RASD

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Contents

1 Introduction

1.1 Purpose of the system and brief description of the problem

PowerEnJoy is an electrical car sharing service, based on a mobile application. The targets of the service, intended as users, are people that needs to move from a place to another within a city and requires a conveyance to move (because they don't have their own or simply can't use it).
A user can make a reservation for a car, using the mobile app and his/her account, and check for the availability and status of all the cars within his/her position, identified using GPS localisation, or a specific one, inserted manually by the user. As stated before, to access the service, the user must possess a private account, so a registration is needed.
The system provides the users a safe way (identification code) to access the cars, and the riding service and keeps trace of the status of all the cars.
Moreover, the system prizes or punishes a respectively good or bad behavior from the users, applying a discount or an overcharge on the cost of a ride. As esxample, if the user leaves the car without much battery, he/she will have to pay more than the standard cost of the ride, because the car will need to be charged and this operation has a cost. On the other hand, if a user plugs the car before ending the service, it receives a discount.
The system includes other functionalities, such as GPS based maps available in every car, an emergency procedure in case an accident occur during a ride and the notification of a car status if the user requested it.

The purpose of the system, referring to both the main and each car systems, is to offer a reliable, efficient and safe service, allowing the user to benefit of the offered electric cars when needed.

1.2 Goals

- [G1] Ensures that only the account owner can access his/her own account, if he/she is already registered.
- [G2] Allows the user to reserve an available car for up to one hour before the service starts.
- [G3] Allows the user to take back his/her reservation for an available car before the "picking up time" expires.
- [G4] Allows the user to monitor the status of the available cars within an area that he/she specified, or in the nearby areas, for a possible reservation. If the car has a low battery charge, such as less than 20%, it does not appear on the user interface.
- [G5] Ensures that the user is able to trace/check the status of a car, available or already reserved, and receive push notification about it.
- [G6] Ensures that the user is able to access, and open, the car he/she reserved, if he/she is in time.
- [G7] Ensures that the service, and the carghing on the user, starts only when the engine of a car is ignited.
- [G8] Ensures that the user is informed real-time on the current cost of the service, when using it, and the possible discounts and overcharges.
- [G9] Allows the user to stop the car for a brief moment to rest or to pick up / leave passengers. He/she will however still be charged.
- [G10] Ensures that the user knows the safe area around him/her. is informed by the car internal system of the safe-areas around him/her, within a specified range (like a mini-map).
- [G11] Allows the user to press a button on the car to contact an operator in case of emergency, such as a car accident, a mechanical problem or sudden ilness.
- [G12] Ensures that when the user leaves the car and closes the door, the service ends.
- [G13] Ensures that the user receives a discount or overcharge when specific conditions are met.
- [G14] Ensures that the user is notified of the applied discount and overcharges once the service ends and payment is applied
- [G15] Ensures that when the user picks up a car, it has no mechanical or electrical problem.

1.3 Goals further description

- [G1] leaves out a particular scenario. The system won't actually be able to know if the person accessing the account is the real owner. A user can just give the credential to a friend, and this friend can access and use the service as if it was the real user. Such case, is a decision, or problem, of the user and the system can't do anything to avoid or simply recognise it.
- [G4] denies the possibility to use a car when the battery is very low, less than 20% of charge. This represents the behavior of a person in the real world. Nobody would chose a car if it would not be able to reach the destination. A user would prefer a charged car, to drive for longer distances.
- [G5] derives from the idea that multiple users may want to use tha same available car. Only one is able to make a reservation, but the others may be interested to check if the car is effectively taken by the reserving user. It could happen that he/she takes back the reservation or simply doesn't pick up the car within the reservation time. In such case, the car would be available once again and all the interested users will receive a notification about it.
- [G9] is one of the functional goals that provides the user a reliable way to "help" the service to work correctely. Being notified of the nearby zones to park, it will be unlikely for him/her to abandon the car midway.
- [G12] can be further broken into two implicit sub-goals:
  - [G12.1] Ensures that when the user is in a safe area and leaves the car the car system stops charging him/her.
  - [G12.2] Ensures that when the user has left the car and closed the door, the service ends.
- [G13] refers to the particular condition expressed in the project description. If the user takes on two ore more passengers, he/she receives a discount of 10% on the cost of the ride. If the user leaves the car with more than 50% of the battery available, a discount of 20% is applied. If the user plugs in the car before ending the service, the applied discount is 30% over the total. However, if the user leaves the car 3 km far from a safe area or with less than 20% of the battery available, he/she is overcharged of 30% of the cost of the ride.

