



# POLITECNICO MILANO 1863

Computer Science and Engineering

A.A. 2016/2017  
Software Engineering 2 Project:

“PowerEnJoy”

**R**equirements **A**nalysis and **S**pecification **D**ocument

November 8, 2016

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## Revision History

Revision	Date	Author(s)	Description
1.0	13/11/16	Piazzolla Millimaggi	First document issue

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# 1 Introduction

## 1.1 Purpose

This document is the RASD (Requirement Analysis and Specification Document). The goal of this document is to describe the functional and non-functional requirements of the system in order to show the constraints on the software that the developer has to take into account. This document can have a legal value and can be used as a contractual basis between the customers and the developers.

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## 1.2 Scope

The system the has to be developed is called *PowerEnJoy*. It is a digital system for the management of a car-sharing service that only employs electric cars. In particular the aim is to develop a mobile application that allows the user to pick up and use electric cars in the areas reached by the service.

## 1.3 Definitions, Acronyms, Abbreviations

### 1.3.1 Definitions

- User: is a general person who uses “PowerEnJoy”.
- Registered User: a user that have completed the registration process.
- Guest: a visitor, not authenticated user.
- Driver: authenticated user that drive the requested car.
- Car reservation: allocation of a car for a defined amount of time.
- Safe area: area in which the User can find cars, pick them up and park them.
- Special parking area: area in which the user can park the car and also charge it plugging it into the power grid.

### 1.3.2 Acronyms

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- RASD: Requirements Analysis and Specification Document.
- DB: Database.
- DBMS: Database management system.
- API: Application Programming Interface.



- OS: Operating System.
- JVM: Java Virtual Machine.
- J2EE: Java Enterprise Edition.

### 1.3.3 Abbreviations

- [Gn]: n-goal.
- [R-n]: n-requirement.

## 1.4 Reference documents

- IEEE Std 830-1998 IEEE Recommended Practice for Software Requirements Specifications.
- IEEE Std 1016 tm -2009 Standard for Information Technology-System Design-Software Design Descriptions.
- ISO/IEC/IEEE International Standard - Systems and software engineering – Life cycle processes –Requirements engineering

## 1.5 Document Overview

The structure of this document follows the IEEE standard for the editing of a RASD document. In particular the structure is:

- Introduction: it provides a general description of the document and the system that has to be developed
- Overall Description: it provides a general description of all the things that affects the work on the project and the elaboration of the requirements. So it gives information about hardware and software choices and availability, the main functions of the product, the description of the people at whom the product is addressed, the constraints that will limit the work of the developer, the assumptions done before the development and the dependencies that the use of the product will have from hardware and software entities
- Specific Requirements: it provides a detailed description of the requirements of the product

## 1.6 Given Problem

## 1.7 Proposed System

## 1.8 Stakeholders

Matteo: io qui la farei un po' discorsiva visto che sono solo i cittadini (magari anche i turisti)

- Citizens

## 1.9 Actors

The entities identified in the problem description are the following:

- GUEST: is a visitor, someone that isn't signed-up yet. He can visualize "PowerEnJoy" Web site and download the mobile app but he cannot access to any service.
- USER: is a client signed-up, via Web or mobile app. He accesses "Passenger Area" and, after being successfully logged in, he can see his personal section, modify his personal information. He can also access to all services, view a map of available cars, make car reservations, modify or cancel them.

## 1.10 Goals

- [G1] Allow guests to register to "PowerEnJoy" service through both website or mobile application.
- [G2] Allow registered users to login and logout.
- [G3] Allow authenticated users to modify their personal details and payment informations.
- [G4] Allow authenticated users to view a list of available cars in a configurable radius of distance from user position or specified address.
- [G5] Allow authenticated users to view available cars, safe areas and special parking areas on a map in the application.
- [G6] Allow authenticated users to request for pick up an available car for a limited time and unlock it when the User is in proximity.
- [G7] Allow authenticated users to drive the unlocked car inside the border of the city.
- [G8] Allow driver to be constantly informed about the service through a screen on the car.
- [G9] Allow driver to get discount in base of pick up/parking position of the car, number of passengers and status of the battery.
- [G10] Allow the system to charge the user with an extra fee if he doesn't pick up a car reserved within an hour from the reservation.
- [G11] Allow the system to make a car available again after an hour from that car reservation.

In teoria la lista dei goal deve essere presente

Forse meglio dividere G6 in 2 (una per la request e uno per lo sblocco)

- [G12] Allow the driver to conclude his travel and stop being charged after he turns off and exits the car.
- [G13] Allow the system to charge the user with an extra fee if he leaves the car at more than 3 km from the nearest power grid station.
- [G14] Allow the user to put the car in charge when he leaves it in a special parking area.

## 2 Overall Description

### 2.1 Product perspective

(further details on the shared phenomena and a domain model—>class diagrams and statecharts)

The system that we are going to develop is made of several parts.

- A Mobile Application usable from every Tablet or Smartphone that has access to an internet connection. The application will be available on Android and iOS.
- A Website where a user can find information about the service.
- A Server backend to manage the service.

#### 2.1.1 System interfaces

The system will depend on a device installed onboard every 'PowerEnjoy car. That onboard device will communicate with the user and via internet to the server.

