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Software Engineering 2 project: *PowerEnJoy*

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RASD

Requirements **A**nalysis and **S**pecification **D**ocument

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1 Introduction

1.1 Purpose

ShareEnJoy is a new company that wants to enter the car sharing market and wants to provide a service based on electric vehicles only.
The way they want to implement their service is classical and very common to other car sharing services: it will be available in a specific geographical area (called safe area) for each city where the service will be activated. Users will be able to reserve and then rent a vehicle, use it for as much time as they desire and then be charged based on the rental time.

As the car sharing service is based on electric vehicles only, the system must provide some specific functionalities in order to handle electric vehicles behaviours and needs. For example, the company owns some electric recharging stations spread among the safe area and users should be encouraged to terminate their rentals in these stations. ShareEnJoy needs a digital management system

in order to support all the activities for both their customers and their operators.

1.2 Scope

Following the "The World & Machine" approach by M. Jackson and P. Zave we can identify real word entities that interact with the system ("the Word"), specific system entities ("the Machine") and the intersection beetwen them ("the shared phenomena").

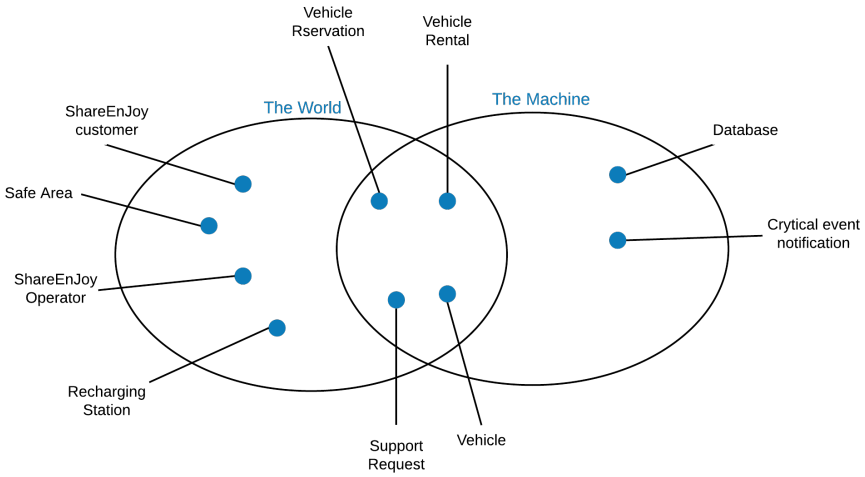

Figure 1: "The World & Machine" Venn diagram

The system will be composed of three main modules with different roles and purposes:

ShareEnJoy Mobile App This component is intended to be used by ShareEnJoy customers and will offer the functionality to see available vehicles in a specific geographical area, to reserve and then to rent a vehicle. It also allows users to unlock a reserved vehicle when they're nearby Through the app users can also send support requests to ShareEnJoy support staff.

ShareEnJoy Control Room This component is intended to be used by ShareEnJoy operators in order to have a real time blueprint of the system, to handle support requests and to be notified for some specific events (e.g. an automatic payment failure, a car that runs out of battery).

ShareEnJoy Core This component is intended to contain all the system logic. It should work as a connection node between all the other components as well as connection point to vehicles. It should handle user's payments through a payment gateway and perform automated tasks.

A list of high level goals that the system should accomplish is the following:

|G1| The system should know vehicles position and information such as model, battery percentage, mechanical issues and damages.

|G2| The system should be able to show on a map the position of available vehicles together with some selected status information (e.g. battery percentage) and estimated information (e.g. kilometers authonomy).

|G3| Users should be able to register and insert a payment method.

|G4| Users should be able to reserve a vehicle, unlock it when they're close to it's position and start the rent.

|G5| The system should charge the users after each rent with fees based on company policies.

|G6| Users should be able to send a support request.

|G7| Company operators should be able to handle support requests forwarded by users.

|G8| Company operators should be able to see and handle notifications sent by the system.

