**Introduction**

**General description of the problem**

We will project PowerEnJoy, a car sharing service that allows people to reserve and drive electrical cars in Milano.

The system allows users to reserve a car via mobile app or via web app, using a GPS system to identify the position of the user and the position of the available cars near him/her.

Users should only see the available cars displayed in a map, that means that he can’t see cars already reserved by other users or cars that are already running.

Users can drive a car everywhere but they must park within safe areas (defined accurately by the company), otherwise they will pay a fee.

We decided that the registration is mandatory before using the service to collect all the needed information about people who want to drive PowerEnJoy cars.

The system provides user some eventual discounts, for example if a user shares the car with at least two other people or if he/she charges the car at least at 80% of the power at the end of the ride.

The society has also assumed some operators to deal with bad behaviors by users, like out of charge cars parked somewhere in the city or cars left out of safe areas.

**Stakeholders identifying**

ElectricEngine Inc. is our stakeholder: it is an enterprise that has produced electric cars from 1999 and has decided to invest in car-sharing in our city.

It wants a service completely eco-friendly using its model of electric car called “Volta”; its CEO is our Prof Luca Mottola.

However, we can adapt this system to accomplish other requests from other enterprises with the same type of cars.

**Actors identifying**

* Guests: people who hasn’t registered to the service yet, they only can read a description of the service or sign up.
* Users: people who has already signed up so that the system has given them the password that can be used to access the system.
* Operators: people who are supposed to retrieve cars left parked out of battery or more than 3 km away from power grid stations.

**Goals**

The goals are:

1. [G1] make car sharing eco-friendlier using exclusively electric cars. (attori?)
2. [G2] allow guests to sign up or read a short description of the service.
3. [G3] allow users to sign in with their credentials.
4. [G4] allow users to know if there are available cars near them.
5. [G5] allow users to reserve an available car for up to one hour and to know if their reservation went successfully.
6. After the reservation of a car, allow a user to see the position of that car in a map.
7. Allow a user to unlock and have access to a car if and only if he/she is close to that car and the it is reserved by him/her.
8. [G6] allow users to drive the car.
9. [G7] allow users to receive a discount if they carry more than 2 people.
10. [G9] allow users to know the car’s battery level before reserving or unlocking it.
11. [G10] apply a fine to users if the car has been parked more than 3 km from the nearest power grid station or with less than 20% of battery.
12. [G11] reward users with a discount if they leave the car with more than 50% of battery.
13. [G12] reward users with a discount if they leave the car in charging into a power grid station.
14. [G14] allow users to see the battery level of the car and how much money they’re spending during a ride from an LCD screen.
15. [G15] allow operators to know if a user left a car parked more than 3 km away from the nearest station or with less than the 20% of the battery remaining. (come li avvisiamo gli operators?)
16. MONEY SAVING OPTION!

**Domain assumptions**

* Someone must be successfully registered before taking benefits from the service.
* Users must login to the system before reserving a car.
* A user can’t reserve multiple cars at once, only one reservation is allowed.
* A car can’t be reserved simultaneously by two or more users, once a car is reserved it disappears from the list of available cars.
* Cars have a unique ID number.
* The same person can’t have multiple accounts.
* The maximum of other passengers excluding the driver during a ride is 4.
* Only the owner of a reservation can drive the car he has reserved.
* All the GPSs always give the right position of the cars and must be always working.
* Only credit cards can be used for payment by the users.
* If the credit card of a user is out of money during a ride, the user will receive a beep from the car, and he should end his ride within 5 minutes, otherwise his account will be blocked. (da definire bene questa cosa)
* In case of bad behavior by the user, the fine will be payed by himself/herself.
* If a user doesn’t park the car in a safe area at the end of the ride, he will pay a fine.
* Every operator knows if there are cars in need of assistance and/or how to handle assistance requests
* The company already handles the information about the operators, so we don’t have to deal with them

**Glossary**

Guest: person who hasn’t registered yet to the service. He can only read a description or sign up.

Registration: process that permits to a Guest to provide his password so that he can access to the system. In the registration process he must compile a form giving these information:

* Name
* Surname
* Username
* Phone number
* Birth date
* Birth place
* Sex
* Email address
* SSN
* Address
* Zip code
* Credit card number
* Driving licence’s number

the system will reply sending him an email containing the user’s password

User: person who has already registered and can access to the system using his username and password to reserve or unlock an available car.

Reservation: a process thanks to which a user can reserve an available car up to one hour: from when he reserves it, he has only one hour to reach it and to begin his ride until the system cancels his reservation and gives to him a fee of 1 Euro.

Ride: is the time from when a user unlocks a car to when he exits from it and leaves it parked.

Available car: is a PowerEnJoy car that is not reserved by another user and no other user is driving it.

Safe area: a car is parked in a safe area if it is in one of the parkings belonging to the set pre-defined by the management system.

Sharing discount: is a discount of 30% given to users who carries at least other two people.

Power grid station: is the station where the car can be plugged to charge it.

**Constraints**

Regulatory policies

The system must ask the user the permission to get his position and the permission to manage sensible data (position, phone number) according to the privacy law. Furthermore, the systems must not use notiﬁcations to send SPAM respecting the privacy law.