#### 2.1.2 User interfaces

The available interfaces will be:

- the mobile application
- the website

The website will be implemented with a responsive design to adapt to all most common screen aspect and resolution with clear and minimal UI to favorite accessibility. The mobile application will be graphically similar to the website with a few views. The use of the website or the mobile application won't be necessary during driving.

#### 2.1.3 Hardware interfaces

The main hardware interaction concerns the geolocalization feature, and in particular the GPS hardware on the smartphone device. The application need an internet connection so a smart device with a 3G or LTE connectivity is required.

#### 2.1.4 Software interfaces

To provide the best use of the service through the website an HTML5 compliant browser is required and an up-to-date version of Android or iOS operating system for the mobile application.

## 2.2 User characteristics

Everyone who has a car license will be able to register to the car-sharing service and drive one of the electric car available. Because of the variety of people that will use the service, the mobile application must be simple and user-friendly, so that anyone can use it even if it has a little knowledge about the use of a mobile device.

## 2.3 Constraints

## 2.4 Assumptions

1. Cars can be parked in every area of the city where the parking is allowed, either it is free or chargeable. The company takes care of the payment for chargeable parkings.
2. Every car can be uniquely recognized by his plate number.
3. The position of the users are well-known thanks to GPS.
4. The user is the one and only who drives the cars he reserves.
5. Any user who reserves a car has enough money on his credit card to pay the travel.
6. Every car is periodically checked to ensure proper operation.
7. The travel of a driver is considered finished when the the engine is off and after a minute from the moment in which he closes the car doors.
8. Power EnJoy offers different models of cars with different engine sizes

Da com-  
pletare!

## 2.5 Regulatory policies

It's user responsibility to ensure that the use of the system complies with the local laws and policies. If the user register to the service must allow for the permission to acquire, store and process personal data and web cookies. The system must offer to the user the possibility to delete the account and all the personal data.

### 2.5.1 Possible Future Implementations

Depending on the success that the developed system will have, it will be possible to extend the car-sharing to Scooters and Mini-Cars, in order to reach also younger customers.

Another possibility for the future is to allow users to get in touch with strangers and pick them up in the middle of the travel.

Another future improvement could be the possibility for the users share a trip with strangers and split the charge as other services like BlaBlaCar.

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## 2.6 Product requirements

### 2.6.1 Functional Requirements

- User registration
- Login
- Check for cars availability using user's position
- Check for cars availability using address
- Reserve a car
- Cancel a reservation
- Check the amount paid for a travel
- Check the log of reservations done
- View the details of cars available (level of the charge)

## 3 Specific Requirements

### 3.1 Functional Requirement

With these requirements are defined features and functions with which the user will interact directly.

#### 3.1.1 [G1]Allow guests to register to "PowerEnJoy" service through both website or mobile application.

- **[R-1]** The system shall allow registration only if the patent license number is provided.
- **[R-2]** The system shall provide a home page in which a guest user must be able to know what the service is.
- **[R-3]** The system shall demand the User to read and accept all term of use of the service.
- **[R-4]** The system shall provide a form in which a Guest can insert his personal data for the registration to the service.
- **[R-5]** The system shall provide a form in which a Guest can insert his payment information.

**3.1.2 [G2]Allow registered users to login and logout.**

- **[R-6]** The system shall show a sign-up page with a login form and a logout button if the User is already logged in.
- **[R-7]** The system shall validate any input in both client and server side.
- **[R-8]** The system shall prevent anyone from logging more than once at a time.
- **[R-9]** The system shall show an error message in case of wrong credential.
- **[R-10]** The system shall provide a password recovery procedure.
- **[R-11]** The system shall prevent brute force attack limiting the number of try per IP address.
- **[R-12]** The system shall redirect the User to the homepage as a guest after the logout.

**3.1.3 [G3]Allow authenticated users to modify their personal details and payment informations.**

- **[R-13]** The system shall show an account page with all the information that the User sent during account registration.
- **[R-14]** The system shall ask for the password before saving the edited details.
- **[R-15]** The system shall send an email to notify the changes.

**3.1.4 [G4]Allow authenticated users to view a list of available cars in a configurable radius of distance from user position or specified address.**

- **[R-16]** The system shall show on a web page or a view in the application the position of the available car.
- **[R-17]** The system shall allow the User to set a search radius.
- **[R-18]** The system shall ask the User for the GPS position or to provide an address.

**3.1.5 [G5]Allow authenticated users to view available cars, safe areas and special parking areas on a map in the application.****3.1.6 [G6]Allow authenticated users to request for pick up an available car for a limited time and unlock it when the User is in proximity.**

- **[R-19]** The system shall not allow the User to request multiple cars at the same time.

- **[R-20]** The system shall check if the payment information are valid and show an error if not.
- **[R-21]** The system shall automatically cancel a car reservation if the User don't unlock the car in one hour without charging the User.
- **[R-22]** The system shall check for the User position and if the distance from the car is less than 50 meters allow to unlock the car.

**3.1.7 [G7] Allow authenticated users to drive the unlocked car inside the border of the city.**

R23=R25

- **[R-23]** The system shall inform the User if she is driving outside the city area.
- **[R-24]** In case of driving outside the city area the system shall charge a 100% more of the current charge.