1.4 Glossary

- User: is the person that benefits of the car-sharing service. The user is able to make reservations, check cars and ask for notification using his/her own account. To register and be able to use the service, the user must provide name, surname, phone number, e-mail, payment information, such as a credit card number, and his/her Driver License. The user is, in fact, the person who drives a car.
- Car: is one of the electric car provided by the service. The car contains various sensors which are able to detect the number of passengers, the status of the mechanical and electrical components of the car. It also possess its own system, connected to the main system of the service. This system is costantly updated on the status of the car. The car has also a screen that makes possible an interaction between the user and the car system, and a button that the user can press in case of emergency.
- Reservation: it's the process by which the user can make a request for a car. First, the user must access his/her own account. From there, he can insert an address or chose his location, via GPS, to search for available cars from the suggested zone. Lastly, he can request a specific car to use.
- Monitoring: it it the process by which the user can chose one or more cars to be notified about its availability. The monitoring only involves cars that are not already picked up and
- GPS: global navigation satellite system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.
- Picking up time / Reservation time: it's the period of time between the time when the user reserves a car from his/her account and the unlocking of the car by the same user. The maximum reservation time, allowed by the system, is one hour.

- Status: referred to a car, it is the set of the information that describes it. They include:
  - Location
  - Battery charge
  - Money counter
  - Components state
- Passenger: is a person who can benefit of the service without driving the car. The passenger can use a car only when an user is driving it, and it doesn't need to be registered to use the service.
- Technician: is the person dedicated to repair and fix the car. It is provided by an external company.
- Opertor: is the person that communicates with the user whenever an accident happens during the service and emergency button on the used car is pressed. The operator contacts other services depending on which type of accident occured, such as ambulance, police, firetrucks, technicians. As the latter ones, the operator is provided by an external company.
- Safe area: it is a specific area where the electric cars of PowerEnJoy service can park. The set of safe areas is pre-defined and owned by the company/society that requested the management system for the service.
- System: it is the new system to create. It refers to the software and hardware needed in order to make the service work. The system is composed of a database (or more than one) to store the users and cars information, and the software needed to manage users actions and the single cars.
- Car system: is the system, mostly hardware, contained in every car. It checks and elaborates the status of the car and interfaces the transport, the user and the system. The user can interact with the car thanks to an installed screen, that shows informations about the service cost, a GPS based map, discounts and so on. Every car system sends information to the system via 3G connection, and viceversa.
- Discount: is an amount of money that has to be subtracted from the ride cost of a user, at the end of the service, if certain conditions (described in section 1.1, goals specification 3) are met.
- Overcharge: is an amount of money that has to be added to the ride cost of a user, at the end of the service, if certain conditions (described in section 1.1, goals specification 3) are met.
- Ride: it is the journey in the electric car. It starts when the user turns on the car and ends when the user leaves the car and closes the open doors. In the way a ride is defined, its duration coincides with the period of time where the user is charged for the service.
- Service: it refers to the whole process of reservation, ride and payment of a car, done by the user.
- Push notification/ push message: it is a notification sent to a smartphone using the mobile application.
- SMS: short message service; it is a notification sent to a mobile phone, we need a GSM gateway to use it.
- GMS gateway: device that allows SMS text messages to be sent and/or received by email, from Web pages or from other software applications by acquiring a unique identifier from the mobile phone's Subscriber Identity Module, or SIM card.

