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**Computer Science and Engineering**

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Software Engeneering 2 Project:

**“Power&Joy”**

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

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Prof. Luca Mottola

Joshua Nicolay Ortiz Osorio Matr. 806568  
Michelangelo Medori Matr. 806568

**Contents**

1 **Introduction**............................................................................................................................

1.1 Purpose....................................................................................................................  
 1.2 Description of the Given Problem............................................................................  
 1.3 Stakeholders.............................................................................................................  
 1.4 Glossary....................................................................................................................  
 1.5 Reference Documents..............................................................................................  
 1.6 Overview..................................................................................................................

2 **Overall Description**.................................................................................................................

2.1 Product Perspective.................................................................................................  
2.2 Actors Identifying.....................................................................................................  
2.3 Goals (Product Functions)........................................................................................  
2.4 Domain Properties...................................................................................................  
2.5 Text Assumptions.....................................................................................................  
2.6 Constrains.................................................................................................................

3 **Specific Requirements**.............................................................................................................

**1.Introduction**  
  
  
**1.1 Purpose**

This is the first of a series of documents aimed to project a digital management system for a car sharing service. Identifying stakeholders, modeling scenarios and formalizing requirements and constrains of the system are the main topics of this document.

**1.2 Description of the given problem**

We are going to design a digital management system for a car sharing service that only employs electric cars (i.e. cars powered by rechargeable batteries), which are environment-friendly and noise-free.  
Precisely, we want to offer the possibility to users to choose a car among an amount of cars dislocated into Milan's urban area, to travel across the city.  
Electric cars gather their fuel when they are plugged into proper power grids; these grids are placed all around the city: they can be found into specific charging stations, beyond near a decent number of parking lots around Milan.  
Cars can be parked everywhere inside Milan urban area (i.e. any kind of appropriate car park, accordingly to Italian laws, included pay and display parking lots).   
Operators are available to make sure that cars are never left with less than 20% battery charge by charging them into near charging stations.  
The final aim of the system is to provide a service within anyone's reach, that stands for a solid alternative to public transport.

**1.3 Stakeholders**The only stakeholders that we have is Power&Joy society that require the management system of car sharing.

**1.4 Glossary**

* **System:** is the system we will create which is going to manage the car sharing service. The system has a dedicated database where it can store and access all needed information
* **User** : every person register in the system that want to use a car.
* **Not Register User (NRU)** : all people not registered in the system.
* **Operators:**  employees working on charging stations whose job is recharge every car that has less 20% battery level and to provide assistance to the users.
* **Passenger :** a person who is traveling in a car without driving it.
* **Registration:** consist in the act of insert all the needed information into the system as
  1. First name and Last name
  2. E-mail
  3. Password
  4. Phone number
  5. Birth date
  6. ID card code
  7. Drive license code
  8. Credit card number
  9. Fiscal code
* **Safe Area:** Milan’s urban centre.
* **Power grid station:** a stopping place for electric cars equipped with electric socket and where operators work.
* **Available car:** is a car that is not currently used by other users and has the battery charge level over 30%.
* **Parking lot:** everyavailable car park inside the Safe Area that respect to the Italian traffic laws.
* **Special Parking lot:** every parking lot equipped with electric socket.
* **Safe Zone**: is a circular zone with 3 km of diameter which centre is a power grid station.
* **Reservation:**  is the ability of reserve a car for at maximum 1 hour, then the reservation expires.
* **Contactless card: card acquired by users at the moment of the registration used to unlock the reserved cars.**
* **Special contactless card: Magnetic card acquired by operators at the moment of the registration that can be used to unlock any car.**
* **Unlock Car:** to undo the lock of car’s doors by placing the contactless cards or special contactless cards near specific sensors placed over the car doors.
* **Password:** is the key to log in to the system.
* **Status (of a car): any of the possible conditions of the cars (out of charge/assistance needed/out of safe area/no issues). A car can have more than one status at once. Each status is identified by a color.**
* **Reserved area: special section of the system where operators can register and log in, and from which they can access information about the position and the status of all the cars.**
* **Path:**
* **Ride:** it starts one minute after the unlock car and ends when the user shut down the car and push on the display “end the ride”.
* **Pit Stop:** it happen when the user stops the car for a short period of time (maximum 60 minutes) and keep the car reserved in order to continue the ride.
* **End the ride:** user stops the car, leaving it in a safe parking lot so that the car is made available for other reservations by other users.

