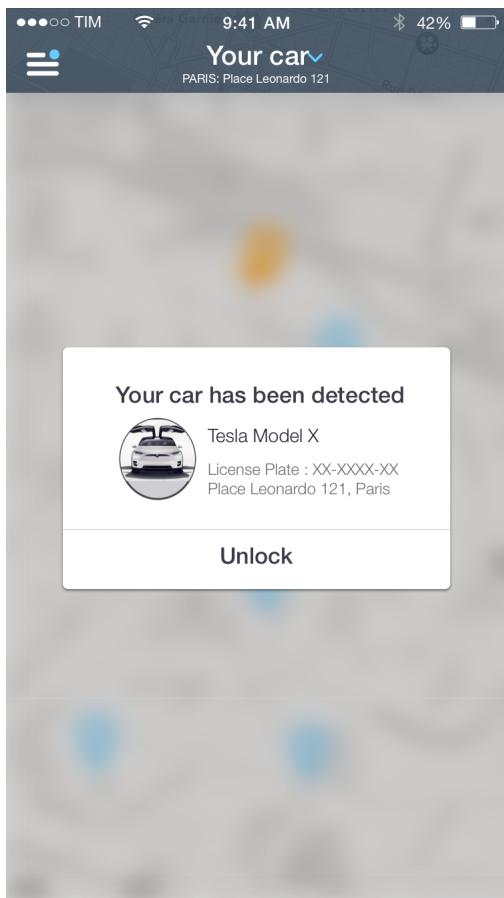


Figure 9: Unlock car

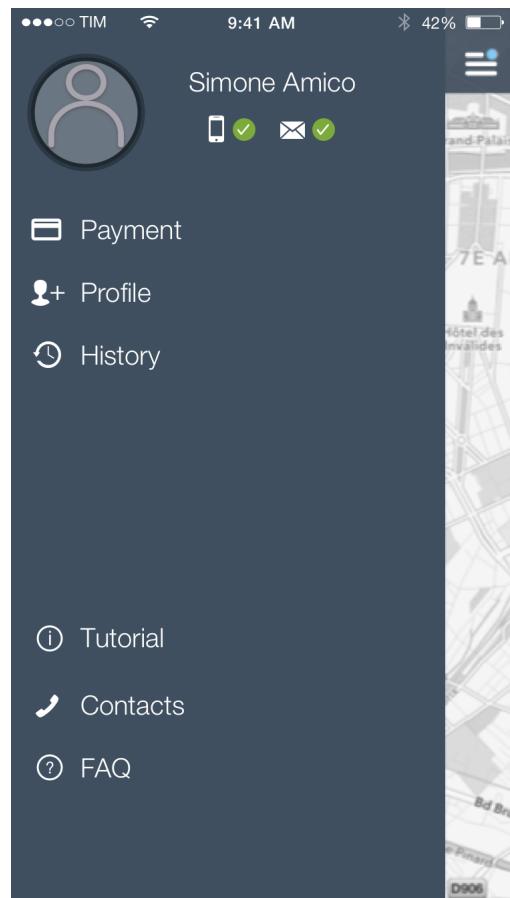


Figure 10: Menu

3.1.2 Web Application

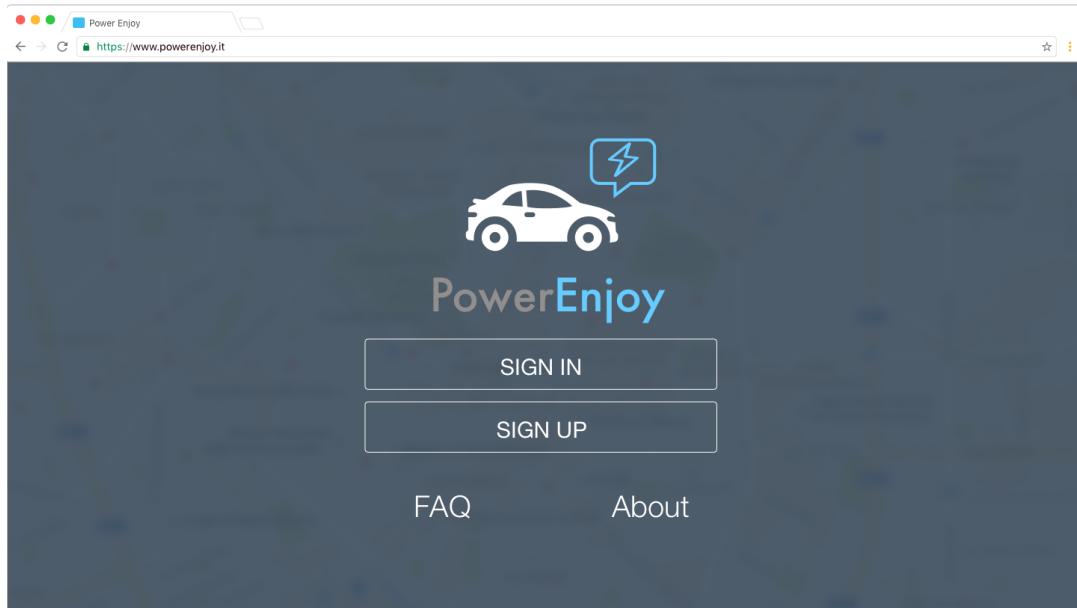


Figure 11: Homepage

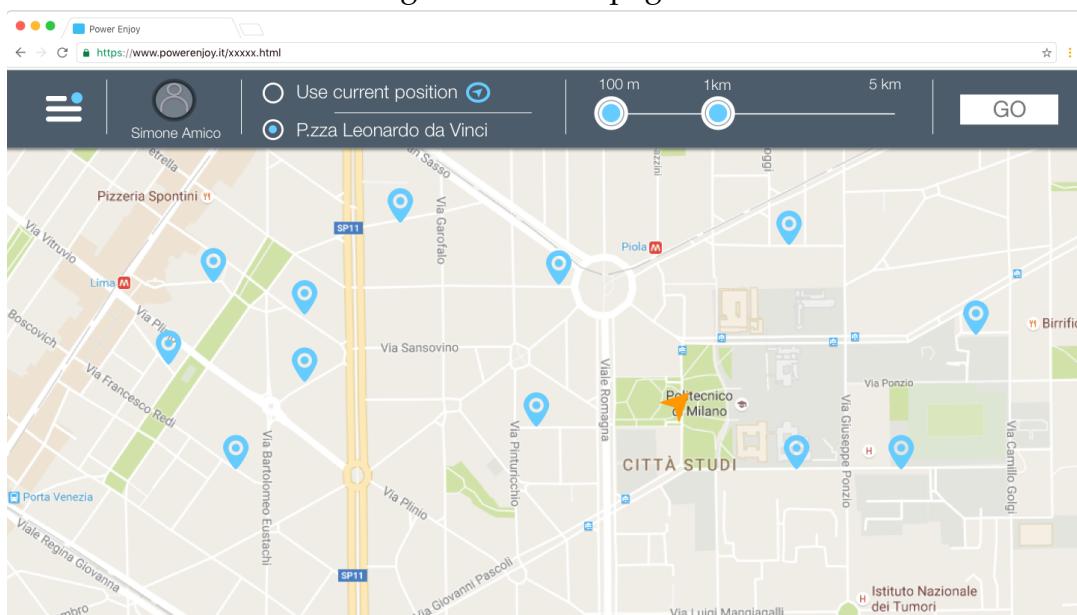


Figure 12: Main page with map an car locations

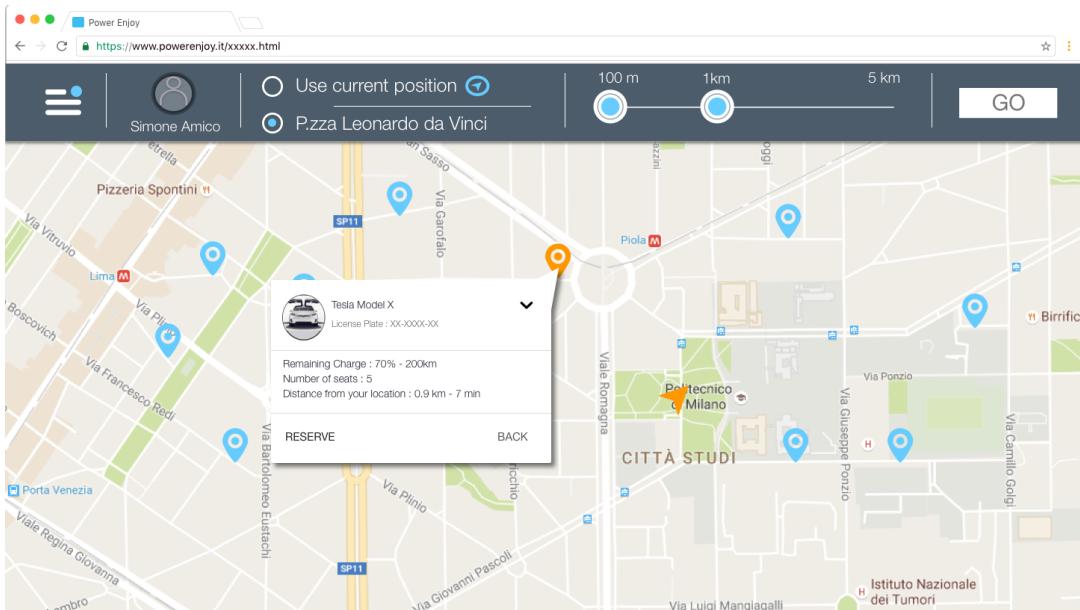


Figure 13: Main page with car selection

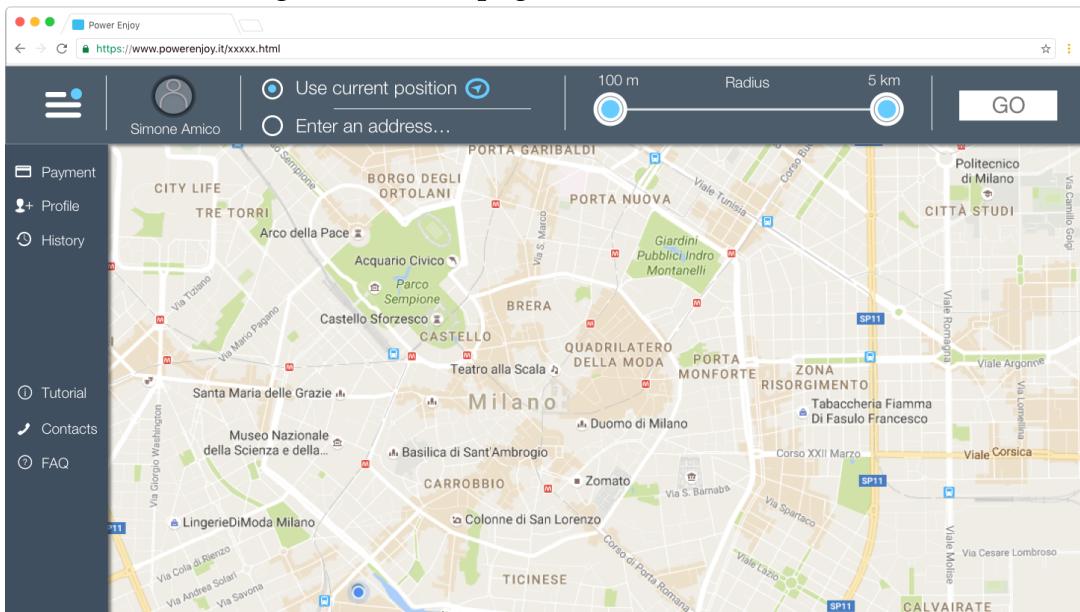


Figure 14: Main page with account info bar

3.1.3 On-Board Application (Touch)

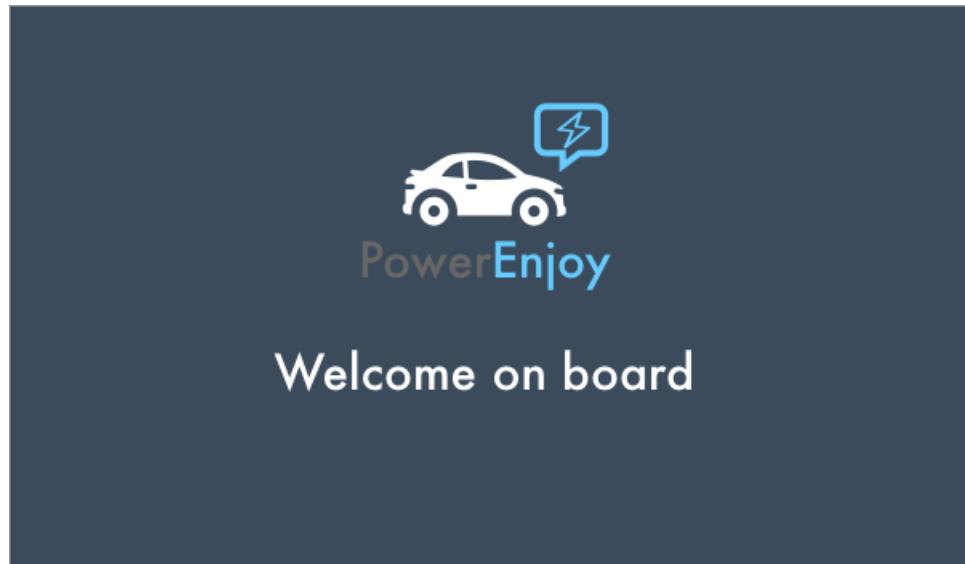


Figure 15: Welcome screen

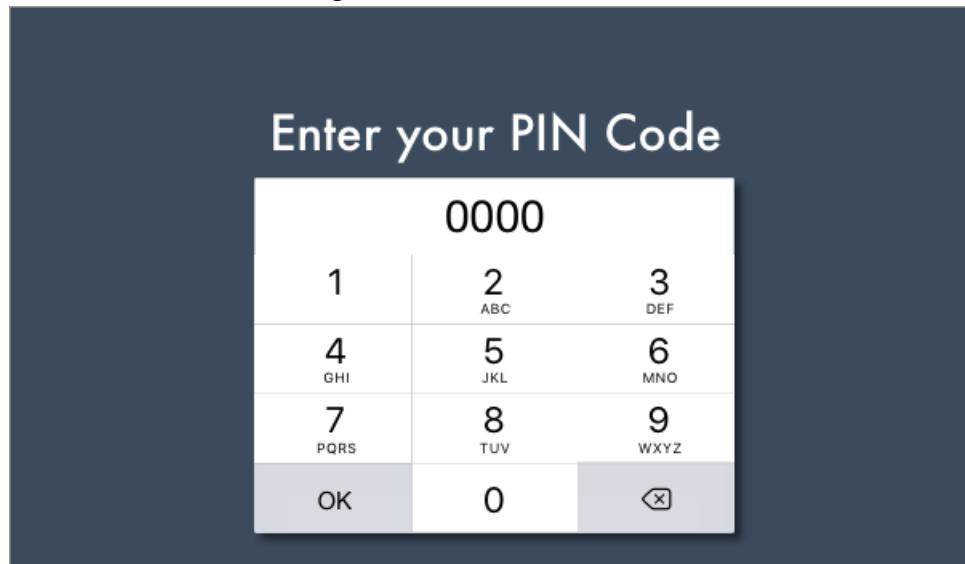


Figure 16: Pin request

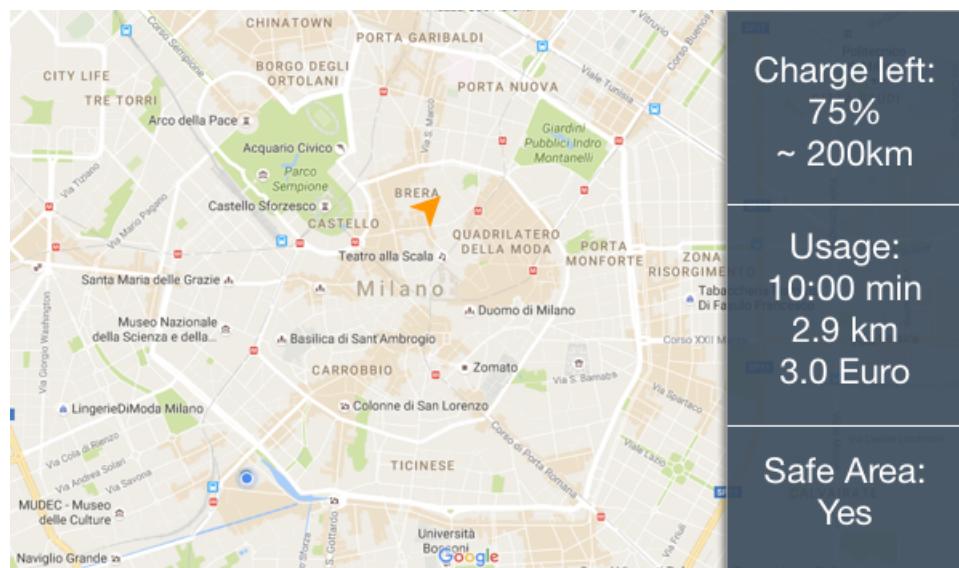


Figure 17: Main screen

3.2 Scenarios

3.2.1 Scenario 1:User sign-up

Maria is going out with friends for dinner .She doesn't own a car but has to travel to the other side of the city. She knows that a taxi ride would be expensive and other