1.3 Definitions, acronyms and abbreviations

In order to avoid ambiguity and possible misunderstanding here are formally listed some recurrent terms and acronyms used in this document.

The System	The digital management system to be developed.
ShareEnJoy	The company to develop the system for. Also referred as 'the company'.

Vehicle	A vehicle owned by the company that can be used in the car sharing service.
User	A person who wants to use the system and it's not a member of the company.
Logged-in user	A user who has completed the log-in process so that it can be associated with a real identity and payment information.
Customer	A user or a logged-in user.
Operator	A person who wants to use the system and it's authenticated as a member of the company.
Availabe vehicle	A vehicle that is not reserved by anywan and can be reserved by a logged-in user.
Reserved vehicle	A vehicle that has been reserved by a logged-in user.
Rented vehicle	A vehicle that is currently rented by a logged-in user.
Expired reservation	A reservation that has not been cancelled or transformed in a rental after a certain amount of time defined by company policies.
Safe Area	The geographical area in which a vehicle can be parket and rental terminated.
DBMS	Database Management System
TBD	To Be Determined

1.4 Reference documents

|REFD1| Assignments AA 2016-2017

|REFD2| ISO/IEC/IEEE 29148, first edition, 2011-12-01

|REFD3| Requirements Engineering Part III

|REFD4| IDC Research Inc analysis on mobile operating systems market share `http://www.idc.com/prodserv/smartphone-os-market-share.jsp`, 2016 Q2

|REFD5| Android distribution per version `https://developer.android.com/about/dashboards/index.html`, as of 2016-11-02

|REFD6| iOS per version distribution `https://david-smith.org/iosversionstats/`, as of 2016-11-02

1.5 Overview

TODO

2 Overall Description

2.1 Product perspective

The central component of the entire system is the ShareEnJoy Core module which is where all the logic is put. This module of the system is in charge of providing an interface to vehicles on-board information system, of processing requests from the other modules of the system, of accessing system database and of interfacing with the payment gateway.

All the other modules of which the system is made of (i.e. ShareEnJoy Mobile App and ShareEnJoy Control Room) should interface with the core module in order to accomplish required tasks (e.g. user's registration and login, vehicle reservation request, etc).

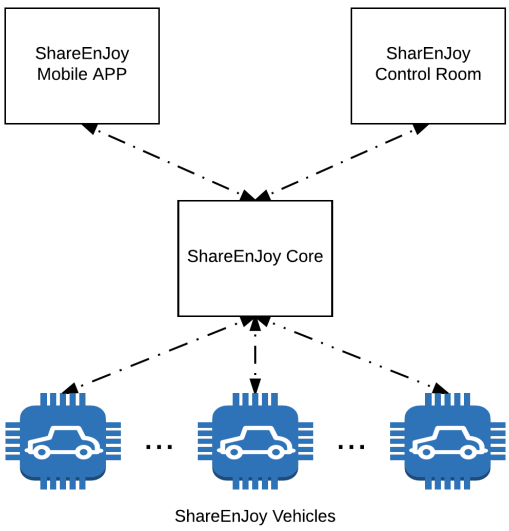

Figure 2: Block diagram of the system structure

2.1.1 User Interfaces

ShareEnJoy Mobile App This module will be implemented as a mobile application and it's intended for costumers. It's important that the most used commands are visibile and easy navigable. Secondary commands of less frequent usage can be organised in secondary less visible menus.In order to avoid mistakes between commands it's better

to not have too many selection on every page, text explainations should be clear and concise. Error windows should show short error descriptions together with an error identification code.The applica-

tion should follow the design guidelines of the different operating system it will be implemented for (i.e. Material design for Android, ModernUI for iOS) and support all screen resolutions between ldpi and xxdpi.