**3.1.8 [G8] Allow driver to be constantly informed about the service through a screen on the car.**

- **[R-25]** The system shall inform the User if she is driving outside the city area.
- **[R-26]** The system shall inform the User of the amount that will be charged.
- **[R-27]** The system shall inform the User of the position of charging areas nearby the current car position.
- **[R-28]** The system shall show on a map the special parking area and the safe area nerby the current car position.

**3.1.9 [G9] Allow driver to get discount in base of pick up/parking position of the car, number of passengers and status of the battery.**

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- **[R-29]** The system shall detect the number of passengers on the car
- **[R-30]** The system shall apply a discount of 10% on the last ride if it detects the presence of two other passengers on the car in addition to the driver.
- **[R-31]** The system shall check the level of the battery when a car is left.



- **[R-32]** The system shall apply a discount of 20% on the last ride if it detects that the car was left with no more than 50% of the battery empty.
- **[R-33]** The system shall check if the user plugges the car into the power grid when he left the car in a special parking area.
- **[R-34]** The system shall apply a discount of 20% on the last ride if it detects that the user takes care of plugging the car into the power grid when he leaves the car in a special parking area.

**3.1.10 [G10] Allow the system to charge the user with an extra fee if he doesn't pick up a car reserved within an hour from the reservation.**

- **[R-35]** The system shall charge the user with a 1 euro fee if he doesn't pick up a requested car within an hour from the reservation

**3.1.11 [G11] Allow the system to make a car available again after an hour from that car reservation.**

**3.1.12 [G12] Allow the driver to conclude his travel and stop being charged after he turns off and exits the car.**

- **[R-36]** The system shall detect the car turning off and the closure of the doors and stop charging the driver after this two actions are accomplished

**3.1.13 [G13] Allow the system to charge the user with an extra fee if he leaves the car at more than 3 km from the nearest power grid station.**

- **[R-37]** The system shall calculate the distance from the parking position to the nearest power grid station and if that distance is more than 3 km, shall charge the 30% on the last ride.

**3.1.14 [G14] Allow the user to put the car in charge when he leaves it in a special parking area.**

- **[R-38]** The system shall detect that the car is plugged into the power grid and start charging the battery

## **3.2 Non-Functional Requirement**

- PowerEnJoy has to be available 24h/7d.
- Both mobile application and website must be reactive and usable.

### 3.2.1 Reliability

The service has to guarantee an 24h/7d availability. Components of the project code will be tested after the implementation phase to ensure that they are functional. All the critical software bugs found must be patched in at least 48h. If a Backend API change must guarantee support for client that implement older API. All the system data must be constantly backed up to assure the data recovery in case of fault.

### 3.2.2 Performance

### 3.2.3 Usability

- The User must be able to use the system with mouse, keyboard and touchscreen.
- The User must be able to choose from several language.
- At the first login the system must provide a simple and skippable 3-views tutorial of the service.

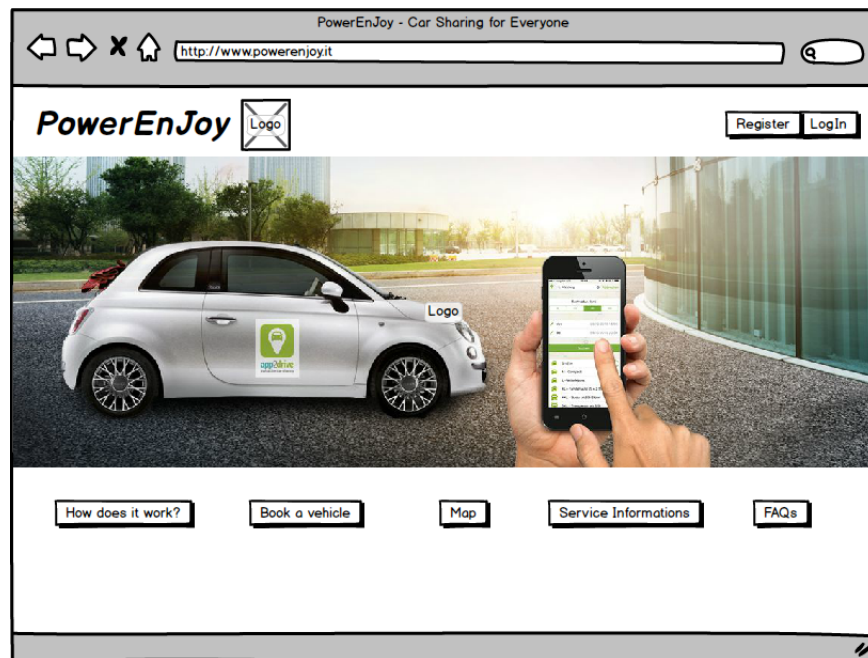


Figure 1: PowerEnJoy website homepage

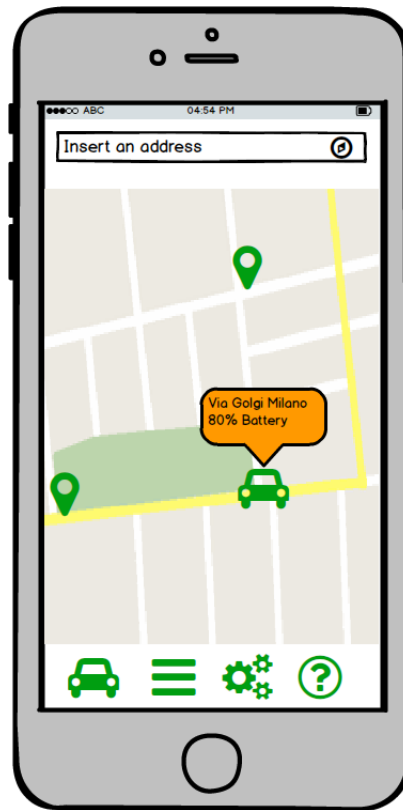


Figure 2: PowerEnJoy Mobile Application map view

### 3.2.4 Security

The system must ensure that all data is protected from unauthorized access. Password should be saved on a DB hashed and salted. Every input from the user and every request must be sanitized