1.5 References and overview

2 Overall description

2.1 Interfaces description

- Interface with GSM provider to send SMS notifications to the users.
- Interface with the external staff. Technicians and operators are provided by a different company and the system needs to interact with them.

- Interface between the user and the car system. There are two levels of interaction:
  - The user can check for general informations of a car via his/her account, on the app.
  - The user has more detailed informations on the car, the service cost and the location during the ride, interacting with the car screen.
- Interface between the user and the system, via app. The user is able to access the offered services thanks to the application.
- Interface between the car system and the system, to enable the communication of data.
- Interface between the system and the GPS map provider.
- Interface between the cars and the recharge stations, that enables the recharge of the vehicle. It is composed by a plug and sensors connected to the car system that are able to recognise if the car is plugged (and recharging).
- Interface between the cars and the people, both users and technicians. This interface refers to a device connected to the car system that is able to recognise codes and unlock the car.

2.2 Product functions

2.3 Constraints

2.3.1 Regulatory policies

When registering, the system shows the user the license he/she has to accept in order to benefit from the offered services.
Treatment of personal data follows the rules described by the law (Law D. Lgs. 196/2003 in Italy).
The system also asks the permission to use and manage sensible data such as position, mail and phone number, in order to achieve its purposes, respecting in every conditions and cases the privacy law.
The system mustn't use push notifications and SMSs to send SPAM and third party advertising, but can only use such means according to the offered services.

2.3.2 Possible software limitations

Problem regarding APIs management and integration can arise, leading to major complexities of the system and delays in the development of the system software.
The software that manages the system may not implement all the needed functionalities. Such problem is mostly due to a bad development.

2.3.3 Hardware limitations

The mobile device owned by the user is subject to many problems, mostly regarding the connectivity of network and localisation services:

- 3G connection, to use the app
- GPS, to use particular services of the app, such as providing the user position to find available cars
- Space for app package on the device memory
- Battery consumption

Domain assumptions

- All the GPS localisation services have no fault and always returns the correct position of a device (car, phone, tablet...).
- If a car is locked, nobody can access it. However, technicians are able to use a code to operate on it.
- The databases on which the system relies on works without problems (no data loss, no incoherence).

- Once a user is registered, the system won't accept any other registration with his/her data. In other words, a user can register only once.
- Once a user is registered, his/her information will be saved and present in the system database.
- All the notifications that a user can receive from his/her account are immediate and always working.
- All the updates of the status of a car are immediate and correct.
- A user will never leave the car in a zone unreachable by GPS localisation or too far from the nearest safe area.
- A user will never leave the car with a door open, and neither the passengers will.
- A user will never leave a door open for more than ten minutes.
- Users will encounter no problems when accessing the car using a code.
- When registering, users will insert only Credit Card info or Debit Card info as methods of payment.
- Technicians and operators are always available and provided by a third party agent.
- Passwords and codes are unique.
- Discounts and overcharges are always calculated and applied in the correct way.
- Technicians and other services (police, ambulances, firetrucks) will reach the location addressed by the user/operator in the shortest possible time.
- Every car is able to detect it a mechanical/electrical problem occurs, and modify its internal status.
- The set of safe areas for parking cars is pre-defined by the management system.

3 Requirements

3.1 Functional requirements

- [G1] Ensures that only the account owner can access his/her own account, if he/she is already registered:
  - [R1.1] When the user registers, the system shall send him/her a mail or an SMS containing an unique code, that she/he can use to access his/her account.
  - [R1.2] When the user inserts is credential to log into his/her account, the system shall verify the correctness of the inserted data, the unique code expressed in requirement [R1.1].
- [G2] Allows the user to reserve an available car for up to one hour before the service starts:
  - [R2.1] When the user selects the option to reserve a car, the system shall verify if it is already reserved.
  - [R2.2] When the user selects the option to reserve a car, the system shall check if the reservation time is less than one hour.
  - [R2.3] If the check described in requirement [R2.2] is negative, meaning that the user expressed a reservation time longer than one hour, the system shall reject the user's request.
  - [R2.4] When the user selects the option to reserve a car, the system shall verify if it the user has already made a reservation. If he/she has, the system shall notify him/her with a message on the screen.
  - [R2.5] If the reservation time expires, the system shall cancel the user reservation and charge him/her of 1 EUR. The system shall also send a push notification the user to inform him/her of the fee.
- [G3] Allows the user to take back his/her reservation for an available car before the picking up time expires:

  - [R3.1] When the user makes a reservation for an available car, the system shall provide him/her an option to take back the reservation, from his/her account.
  - [R3.2] When the reservation time expires, the system shall disable the option to take back the reservation.
  - [R3.3] When the reservation time expires, the system shall check if the user picked up the car.

- [G4] Allows the user to see the status of the available cars within an area that he/she specified, or in the nearby areas, for a possible reservation. If the car has a low battery charge, such as less than 20%, it does not appear on the user interface:
  - [R4.1] The system shall be able to detect the user position, using GPS localisation of the device he/she is using (automatic localisation).
  - [R4.2] The system shall be able to recognise and locate the address given by the user (manual localisation).
  - [R4.3] The system shall display a list of the available cars with more than 20% of the battery charge, within 5km from the given location.
  - [R4.4] For every car in the list described in requirement [R4.3], the system shall provide essential information, as battery charge, estimated working distance, location, distance from the given address/current user location, maximum number of passengers.

- [G5] Ensures that the user is able to trace/check the status of a car, available or already reserved, and receive push notification about it:
  - [R5.1] When the user starts the reservation process, by giving a specific address or using his/her location, the system shall generate a list of the available cars, described in requirements [R4.3] and [R4.4], and a list of the already reserved cars. Both lists describes the status of the cars, as pointed out in requirement [R4.4].
  - [R5.2] The system shall provide the user two options regarding a car: reservation or monitoring.
  - [R5.3] When the status of a car is updated, from reserved to available or from reserved to picked up, the system shall notify all the users that made a notification, grouped in a list, on that car.
  - [R5.4] When the user decides to not be notified on a car for which he/she previously requested a notification, the system shall delete the user from the list of users that wants to check the status of that car.

- [G6] Ensures that the user is able to access, and open, the car he/she reserved, if he/she is in time:
  - [R6.1] When the user communicate via his/her account that he/she's nearby the car he/she reserved, the system shall send an SMS or a mail to the user, containing a unique code to unlock the car.
  - [R6.2] When the user communicate via his/her account that he/she's nearby the car he/she reserved, the system shall make the car unlockable only the code descripted in requirement [R6.1].
  - [R6.3] If the user doesn't reach the car within the reservation time and he/she already received the code to open it, the system shall reset the sequence needed to open the car, making the user unable to access it.
  - [R6.4] If the user doesn't reach the car within the reservation time, the system shall follow what requirement [R2.5] states, in addition to requirement [R6.3].

- [G7] Ensures that the service, and the carghing on the user, starts only when the engine of a car is ignited:
  - [R7.1] When the user is in the car, that is turned off, and presses the ignition button, the system shall start the car, initializing its screen and the car internal system.
  - [R7.2] When the user is in the car and press the ignition button, the system shall begin to charge the user per minute, after having resetted the internal system of the car, as stated in requirement [R7.1].
  - [R7.3] If the user presses the ignition button when the car is already on, the system shall avoid a re-ignition of the engine, and simply do nothing.