forms of public transport are packed with people during rush hour. She decides to download the PowerEnjoy application. Once the download is completed she fill out the necessary registration informations providing a valid license and payment method and is ready to go and enjoy the evening with her friends.

Actor	Guest
Goal	User registration
Input Condition	NULL
Event Flow	<ol style="list-style-type: none">1.Open the app/webpage2.Click on the "sign up" button.3.Fill out the required fields.4.Press confirmation button5.The system checks the input and sends out a confirmation message.
Output Condition	Guest end the registration process and is now a user so he/she can use his/her credentials to log into the system and use the service.
Exception	<p>The user is already registered.</p> <p>The guest data are invalid (invalid payment method or driver's license)</p> <p>No internet connection or server malfunction.</p>

Table 1: User Registration

3.2.2 Scenario 2: Log in

Angelo woke up late for his exam and has to hurry up. The bus stop is too far away from his University so he has to find an alternative. So he logs into the system to look immediately for a car.

3.2.3 Scenario 3: Reserve a car

Francesca has to take the train. The station is far away so she has to drive but she doesn't want to leave her car parked in an expensive car lot. She decides to search and reserve the nearest PowerEnjoy.

3.2.4 Scenario 4: Unable to reach car in time

Giacomo wants to meet his friends at the cinema. He reserves a car near him but as he steps out of his front door he meets an old friend who offers him a lift. Giacomo never reaches the car he reserved so he has to pay a fee of 1 Euro for not unlocking the car within one hour.

3.2.5 Scenario 5: Car problems

Gianni reserved a car but once he reached it he notices that the car has a flat tire. So he calls the Support Operator for help.