### 3.2.5 Performance

### 3.2.6 Maintainability and Portability

### 3.2.7 Network connections

### 3.2.8 Cookies

### 3.2.9 Hardware requirement

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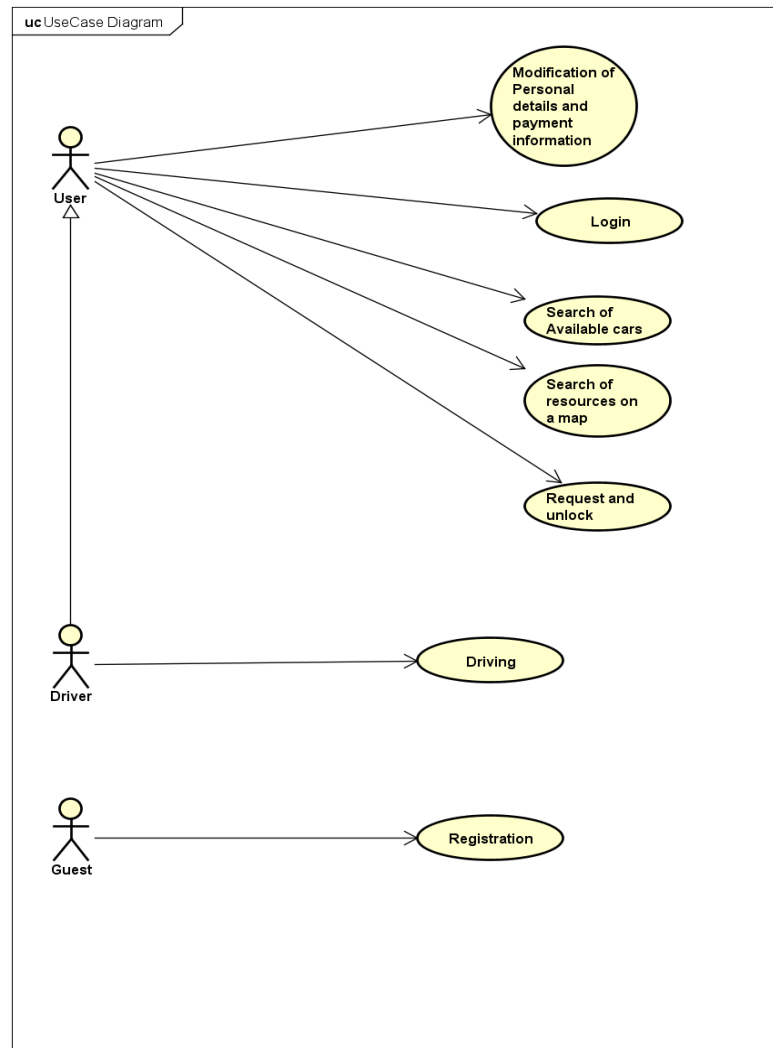
The communication between client and server is done using HTTPS REST

API encrypted with TLS connections. Nginx webserver and a large use of caching. Google Maps API.

#### **3.2.10 Concurrent operations**

### 3.3 Use Case

#### 3.3.1 Use Case Diagram



### 3.3.2 User Registration

Use Case Name	User Registration
Actors	Guest
Goals	[G1] Allow guests to register to "PowerEnJoy" service through both website or mobile application.
Preconditions	Guest hasn't registered to the webapp yet.
Postconditions	Guest is signed-up and promoted to "PowerEnJoy" User.
Normal Flow	<ol style="list-style-type: none"><li>1. Guest accesses to the webapp or the mobile application</li><li>2. Guest clicks on "Sign Up" button</li><li>3. Guest fill Sign-up form fields, entering<ul style="list-style-type: none"><li>-Name</li><li>-Surname</li><li>-Email address</li><li>-Password</li><li>-Telephone Number</li><li>-Driving License number</li></ul></li><li>4. Guest accepts the term of use</li><li>5. Guest clicks on "Confirm" button</li></ol>
Alternative Flows	-
Exceptions	<ol style="list-style-type: none"><li>1. At least one field is empty when the guest has confirmed. The system shows again the registration form, showing in addition a message advising the guest that she missed a field.</li><li>2. At least one field is invalid when the guest has confirmed. The system shows again the registration form, indicating the invalid field.</li><li>3. Entered email is already associated to another account. The system shows again the registration form, showing in addition a message advising the guest that the email is already associated to another account.</li></ol>

