PARTE 1 - INTRODUCTION

Description of the given problem
According to the assignment document the problem consists in the definition and implementation of a system that manages the activity of an electrical car sharing. The activity itself doesn't need to be explained because car sharing is a largely spread out costume.
More in depth, the system have to allow people to join a community of car sharers by registering into the system and after this they can share cars with neighbors and friends in order to save money together and reduce pollution made by public means of transport and private cars.

Goals
In this section of the document, we are presenting the main goals that the software-to-develop must fulfill in order to satisfy the requirements:

- Users must have the possibility to register to the system to become part of the community. They must provide their credentials (such as first name, last name email address and so on) and a valid method of payment that can be an IBAN code or a credit card code. After the online registration, users will receive a confirmation email that includes a password for the access to the system and a link that will conclude the registration task and will show the user his personal area from where he/she can decide to do stuff.
- The user can select the parking lot from a subset of them where to pick the car. The user's position or the input of an address will be the base on which the system will show a subset of parking lots: the system will choose the parking lots with at least one available car in a range of 100 meters (this is only an indicative value) from the given position.
- The user will be able to reserve a car for up to one hour from the pickup, from the list of the available ones in the selected parking lot. Then the system will lock automatically the selected car to everyone until the reservation time, with except to the user that will use his personal badge to identify himself and let the system know that he's picking up the car.
- The system must control that every reserved car will be picked in the time range: if this condition is not satisfied, it will assign an extra fee of 1€ to the owner of the unpicked car and then it will set the car as available in order to allow other people to pick that car.
- The system must charge the user by a certain amount of Euros per minute. The time outside the predefined areas will contribute to calculate the final amount for the user to pay and a built-in-car screen will show this information to the user/driver. This amount can be decreased or increased by:
  - The number of passengers of the car (a sensor will count the passengers in order to apply a 10% discount on the final amount);
  - The battery charge remaining (if the battery has more than 50% of the charge, the system must apply a 20% discount);
  - If the car is parked in a charging station and the user plugs the car BEFORE he/she registers the exit, a 30% discount will be applied;
  - If the car has less than 20% of the battery charge or the user leaves it in a parking area further that 3 Km from a charging station, a 30% extra free will be applied;
- The system must provide the user the possibility to select the money saving mode: with this option activated, the user has to input the final destination and the system will tell the user the best charging station where to leave the car in order to receive a discount. The system chooses the right charging station based on the position of the other cars and on the availability of power plugs to provide a balanced number of vehicles on each zone of the city.
- To close the bill, the user must park the car in one of the predefined parking areas, exit the car and lock it with his badge. This action will notify the system that the user has left the car in a secure area and he/she terminated the trip. Then the system will send the bill to the user via email and the user will pay according to the payment method specified at registration time. The car will then set as available again.

Domain properties

Since the world is the base of the software, we assumed it in this way:
- Users reserve always the cars at most one hour before they pick it up;
- Users have all a smartphone from where they can use the mobile application or the web version of the service and their smartphones have GPS;
- Users have always internet connection from their devices in order to tell to the system that he/she is nearby;
- GPS give always precise information about car position;
- GPS cannot be faked or modified by anyone;
- All cars have GPS and the system can track them;
- All cars are the same and they consume the same amount of battery charge;
- If a car has a failure, it can't be used until it is repaired.
- When in maintenance, a car is unavailable;
- Cars have a screen only to show battery charge, the system will show all information (such as user charge, nearest charging station, user charge and so on).
- Cars have different sensors such as charging sensor and battery level sensor;
- To check if there is more than 1 passenger in the car, car seats have a sensor that observes a passenger's weight: if it gets a value greater that 40 Kg, the system will evaluate it as a passenger.
- In every parking lot/charging station there is an employee that has to plug cars unplugged or to retrieve badly parked cars with a towing truck;
- There are 2 different kinds of parking: "safe areas" and "special parking areas";
- Special parking areas have sensors that measure the number of in-use plugs;
- A boundary of [numero] km limits a "legal" area where the system won't apply extra fees for check out in a not agreed spot, over standard increase;

Glossary
- Agreed zone: general name that identifies both the safe area and the special parking area (explained later).
- Charging spot: is a parking slot provided with an electrical plug used to charge the car battery.
- Charging station: synonym for special parking area.
- Credentials: these are the personal information of a user. They include first name, last name, email address, password, IBAN (explained later) or credit card number and geographical position.
- GPS (Global Positioning System): is a positioning system based on triangulation with satellites in order to give the exact position of a device in the world.
- IBAN (International Bank Account Number): is a unique string that locates a bank account.
- Parking lot: synonym for safe area.
- Safe area: is a parking agreed by the car sharing company where users should park rented cars. There are a certain number in the city and they are equally distributed in the territory.
- Special parking area: is a parking with charging spots agreed by the car sharing company where users should park rented cars. Users can park cars here and they can charge them.