**1.5 Reference Documents**

These are the documents we used as guideline:

* Specification Document: Assignment AA 2016-2017 (RASD)
* IEEE Std 830-1998 IEEE Recommended Practice for Software Requirements Specifications.
* Examples Documents: RASD sample from Oct. 20 lecture.

**1.6 Overview**

After a short description of the system’s properties, we define goals (e.g. the functions the system has to be able to perform) and constrains, and make assumptions that we suppose hold in the analyzed world. Then we analyze and formalize the goals with the help of UML diagrams (use case, sequence diagrams, class diagram) and the formal language Alloy.

**2. Overall Description**

**2.1 Product Perspective**

We want this service to be accessible via mobile or web app. Every user (i.e. person who wants to reserve and ride a car) must register to the system via the mobile or web app providing general information (full name, age, sex, e-mail etc.) and specific ID's (fiscal code, drive license code). Once registered, the system allows user to view on a map the current geographical position of every available car, thanks to GPS sensors on each car. Cars already in use by other users do not display, but the system can access the information about the positions of every single car, weather they are being used or not, any time it needs to (in case of assistance requests et al.).  
  
Users can choose a car at the time, and make a reservation for it. They shall reach the car within 30 minutes from the moment the reservation is made, to be able to use the car.  
When near, users can unlock the car by simply placing their contactless card (provided at the moment of the registration) near the sensor placed on the car door.  
The system unlocks the car soon after and the user is able to get in. In order to start the ride, the user simply needs to push a button placed inside the car.   
  
Once the car is started, the user starts to be charged per minute of ride.   
Before starting the ride, the system encourage the user to make sure the car is not damaged or compromised, and to communicate it, in case issues are found, via the mobile app or a phone call.  
Once they ended the ride, users can park cars in every available car park inside the urban area (which includes any kind of parking lot, accordingly to Italian laws, pay and display car parks included).   
  
Some special parking lots are equipped with power grids to recharge the car, and discounts are available in case users take car to plug the car in.  
Discounts are also available in case the user leaves the car with more than 50% battery charge, while the user is going to pay 30% more of the price of his ride in case he leaves the car with 20% battery charge or more than 3 km away from the nearest charging station.  
Payments are always carried out through the credit card that the user has to insert at the moment of the registration and a receipt is available to view with the mobile app or e-mail.

**WORLD**Cars  
Stations  
Parking

**MACHINE**Database Queries  
Shortest Path  
 Computation

Car Codes  
Update Position Car  
Report an Issue  
Battery Charge Level  
Reservations  
Timer  
Unlock Car

**2.2 Actors Identifying**

There are two main kind of people the System needs to interact with:

* Users
* Operators

Both of them need to be registered into the system.  
Operators work at the charging stations and need to pick up and recharge every car below 20% battery charge and provide assistance to users, if needed.  
The goals concerning these two groups of people are described below.

**2.3 Goals (Product Functions)  
  
Users:**

1. The system shall allow users to register via the web or mobile app by inserting all the required information
2. The system shall allow users to see the positions of all the available cars on a map
3. The system shall allow users to make a reservation for an available car
4. The system shall allow users to unlock the car
5. The system shall allow users to start the ride
6. The System shall allow users to make a pit stop of maximum 60 minute
7. The system shall allow users to end the ride only if the car is parked inside the safe area
8. The system shall allow users to communicate if the car they reserved is damaged or issues are found (e.g. dirt, damages, etc.).
9. The system shall compute the price of every ride taking into account discounts and penalties and send it to the system which take care of the payment
10. The system shall allow operators to register into the reserved area only accessible from the web service
11. The system shall allow operators to log into the reserved area with a password they have chosen at the moment of the registration
12. The system shall inform operators about the changes of the status of every car by changing the colours associated to each one and sending notifications only to those operators that work on the nearest charging station
13. The system shall allow operators to unlock any car by placing their special contactless card over the sensor of the car