### 3.3.3 User Login

Use Case Name	User Login
Actors	User
Goals	[G2] Allow registered users to login and logout.
Preconditions	User has signed-up as PowerEnJoy User.
Postconditions	User is redirected to personal area.
Normal Flow	<ol style="list-style-type: none"> <li>1. User accesses to the webapp or the mobile application</li> <li>2. User clicks on "Log-in" button</li> <li>3. User fills username and password fields of Log-in form</li> <li>4. User clicks on "Submit" button</li> </ol>
Alternative Flows	-
Exceptions	<ol style="list-style-type: none"> <li>1. Invalid username and/or password. User is redirected by the system again to the page of Login form.</li> <li>2. At least one field is empty. User is redirected by the system again to the page of Login form.</li> </ol>

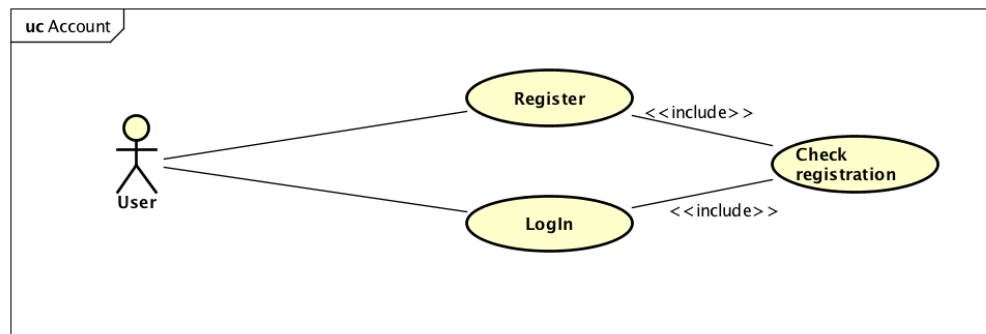


Figure 3: Use Case Login and Registration procedure. Refer to Goal 1 and 2

### 3.3.4 Modification of personal details and payment information

Use Case Name	Modification of personal details and payment information
Actors	User
Goals	[G3] Allow authenticated users to modify their personal details and payment informations.
Preconditions	User is logged in
Postconditions	User is redirected to the modifications area where he can modify his personal information
Normal Flow	<ol style="list-style-type: none"><li>1. User clicks on "Personal Details" button in his personal area. A page with the personal data of the user is shown</li><li>2. User clicks on "Modify Data" button. A form for modifications is shown</li><li>3. User fills fields he wants to modify</li><li>4. User clicks on "Confirm" button</li><li>5. User is redirected to his personal area</li></ol>
Alternative Flows	-
Exceptions	-



### 3.3.5 Search of available cars

Use Case Name	Search of available cars
Actors	User
Goals	[G4] Allow authenticated users to view a list of available cars in a configurable radius of distance from user position or specified address.
Preconditions	User is logged in
Postconditions	User is redirected to a page with the list of the available cars
Normal Flow	<ol style="list-style-type: none"><li>1. User clicks on "Search a car" button in his personal area. A form is shown</li><li>2. User select a distance from the "Distance from your position" field</li><li>3. User clicks on "Confirm" button</li><li>4. User is redirected to a page showing the available cars</li></ol>
Alternative Flows	<ul style="list-style-type: none"><li>• Different flow from step 2:<ol style="list-style-type: none"><li>2 User write an address in the "Address" field</li><li>3 User clicks on "Confirm" button</li><li>4 User is redirected to a page showing the available cars</li></ol></li></ul>
Exceptions	<ol style="list-style-type: none"><li>1. There aren't available cars within the distance set</li><li>2. There aren't available cars near the address set</li></ol>

### 3.3.6 Search of resources on a map

Use Case Name	Search of resources on a map
Actors	User
Goals	[G5] Allow authenticated users to view available cars, safe areas and special parking areas on a map in the application.
Preconditions	User is logged in
Postconditions	User is redirected to a page with a map where resources (available cars, safe areas, special parking areas) are shown
Normal Flow	<ol style="list-style-type: none"><li>1. User clicks on "Search resources on the map" button. A form is shown</li><li>2. User select a distance from the "Distance from your position" field</li><li>3. User clicks on "Confirm" button</li><li>4. User is redirected to a page showing the resources on a map.</li></ol>
Alternative Flows	<ul style="list-style-type: none"><li>• Different flow from step 2:<ol style="list-style-type: none"><li>2 User write an address in the "Address" field</li><li>3 User clicks on "Confirm" button</li><li>4 User is redirected to a page showing the resources on a map.</li></ol></li></ul>
Exceptions	<ol style="list-style-type: none"><li>1. There aren't available cars within the distance set</li><li>2. There aren't available cars near the address set</li></ol>