Assumptions
- There is a limited number of cars, stations and plugs so, if a user selects the money saving options and there are no available plugs, he/she will not receive a discount.
- The discounts can be accumulated and the system applies them stacking the values e.g. if the user brings 2 passengers and uses less than 50% of the battery, the final amount will be decrease first by 10% and the result will be reduced by 20% and so on.
- When the user uses the service from mobile application or web browser, he/she has to share his/her location.
- When the user rents a car, he/she must specify how much time he/she will use the car (in order to distinguish a theft from a legit usage). If the car will be in a not agreed spot, the employee will retrieve it and park in the right position.
- When a user wants to rent a car, the system will show only the full charged ones;

- The employees can use their credentials to unlock only locked cars that are outside of parking lots and charging stations.
- Users behave unpredictably so they can park in parking areas that are not owned by the car sharing company and leave cars outside parking spots, with the battery fully discharged and so on;
- When a user parks the car in a charging station but he/she doesn't plug the car in, an employee will plug in the car and the system won't apply the discount to the final amount due to the user; he must check also that the car is operative and has no damage. If it has failures the employee has to evaluate the damages and the previous user will be sanctioned.
- Users can drive anywhere in the city, also outside the area of competence of the company. If they do so, an alert will tell them that they are outside the car sharing boundaries so they have to go back or a time fee will be applied. If they park outside of the boundaries, an employee will retrieve the car.
- When a car is parked in one of the previously mentioned zones within the time defined at booking time, the system will close the bill and it will get the right amount directly from the payment method defined by the user when registering.
- If a user uses a car more than the time defined earlier, the system will deduct money from user's payment method at a certain rate, until the car is parked in an agreed zone.

Constrains

The system can run on a mobile device (such as smartphones and tablets via the mobile app) and a PC: the mobile device should have GPS, internet connection and some storage space where to install the application. When users access the service from a PC, they have to share their position through the web in order to allow the system to show up the nearest parking.

Other important constraints to the system are the DBMS, that will store all user data, such as their credentials, payment method and email address, and the access to a SMTP server that allows the system to send email to the users

Proposed System

We think that the best solution for the implementation is to build the software for a web platform and a mobile application in order to allow everyone to use the service anywhere and anytime.

This implementation will allow users to benefit of the service everywhere in order to allow maximum accessibility in any condition.

On the maintenance aspect, the website will be more advanced on new feature releases that the mobile application: in this case every new feature will be available first on the web platform as a preview of the mobile update to come.

Identifying Stakeholders

In case this software has to be released, the stakeholders could be a car sharing company that needs a software system to manage the activity of the enterprise, but in this particular case, where the software has to be developed to demonstrate the ability to find requirements, test and other things, the stakeholders are the professors.

Our main goal is to demonstrate that we are capable of a work like this and that we can organize ourselves to perceive the same objective, even if we cannot encounter in real life due to different personal obligations.

Talking about the final user of this kind of system, we think that the most probable is the common citizen that lives in a city with a lot of traffic that doesn't want to use public means of transport for delays and other discomforts. Our solution could resolve a lot of people's problems.

PARTE 2 - ACTORS IDENTIFYING

Actors identifying

The actors that will use our system are mainly 3:

- User: it is the representation of the common citizen that uses the service for moving/traveling purpose. It will use the system by registering an account, renting cars, notifying the system that it is nearby the car, locking and unlocking the car and checking out;
- Employee: is the actor that has to retrieve badly parked cars or to plug in cars to charge them. He will use the system to locate the car to retrieve from a list of locked cars that aren't parked in an agreed zone yet.
- Admin: maintains the system and manages bureaucracy (intended as fines, external bills and so on). He will not use the system directly to manage this final aspect because the software will not provide means to satisfy these necessities.

PARTE 3 - REQUIREMENTS

Functional requirements
[...]

Non-functional requirements
[...]

PARTE 4 - SCENARIO IDENTIFYING
[...]

PARTE 5 - UML MODELS

Use case diagrams

Use case description

Class diagram

Sequence diagrams

Activity diagrams

State diagrams

PARTE 6 - ALLOY MODELING

Model

Alloy result

World generated

PARTE 7 - FUTURE DEVELOPMENTS

PARTE 8 - USED TOOLS

PARTE 9 - HOURS OF WORK