**2.4 Domain Properties**

**2.5 Text Assumptions**

**2.6 Constrains**

**3. Specific Requirements**

**3.1 Functional Requirements**

1. **The system shall allow users to register via the web or mobile app by inserting all the required information  
   -** The system require to insert all personal information that consist on :First name and Last name  
   E-mail  
   Password  
   Phone number  
   Birth date   
   ID card code   
   Drive license code   
   Credit card number   
   Fiscal code  
   - The system check that all information inserted are valid (e.g. all text boxes must be not empty, the name can not contain numbers etc.)  
   -The system include the information of the new user onto the database
2. **The system shall allow users to see the positions of all the available cars on a map**- The car are equipped with a GPS sensors that allow the system to localize them anytime  
   - The system put all the cars positions on a map that can be visualized by users via web or mobile application
3. **The system shall allow users to make a reservation for an available car**- When the user find a suitable car he can reserve it by clicking on the “RESERVE” button on the application  
   - After doing the reservation the system starts a timer of 60 minutes. If the user is not able to unlock the reserved car before the time expires, the system cancels the reservation making the car available again for other users
4. **The system shall allow users to unlock the car. -The car can only be unlocked using the contactless card owned by the user that reserved that specific car, and before the timer expires. - When the user places the contactless card near the sensor of the car, the system acquires information about the card, verifies that it corresponds to the user that actually reserved that car, and in that case the system shall unlock the car in order for the user to get in. -In case the contactless card is not recognized as valid by the system, the system denies access to the car, until a valid card is recognized by the time the timer expires.**
5. **The system shall allow users to start the ride: -Before starting the engine the system shall remind the user through the onboard computer to check for damages on the car and to communicate it in case issues are found via the mobile app or the same onboard computer -In case of issues, the system shall cancel the reservation and make the car unavailable for users and inform the nearest operators - The system shall start to charge the user by minute of ride as soon as he ignites the car engine. -The system shall display on the onboard computer the updated amount of money spent for the ride.- If the users wants to, the system shall compute the shortest path from the user’s current position to the final destination of the ride and display it on the onboard computer.**

1. **The System shall allow users to make a pit stop of maximum 60 minute - The system shall allow users to make a pit stop of maximum 60 minutes communicating it tapping a button “START PIT STOP” on the onboard computer. When they do it, the system starts a timer of 60 minutes - When the user wants to end the pit stop he needs to tap again a button “RESTART THE RIDE” on the onboard computer, or simply restarting the car - During the pit stop the system shall still go on charging users for 50% of the price during all the time the pit stop lasts or since the timer expires -During the pit stop the system shall always make the car stay reserved for the current user, and unavailable to other users. -When the Timer expires the system cancels the reservation for that car, making it available for other users to use.**
2. **The system shall allow users to end the ride only if the car is parked inside the safe area - When the user wants to end the ride, he has to comunicate it to the system by tapping a button “END THE RIDE” on the onboard computer - Th system shall check if the car is parked inside the safe area using the GPS sensor information, and only in that case allow user to end the ride stopping charging the user. - If the car is not parked into a safe area, the system shall go on charging users until they move the car inside the safe area and tap the button “END THE RIDE” on the onboard computer. - The button “END THE RIDE” shall only be available to press if the car engine is shut down.**

1. **The system shall compute the price of every ride taking into account discounts and penalties and send it to the system which take care of the payment - When a ride ends (if the users taps the “END THE RIDE “ button while the car is parked inside the safe area ,or if the pit stop timer of 60 minutes expires) the system shall compute the total cost of the ride using the price currently displayed on the on-board computer and taking into account the following rules If the system detects the user took at least two other passengers onto the car, the system applies a discount of 10% on the last ride.**

. b)  If a car is left with no more than 50% of the battery empty, the system applies a discount of 20% on the ride.

. c)  If a car is left plugged into on of the power grids available, the system applies a discount of 30% on the last ride.

. d)  If a car is left at more than 3 KM from the nearest power grid station or with more than 80% of the battery empty, the system charges 30% more on the ride.

2. **The system shall allow operators to register into the reserved area only accessible from the web service**
3. **The system shall allow operators to log into the reserved area with a password they have chosen at the moment of the registration**
4. **The system shall inform operators about the changes of the status of every car by changing the colors associated to each one and sending notifications only to those operators that work on the nearest charging station**
5. **The system shall allow operators to unlock any car by placing their special contactless card over the sensor of the car**
6. **. If GPS is turned on, the system displays the closest cars from the user’s current position or from a particular position inserted by the user.**
7. **car via the mobile application or sending an SMS to a predefined number using the phone number inserted during the registration**