- [G8] Ensures that the user is informed real-time on the current cost of the service, when using it:
  - [R8.1] Every minute, the car system shall increase the money counter and display its value on the screen of the car.
- [G9] Allows the user to stop the car for a brief moment to rest or to pick up / leave passengers. He/she will however still be charged:
  - [R9.1] If the user stops the car, the car system shall continue to charge him/her per minute.
  - [R9.2] When one or more passengers leave, the car system shall detect the change and update the status of the car, displaying it to the user.
- [G10] Ensures that the user knows the safe area around him/her during the car ride:
  - [R10.1] When the service starts, described in requirement [R7.1], the car system shall elaborate a detailed map of a 10km radius zone from the car location, using GPS. The map status in continuosly elaborated during the ride.
  - [R10.2] Referring to requirement [R9.1] the car system shall show the map on the car screen, along with the car status, as stated in requirement [R8.2], and the current cost of the ride.
  - [R10.3] When the service starts, in addition to requirement [R9.1], the system shall inform the car system of the location of the safe-zones, distinguishing between normal safe-zones and the ones with power grids. Only the safe-zones with available parking places are shown.
- [G11] Allows the user to press a button on the car to contact an operator in case of emergency, such as a car accident, a mechanical problem or sudden ilness:
  - [R11.1] When the user presses the button, the system shall notify an operator on the location of the car and its status. The operator belongs to an outer service provider agency.
  - [R11.2] When the user presses the button, the system shall arrange a call between the user inside the call and the operator of requirement [R11.2].
  - [R11.3] If the user presses the button multiple times in a short period, less than 2 minutes, the system shall recognise only the first and start the procedure described in the requirements [R11.1] and [R11.2].
- [G12] Ensures that when the user leaves the car and closes the door, the service ends:
  - [G12.1] Ensures that when the user is in a safe area and leaves the car the car system stops charging him/her:
    - [R12.1] When the user leaves the car, along with the passengers, the car system shall check if the car is located in a safe area or not, communicating with the system.
    - [R12.2] If the user has left the car in a safe area, the car system shall stop the charging counter and save the car status.
    - [R12.3] If the user has left the car in a non safe area, the car system shall continue charging the user, as long as all the doors are closed.
  - [G12.2] Ensures that when the user has left the car and closed the door, the service ends:
    - [R12.4] When the user has left the car and closed all the doors, the car system shall communicate the car status to the system. The system shall execute the payment process, communicate the car system to lock the car.
    - [R12.5] When the car system has locked the car and informed the system, the latter shall update the car status in the database, and tag the car available once again.
- [G13] Ensures that the user receives a discount or overcharge when specific conditions are met:
  - [R13.1] When the user leaves the car and closes all the doors, the system shall check the battery of the used car. If more than 50% remains and the car is located in a safe-area, the system shall apply a discount of 20% on the cost of the ride with that car. If less than 20% remains, the system shall apply an overcharge of 30% on the cost of the ride with that car.

  - [R13.2] When the user leaves the car and closes all the doors, the system shall check the number of passengers, calculated when the user reached the safe zone. If it is more than two and the car is located in a safe-area, the system shall apply a discount of 10% on the cost of the ride with that car.
  - [R13.3] When the user leaves the car and closes all the doors, the system shall check if the car is plugged into a power grid. If such condition is met and the car is located in a safe-area, the system shall apply a discount of 30% on the cost of the ride with that car.
  - [R13.4] When the user leaves the car and closes all the doors, the system shall check if the car is in a safe-area or not. The "true" branch consequences are described in requirements [R13.1], [R13.2] and [R13.3]. If the car it's located at more than 3km from the nearest safe area, the system shall apply an overcharge of 30% on the cost of the ride with that car.

- [G14] Ensures that the user is notified of the applied discount and overcharges once the service ends and payment is applied:
  - [R14.1] When the system applies the payment process on the user, it shall inform the user with a push notification of the applied discount and overcharges, based on the requirements [R13.X].

- [G15] Ensures that when the user picks up a car, it has no mechanical or electrical problem:
  - [R15.1] When a car detects a problem, the car system shall inform the main system of the new status. The system shall then contact third party technicians, giving them the location of the car and a unique code to access it. Moreover, the system shall tag the car as unavailable.
  - [R15.2] When the car system notifies the main system that all the problems are solved, the system shall update the car status, reset the access code of the car and tag it as available.