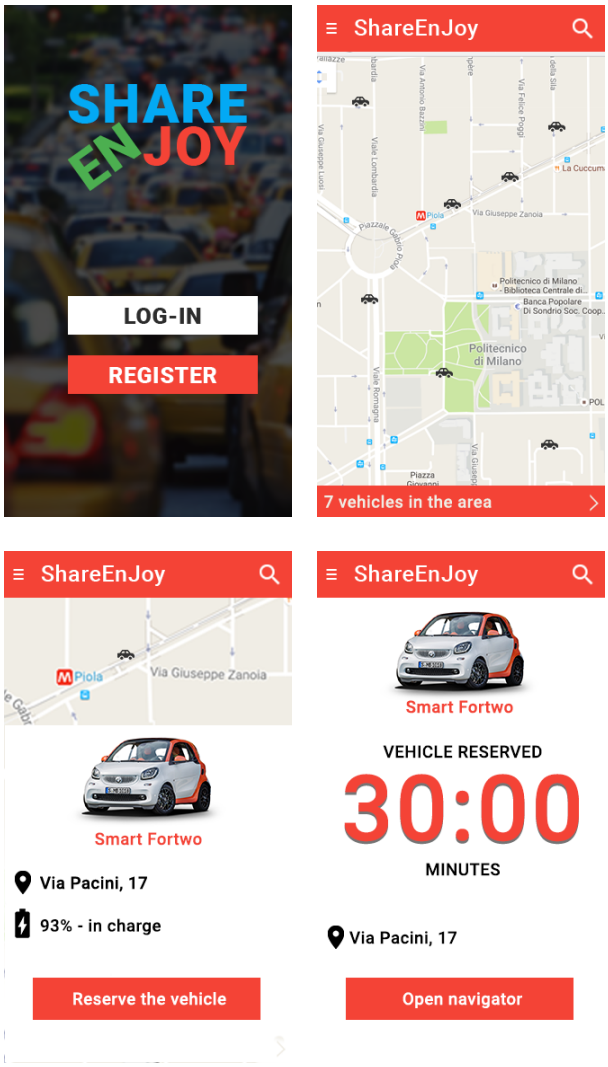

Figure 3: ShareEnJoy Mobile App mockups

ShareEnJoy Control Room This module will be implemented as a web application and it is intended for operators. Functionalities should be well categorized and unambiguous. Most frequently used functions should be as easy and immediate as possibile in order to speed-up operators work and reduce customers wait time. Some macros could be present in order to reduce repetitve tasks. It should be accesible through a common internet connection and it should be well op-

timized for a single chosen browser and a screen resolution. Error windows should show a long error message in order to easily recover.

ShareEnJoy Core This module does not provide a direct user interface since it's intended to be managed and maintained by qualified and specialized staff. It should provide a very detailed activity logs.

2.1.2 Hardware interfaces

ShareEnJoy Mobile App This component should obtain device location by its operating system. If GPS position is unavailable or insufficiently precise, a localization through wifi network could be possibile. If both methods fail or can't provide the desired level of acuracy the application can't work properly.

ShareEnJoy Control Room This software does not have any hardware interfaces.

ShareEnJoy Core This software does not have any hardware interfaces.

2.1.3 Software interfaces

ShareEnJoy Mobile App Android and iOS together cover about the 99% of the mobile operating system market share[1] and are the systems we are going to focus on.
After analysing per operating system distribution and share, a good compatibility tradeoff could be the following.

Mobile device operating system	
Operating System	Min. version
Android	4.1 (API level 16)
iOS	9

With this minimal requirements we can support 97% of android devices[2] and 92% of iOS devices[3]

ShareEnJoy Control Room This software will require a Java EE application server. It should integrate a support ticket system in order to handle support requests forwarded by users.

Application server	
Name	Glassfish
Version	4.1.1

Support ticket system	
Name	osTicket
Version	OSE 1.10

ShareEnJoy Core This software has to interface with vehicles on-board information system, with the payment gateway and with a DBMS. It will require a Java EE application server.