### 3.3.7 Request and Unlock

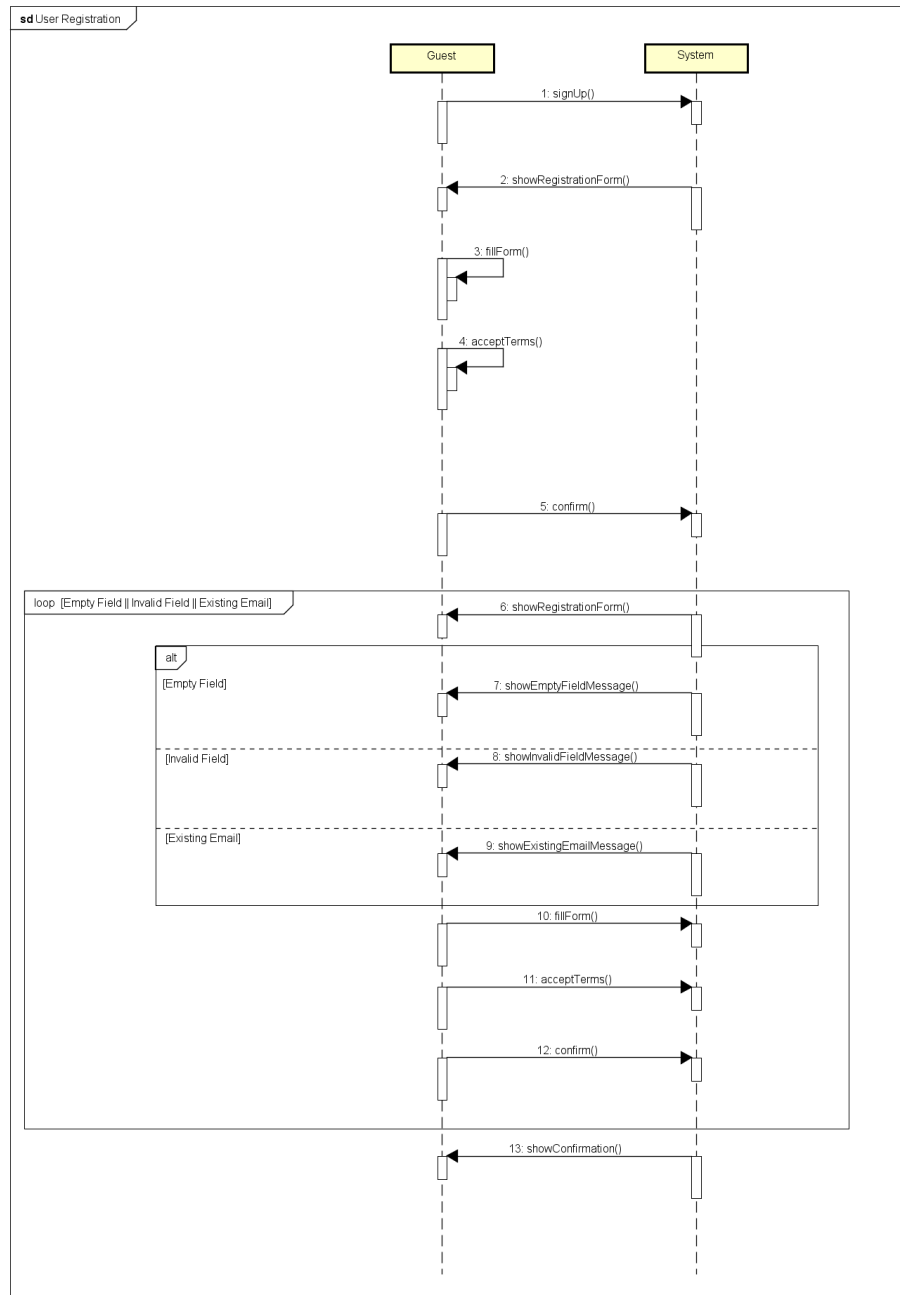
Use Case Name	Request and Unlock
Actors	User
Goals	[G6] Allow authenticated users to request for pick up an available car for a limited time and unlock it when the User is in proximity. [G10] Allow the system to charge the user with an extra fee if he doesn't pick up a car reserved within an hour from the reservation. [G11] Allow the system to make a car available again after an hour from that car reservation.
Preconditions	User is logged in and has searched a car (3.3.5, 3.3.6)
Postconditions	The car requested is reserved for the user
Normal Flow	<ol style="list-style-type: none"><li>1. User selects a car from the list.</li><li>2. A page with information about the car (battery level, model, engine size, autonomy in kilometers) is shown</li><li>3. User clicks the "Request" Button</li><li>4. The car is reserved for the user</li><li>5. User reaches the car and is less than 3 meters far from the car</li><li>6. User unlocks the car clicking on the "Unlock" button in the application</li></ol>
Alternative Flows	<ul style="list-style-type: none"><li>• Steps 1 is different:<ol style="list-style-type: none"><li>1 User select a car on the map.</li></ol></li><li>• Different flow from step 5:<ol style="list-style-type: none"><li>5 An hour passes without the User unlocking the car</li><li>6 The system charges the User with an extra fee of 1 euro</li><li>7 The system cancels the request and makes the requested car available again</li></ol></li></ul>
Exceptions	<ol style="list-style-type: none"><li>1. The car selected has been requested by another user before the User has clicked on the "Request" button.</li></ol>