Interfaces

* Mobile application
  + 3G/4G/Wi-Fi connection
  + GPS
  + Enough space for app package
  + 64 MB of RAM
* Web Browser
  + Modern browser with AJAX
* LCD screen
  + GPS navigator
  + Car battery level
  + Power grid stations positions
  + Real time cost indicator
  + Safe areas

Parallel operations

The server supports parallel operations from diﬀerent clients.

OBJECT FOR THE OPERATORS ???

**Reference documents**

**Requirements**

**Functional requirements**

1. [G1] make car sharing eco-friendlier using exclusively electric cars
2. [G2] allow guests to sign up:

* The system can save the informations of all the people who register themselves.
* The system reply to every registration with a password that the user must use to access.
* the system must be able to control if the registration informations are correct.
* the system must control if the credit card number is valid

1. [G3] allow users to sign in:

* the system must be able to control if the username and the password match one with each other.

1. [G4] allow users to know if there are available cars near them:

* The system must have access to the GPS position of all the available cars and to the user’s or to the position that the user decides to give to the system (he can search for a car in a certain zone even if he is far from it).

1. [G5] allow users to reserve an available car for up to one hour.

* The system must control if every reservation timer is under 1 hour.
* The system must send a fee to users that haven’t taken the cars they reserved within one hour.

1. [G6] allow users to use the car:

* The system controls the duration of a riding.
* the system calculates the cost of the ride in real time.
* the system informs in real time users about duration and the cost of the ride.
* the system calculates and displays the final cost of the ride in order of the fees or the discounts accumulated by users.
* the system controls if the car has been parked in a “safe area”.
* the system must be able to charge the cost of the ride to the user.

1. [G7] allow users to receive a discount if they carry more than 2 people:

* the system must be able to control how many people are in the car using seat sensors.

1. [G8] allow users to know how much money they are spending during a ride:

* the system must display the cost of the ride in real time.

1. [G9] allow users to know the car’s battery level before reserving or unlocking it:

* the system must know the battery level of each car.

1. [G10] allow users to see the charging level during a ride from an lcd screen.

* the system must display the battery level on a lcd screen.

1. [G11] fine users if the car has been parked more than 3 km from the nearest power grid station or with less than 20% of battery

* the system must know the GPS position of every power grid station
* the system must calculate the distance between every parked car and its nearest power grid station.
* the system must have people who will take the out-of-charge cars to the power grid station using special transport means.

1. [G12] reward users if they let the car with more than 50% of battery.

* the system must have people who will take the out-of-charge cars to the power grid station driving them.

1. [G13] reward users if they let the car in charging into a power grid station.

* the system must recognise if every car is in charge or not.

1. [G14] recognise if a user is near a car and unlocks it only if the car is available or was reserved by him.

* the system must have a precise GPS position of every car and user.

1. [G15] allow operators to know if a user left a car parked more than 3 km away from the nearest station or with less than the 20% of the battery remaining.

**Non-functional requirements**

**Functional Modeling**

**Possible scenarios**

Here some possible scenarios of usage of this system.

Scenario 1

Mario should go to work, but someone has parked in front of his garage, so he is unable to use his personal car. Fortunately, Mario is registered to PowerEnJoy, so he picks his smartphone and opens the PowerEnJoy app, then he inserts his credentials to log in the system. After that, he takes a look at the map to see if there is any available car near him. He notices that there is an available car parked 2 minutes walking away from him, so he immediately reserves it to prevent other users to take it away before him. Once he is close to the car, he looks the ID number of the car highlighted in the windshield, then he opens the app again and inserts the code. Since the system recognizes that Mario actually is the user who has made the reservation and he inserted the right code, the car unlocks the door so that Mario can get into it, ignite the engine with the keys provided inside the dashboard, and go to work on time.

Scenario 2

Mario is driving a PowerEnJoy car. Once he arrives to his home, he looks at the monitor to see if he is in a safe area, but he figures out that his car has the battery very low (10%). Since the football match on the TV is starting, he doesn’t want to look for a power grid station to recharge the car, so he leaves it as it is, out of battery. Once Mario gets out of the car, the system detects that Mario’s ride is over, but since the car has been left with less than 20% of battery charged, in addition to the cost of the ride the system will withdraw an additional amount of money as a fine from Mario’s credit card.

Scenario 3

Mario has an appointment to the cinema with his friends Rupert and Anna, but today there is a transport strike and the cinema is quite far from their houses. So, Mario, who is a PowerEnJoy user, decides to go taking his friends up to share the route. Car’s sensors detect that in the car there are more than two passengers in addition to the driver, so the system will apply a discount to the total cost of the ride. Once Mario and friends arrive to the cinema, they decide to leave the car in the nearest power grid station, in order to get another discount. Once the car is attached to the power charger and everyone is out, the system detects that the ride is over and calculates the total amount of money that will withdraw from Mario’s credit card, considering the two mentioned discounts. In the end, Mario and his friends have saved much money comparing to the full cost of the ride without discounts.

Scenario 3

Stavolta Mario è un operatore. Che gli facciamo fare?

**Use case diagram**

**Object Modeling**

**Class diagram**

**State diagrams**

**Dynamic Modeling**

**Sequence diagrams**

**Activity diagrams**

**Alloy modelling**

**Model**

**Alloy tool results**

**World generated**

**Future development**

**Used tools**

**Hours of work**