[1] REFD4
[2] REFD5
[3] REFD6

Vehicles information system	
Name	ShareEnJoy Vehicle I.S.
Version	1.0

Payment Gateway	
Name	GESTPAY
Version	Professional

DBMS	
Name	MySql Community Edition
Version	5.7.6

Application server	
Name	Glassfish
Version	4.1.1

The module can properly work on every operating system as long as these components are installed and work properly.

2.1.4 Communication Interfaces

All modules should communicate with the core module in order to complete tasks, thus the core module can be seen as an internal API provider. All the communications between the modules are bidirectional and could be implemented through the internet HTTPs protocol using a REST approach. Responses could be in the JSON format.

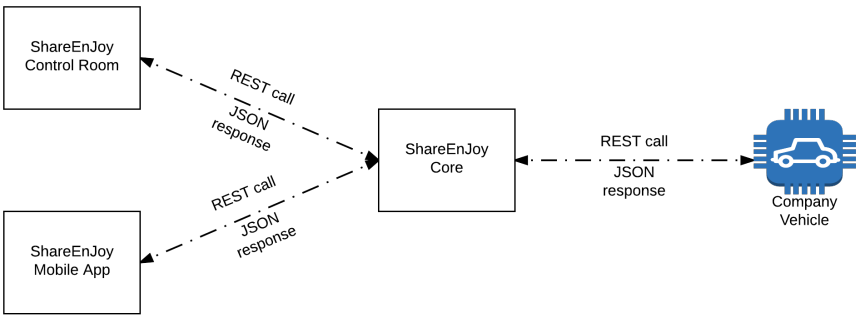

Figure 4: System modules communication scheme

Communication between the core and the DBMS works using the TCP protocol on port 3306.

Communication between the core and the payment gateway works using the TCP protocol on an arbitrary port.

The ShareEnJoy control room can be accessed using the HTTPs protocol on port 80.

2.1.5 Memory constraints

Users must have enough space to install ShareEnJoy Mobile App application on their own devices. The size of the application is still unknown but it can be estimated in less than 100MB.

The system on which the core module will be run requires enough primary memory space in order to install required softwares (section 2.1.3). Other 5GB of primary memory space are required for the database and the software itself. A good amount of secondary memory (i.e. 32GB) will result in better performances for both the software itself and the DBMS.

2.1.6 Operations

TODO

2.2 Product functions

In this section are listed all the functionalities that the system-to-be is going to provide.

2.2.1 Functional requirements

Functional requirements are listed per system module:

ShareEnJoy Mobile App

- Registration
- Log-in
- See and edit logged-in user's own profile information and payment method
- Show available vehicles on map
- Search available vehicles based on GPS localization or specific address
- Show vehicle information (i.e. battery percentage, estimated kilometers authonomy)
- Make new or cancel existent vehicle reservation
- Unlock a reserved vehicle
- Guide the user to the reserved vehicle
- Send a support request

ShareEnJoy Control Room

- Operators login
- Show all vehicles position and information
- Show user's account information, disable an user
- Show user's last activities
- Show users' support requests and allow operators to reply or close the requests
- Show system notifications and mark them has *handling*, *handled*, $not - handled$
- Mark a vehicle as *unavailable* (e.g. when the vehicle has a mechanical issue)
- Charge users for driving fines.

ShareEnJoy Core

- Handle rent events (i.e. *RENT STARTED*, *RENT TERMINATED*)
- Send commands to vehicles (e.g. *UNLOCK DOORS*)
- Charge users after each rent applying company pricing policies
- Handle payment failure: disable the user'acount if it's payment information are nomore valid

- Access and edit the company database
- Notify users via SMS on their mobile phone number or via push notifications through the SharEnJoy Mobile App
- Generate monthly invoices and sent them to the users on their email address
- Detect expired reservation and charge the user for them

2.2.2 Non-functional requirements

- The system must be able to handle thousands of requests simultaneously.
- The system should work properly 24 hour a day, 7 days a week and should provide an high uptime score. Maintenance can be scheduled during the night, when traffic is lower.
- Users' information should be securely stored in the company database and not accessible to unhautorized people. Espacially passwords should be encryptet using efficient cryptography algorithms.