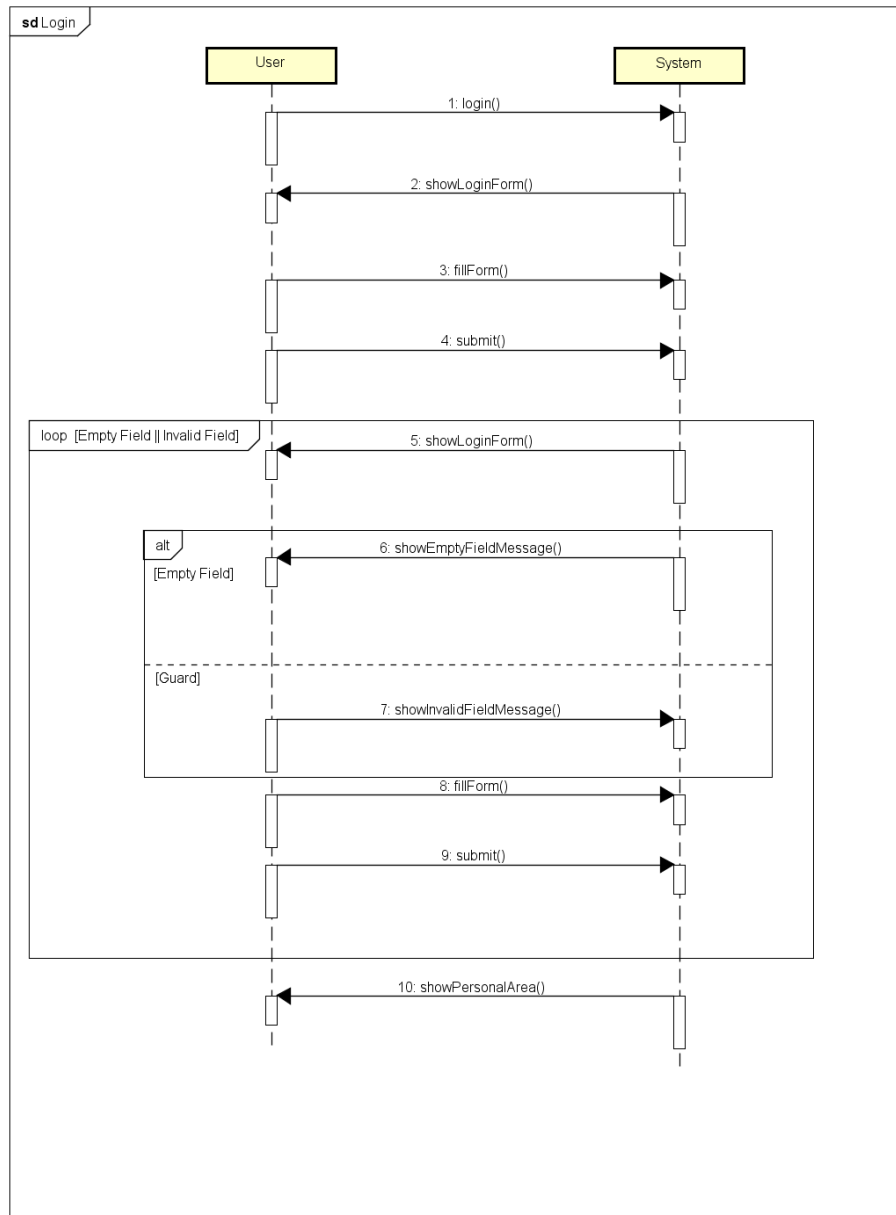
### 3.3.8 Driving

Use Case Name	Driving
Actors	Driver
Goals	<p>[G7] Allow authenticated users to drive the unlocked car inside the border of the city.</p> <p>[G9] Allow driver to get discount in base of pick up/parking position of the car, number of passengers and status of the battery.</p> <p>[G12] Allow the driver to conclude his travel and stop being charged after he turns off and exits the car.</p> <p>[G13] Allow the system to charge the user with an extra fee if he leaves the car at more than 3 km from the nearest power grid station.</p>
Preconditions	Driver is logged in and has searched, requested and unlocked a car
Postconditions	-
Normal Flow	<ol style="list-style-type: none"> <li>1. Driver enters the car, eventually also other passengers enter the car</li> <li>2. Driver starts driving</li> <li>3. The system detects the number of passengers</li> <li>4. The screen shows a map with the position of the car, the safe areas and special parking areas near the car position</li> <li>5. The screen shows the money to be charged up to the current moment</li> <li>6. The system charges the standard fee every minute.</li> <li>7. Driver parks and exit the car and, if any, the other passengers exit the car</li> <li>8. The system locks the car</li> <li>9. The system detects the level of the battery</li> <li>10. The system detects if the car has been plugged in a power grid</li> <li>11. The system detects the position of the left car</li> <li>12. The system applies a discount on the ride of the: <ul style="list-style-type: none"> <li>• 10%, if it has detected the presence of at least two other passengers in addition to the driver during the travel</li> <li>• 20%, if it has detected that the car was left with no more than the 50% of the battery empty</li> </ul> </li> <li>13. The system charges the 30% more on the last ride if it detects that the car has been left more than 3 km far from the nearest power grid station</li> </ol> <p>The system takes the money from the User, using his selected payment method</p>
Alternative Flows	<ul style="list-style-type: none"> <li>• Before the last step, the system detects the presence of at least two other passengers in addition to the driver during the travel and so applies a 10% discount on the ride</li> <li>• Before the last step, the system detects that the car was left with no more than the 50% of the battery empty and so applies a 10% discount on the ride</li> <li>• At step 7 the Driver parks the car in a special parking area and plugs the car into the power grid. Before the last step the the system detects that the car has been plugged into the power grid and so applies a 20% discount on the ride</li> <li>• While driving the Driver exits the city area. So: <ol style="list-style-type: none"> <li>1. An acoustic signal is emitted by the screen</li> <li>2. A message is shown on the screen, warning the Driver that he has exited the city area</li> <li>3. The system charges the 100% more than the standard fee every minute until the driver re-enters in the city area</li> </ol> </li> </ul>
Exceptions	-

C'è da fare  
chiarezza su  
city area/  
safe area

## 4 Sequence Diagrams





## 5 Scenarios

### 5.1 Scenario 1

Andrew is a student. Because in his home city there aren't the courses he wants to attend, he moves to another city. There he rents a flat with other students.