3.2.6 Scenario 6: Share ride with passengers

Lucia's parents are in town and she has to pick them up at the airport. She reserves a PowerEnjoy car as she knows that she will get a discount of 10% on the ride's fee if she takes two passengers with her.

3.2.7 Scenario 7: Drive with Money Saving Option

Flavio wants to attend his brother's football match. He decides to use the money saving option which automatically shows him the optimal parking solution closest to his destination. In return he gets a discount on his ride's fee.

3.2.8 Scenario 8: Leaving a car with battery level >50%

After a long day working , Edoardo is tired but has to visit his ill mother who lives not too far away. He reserves a car and takes a short ride to his destination. He leaves the car with a battery level over 50% so he's entitled to get a discount of 20% on his fee.

3.2.9 Scenario 9: Charge car

Daniele is driving a PowerEnjoy car to get to football stadium. Near the stadium there is a PowerEnjoy charging station. He decides to park the car there and to plug it into the charging station : as a reward PowerEnjoy applies a discount of 30% on his fee.

3.2.10 Scenario 10: Out of safe area parking

Andrea has to meet his girlfriends parents in the suburbs. He decides to take a PowerEnjoy and park on a private driveway. Unfortunately the parking spot is marked as *unsafe* so the onboard display notifies him about the situation. This way Andrea parks the car in an accessible position for everyone.

3.2.11 Scenario 11: Bad parking position

Alessandro is running late for his date and decides the park his reserved car as close as possible. Unfortunately he parks the car far away from the nearest power grid : PowerEnjoy has to take care of this situation , so Alessandro is charged with an additional 30% on his ride's fee.