2.2.3 Company pricing policies

The company has defined some specific pricing policies to be applied in correspondence with some specific user behaviours

- Expired reservation has a cost of 1EUR.
- The rental starts as the user turns on vehicle engine.
- The rental stops as the user parks the vehicle within the safe area and all the passengers leave the vehicle.
- Rental fee is per minute.
- A 10% discount is applied on the total rental fee if there are at least 2 other passengers in the vehicle for more than the 50% of the rental time.
- A 20% discount is applied on the total rental fee if the vehicle is parked with more than 50% of battery capacity available.
- A 30% discount is applied on the total reantl fee if the vehicle is parked in a charging station and the user plugs-in the charging cable.
- A 30% extra fee is applied on the total rental fee if the vehicle is left more than 3KM away from a rechargin station or if the vehicle is left with less than 20% of battery capacity available.
- If more than a discount or an extra fee should be applied, extra fees are applied first in ascendant order, discounts are applied later in descendant order.

2.3 User characteristics

We distinguish beetwen two main categories of users

ShareEnJoy Customers Customers that want to use the service in order to rent a vehicle.

- Users: They can only see the position of available vehicles. Anyone that uses the app without logging-in.
- Logged-in users: They can access to all the functionalities of the service. They are associated with a real identity and a payment method. Logged-in users should possess a valid driving license, which should be indicated during the registration process. People with disabilities that doesn't allow the to drive a normal vehicle cannot register and use the service: this check is done validating drive license data during the registration process.

ShareEnJoy Operators They are workers of the company, thus they have a good knowledge about the service and will follow a training on how to use ShareEnJoy Control Room software.

2.4 Constraints

2.4.1 Regulatory policies

The system needs to store in the company database customers' personal information (e.g. name, surname, address, email address, telephone number) as well as to access users' locations in order to track vehicles. Sensible data treatment should respect local laws belonging to each area where the service will be available.

2.4.2 Safety and security considerations

Communications between system modules should be secure and use latest encryption protocol in order to avoid man-in-the middle or other kind of informatic attacks that could lead to data loss.
Communications towards vehicles should be secured in order to avoid illegal vehicles unlocks perfomerd by malicious users or other types of illegal behaviours.

2.5 Assumptions and dependencies

The system is based on the following domain assumptions:

- Information provided by vehicles on-board information systems (i.e. vehicle location provided by
- GPS, battery percentage, mechanical damages) are always available and accurate.
- If a vehicle cannot obtain location by GPS or has not internet connection it is considered unavailable and not shown to users.

- Vehicles always unlock when the system tells them to unlock. This is true for each type of command.
- Vehicles on-board information systems are always able to detect and provide: battery percentage, number of passengers, mechanical failures, GPS location.
- If a user has a valid driving license then he can access the service (this mainly deals with disabilities).

2.6 Further developments

- Allow the creation of different user groups in order to have different system behaviours based on the group (e.g. different pricing policies for groups).
- Allow the creation of coupons that users can use to have special discounts.

3 Specific requirements

3.1 Functional requirements

3.1.1 Scenarios

In order to better describe functional requirements listed in section 2.2.1 here is a list of possible system usages (scenarios) from various viewpoints

Scenario 1 **User registration and log-in**

Luca is a university student who moved to Milan for studying. He can't afford to buy a car but sometimes he needs to move even when public transports are unavailable (i.e. during the night). He decided to try a car sharing service and downloaded ShareEnJoy Mobile App in order to use it during the incoming weekend. Once the download is complete and the app is installed on his smartphone, Luca starts the registration process: first he needs to create an account filling-in his name and email address, his mobile phone number and choosing an username. Email address is not yet used and username is available, thus he can continue inserting his driving license ID: he missed a characters so the application shows an error message. Luca fixes the mistake and moves on to the latest step in which he is requested to insert his credit card information. A fee of 0,01EUR is charged on his credit card in order to validate it and the registration process is complete.
Luca receives on his email address his password and can now log-in.