During the week he doesn't need any mean of transport and travels only on foot, because his house is very near to the university. In the weekend Andrew wants to have some fun with his friends, but unfortunately the areas with the coolest bars are far from his house and at night there aren't public transports going to those area. Futhermore neither he or his friends have a car, because they are all out of their home towns. So Andrew uses his Power EnJoy application, searches a car near his address, reserves a car, reaches it and drives till his favourite fun area, carrying with him some of his friends.

## 5.2 Scenario 2

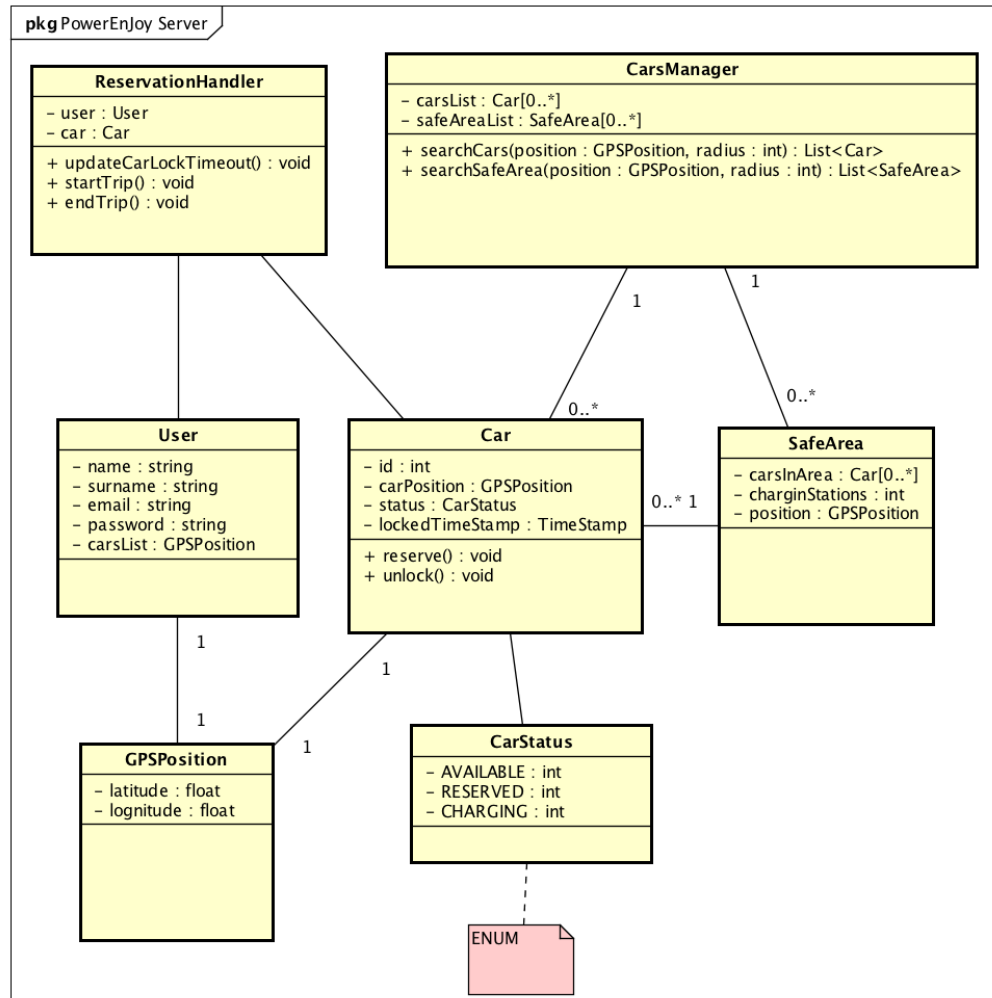
It's Friday night and Bob have to go out with his girlfriend. Unfortunately his parents are away and have the car with them, so Bob searches a car near his home using Power EnJoy application. He sees on the map that there is only one car near his house and that its autonomy allows him only to reach his girlfriend's house. He looks for a special parking area near his girlfriend's house and finds one. So he decides to go to that special parking area, leave there the car, plug it into the power grid and request again for that car. Then he waits there for his girlfriends, having enough charge when she arrives to go downtown.

## 5.3 Scenario 3

Jim and Kate are two young tourists. They walked a lot all the day and so now they want to find an easy way to go to their hotel. Jim his registered to the Power EnJoy car-sharing service, so his reserves and picks up a car. They decide to park the car near the hotel, but when they're going to do that, they see a message telling that they are more than 3 km far from the nearest power station. Because Jim knows would have to pay more because of that and he hasn't a lot of money left, he decides to park nearer to a power station.

## 5.4 Class Diagram

### 5.4.1 PowerEnJoy server



powered by Astah

Figure 4: PowerEnJoy Server Class Diagram



## 6 ORE

23/10/16 Matteo 3h Andrea XX

24/10/16 Matteo 3h

25/10/16 Matteo 1h

01/11/16 Matteo 1h

02/11/16 Matteo 4h