Scenario 2 **Search for a vehicle and make a reservation**

Martin is a business man and he is just landed to Milan Malpensa airport. He is going to have an intensive day and he needs to move fast in the town center. He is taking a train from Malpensa to Stazione Centrale station and during the 30 minutes time trip he plans to reserve a vehicle near Stazione Centrale in order to do not waste time when he will get off the train. He is a ShareEnJoy user and he starts the application on his smartphone: he fills in the address and sees available vehicles on the map. He founds a vehicle with enough power according to his requirements and 3 minutes walking from the station. He decides to reserve the vehicles and clicks the relative button on the application. Now Martin can relax until he reaches Stazione Centrale.

Scenario 3 **Unlock a vehicle and start the rent**

Marco is walking home after his evening gym session when he spots a ShareEnJoy car parked along the street. He is tired by his training session so he decides to check if the car is available. Marco starts the application on his smartphone and checks for available vehicles nearby using his GPS location. The vehicle along the street is available so Marco reserves it and, being less than 5 meters away from the car, he is able to unlock it using the relative button on the application. Marco jumps in the car, secures the fast belt and starts the engine: the rental starts and the price to be paied is shown on the screen installed in the car.

Scenario 4 **User terminates a rent**

Mario and his friends are planning to go the the cinema tonight but the

place they want to reach is not covered by city public transports. Mario is an old ShareEnJoy customer and he knows that the place is inside the safe area and that ShareEnJoy applies a special discount on the rental fee if there are passengers. He rents a vehicle and reaches the cinema: once there, he stops the engine and terminates the rent. An SMS sent to his mobile phone number informs him of the final price, which was influenced by a number of company policies. 9EUR is the base price, plus he has got a 10% discount because he traveled with friends, a 20% discount because he left the car with more than 50% of the battery capacity available and a 30% extra fee because there are no recharging station in a 3KM range from the cinema. Mario thinks that 8,43EUR is a very good price to spent a cinema night with friends (with which he will divide the cost later!).

Scenario 5 **User sends a support request and operator handles it**

Mario had a really busy day and he is now looking for an available ShareEnJoy car so that he can reach his friends at the restaurant. Mario uses the application on his smartphone to reserve a vehicle but when he reaches the car he has an unexpected surprise: the car has no wheels because they have been stolen. He uses the application to open a support request describing the problem. The operator sees the request in the ShareEnJoy Control Room software and gives instruction on what to do to the client. Then, he marks the car as unavailable and sends a notification to the mechanics team.

Scenario 6**User tries to terminate the rent outside a safe area**

Marta is new to the car sharing services and it is the first time she rents a ShareEnJoy vehicle. She wants to reach Rho, a town near Milan, but it is outside the safe area and she has not read information documents. Once she reaches her destination, she stops the engine and tries to terminate the rent: a message on the screen installed in the car and an SMS sent to her mobile phone number notifies her that she can't terminate the rent in that location and that she will be charged until she will terminate the rental inside the safe area. Marta checks the map and starts the engine again in order to move the car inside the safe area, which is just 700mt away from her destination.

Scenario 7 **User's payment fails**

Carol has just terminated a rental but she has no left money on her prepayed credit card. As soon as the ShareEnJoy Core Module tries to make a payment and it is refused, it disables Carol's account and sents her a notification both via SMS and email. She will not be ablo the use her account to rent a vehicle until she will update her payment information and pay the given amount.

Scenario 8 **User took a driving loan**

A driving loan has just been received at the ShareEnJoy headquarter. The operator takes the loan and just inserts the amount and the date with the time in the ShareEnJoy Control Room software. The system automatically charges the user who was driving the vehicle in that specific time. The user is notified via both SMS and email.