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Design Document

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1 Introduction

1.1 Purpose

The purpose of this document is to give the detailed structure of PowerEnJoy software system.

So we try to give developers a clear representation of:

- The high level architecture of the system.
- The design patterns applied in order to achieve our specific necessities.
- The main components and the interfaces they provide.
- The Runtime behaviour.

1.2 Scope

PowerEnJoy project aims to give users, operators and callcenter operators access to the system services they need and they are supposed to access.

The system allows:

- Users to manage their personal data through both a web and a mobile app and Active Users to manage reservations only through the mobile app.
- callcenter operators to manage assistance tickets, that will be managed by PowerEnJoy itself.
- PowerEnJoy operators to manage the opened assistance tickets, take them in charge and update car's and user's data accordingly.

The system architecture shall guarantee future proof scalability and allow subsequent improvements and general reliability.

1.3 Abbreviations, Definitions and Acronyms

1.3.1 Abbreviations:

- Gn: the n-th Goal
- An: the n-th Assumption
- Rn: the n-th Requirement

1.3.2 Acronyms

- CC: Credit Card
- DL: Driving Licence
- AU: Active User

1.3.3 Definitions

- Visitor: person that may not be registered to the system or not logged in.
- User: a registered and logged in Visitor, that may be still waiting for his information to be verified.
- Active User: a User whose data (CC, DL) have been verified. (Shares all User's characteristics)
- Safe Zone: predefined zones where parking is allowed, parking is forbidden in any other zone.
- Park: park the car in the safe zone and terminate the rental.

2 Architectural Design

2.1 Overview

The system adopt a three tier architecture with a thin client composed by a web and a mobile app, both managed by a specific server side client handler

2.2 Component View

2.3 Deployment View

2.4 Runtime View

2.5 Component Interfaces

2.6 Selected Architectural Styles And Patterns

2.7 Other Design Decisions

3 Algorithm Design

All algorithms needed in the project are trivial but the one dealing with uniform repartition of cars in the city. This problem has been studied a lot and there are in literature various algorithms that solve it. They are mainly based on mixed integer linear programming techniques and in particular [1] presented a complete model. In [2] is presented a greedy algorithm that achieves almost the same result. In [3] a more sophisticated approach is used taking into account a three dimensional objective function and exploiting genetic algorithms and local search methods. [4] offers a sort of classification of the strategies proposed in the past years.

For our purpose the approach described in [2] is the best since it minimizes the number of the operators needed to relocate cars and so the costs.

Riferimenti

- [1] A. G. Kek, R. L. Cheu, Q. Meng, and C. H. Fung, “A decision support system for vehicle relocation operations in carsharing systems”, *Transportation Research Part E: Logistics and Transportation Review*, vol. 45, no. 1, pp. 149–158, 2009.
- [2] R. Zakaria, L. Moalic, A. Caminada, M. Dib, “A Greedy Algorithm for relocation problem in one-way carsharing”, 10th International Conference on Modeling, Optimization and Simulation - MOSIM’14 – November 5-7-2014- Nancy – France “Toward circular Economy”.
- [3] Moalic, L., Lamrous, S., & Caminada, A. (2013). A Multiobjective Memetic Algorithm for Solving the Carsharing Problem. *Proceedings Of The 2013 International Conference On Artificial Intelligence Icai 2013*, Vol. 1, pp. 877-883.
- [4] S. Weikl, K. Bogenberger, “Relocation Strategies and Algorithms for free-floating Car Sharing Systems”, 15th International IEEE Conference on Intelligent Transportation Systems Anchorage, Alaska, USA, September 16-19, 2012.

4 User Interface Design

Below are some mockups to show how users will interact with the service. Since PowerEnJoy can be used both from a computer (except unlocking the car), both Mobile and Web mockups are provided. Moreover, since both users and Operators have access to the service via browser/app, interfaces for both types of users have been created.

4.1 User Interfaces

As anticipated, in this section all User mockups are analyzed. These mockups show how all actions will be performed by our users. This section is further split between Web interfaces, imagined for standard browsers, and Mobile interfaces, designed having a smartphone App in mind

4.1.1 Web Interfaces

4.1.1.1 Home Page (Web) From the home page any user can try to login inserting username and password or they can choose to sign up and go to the registration page. This page will likely show a description of the service as well as providing links to other important part of the website (Map, Pricing, About Us).

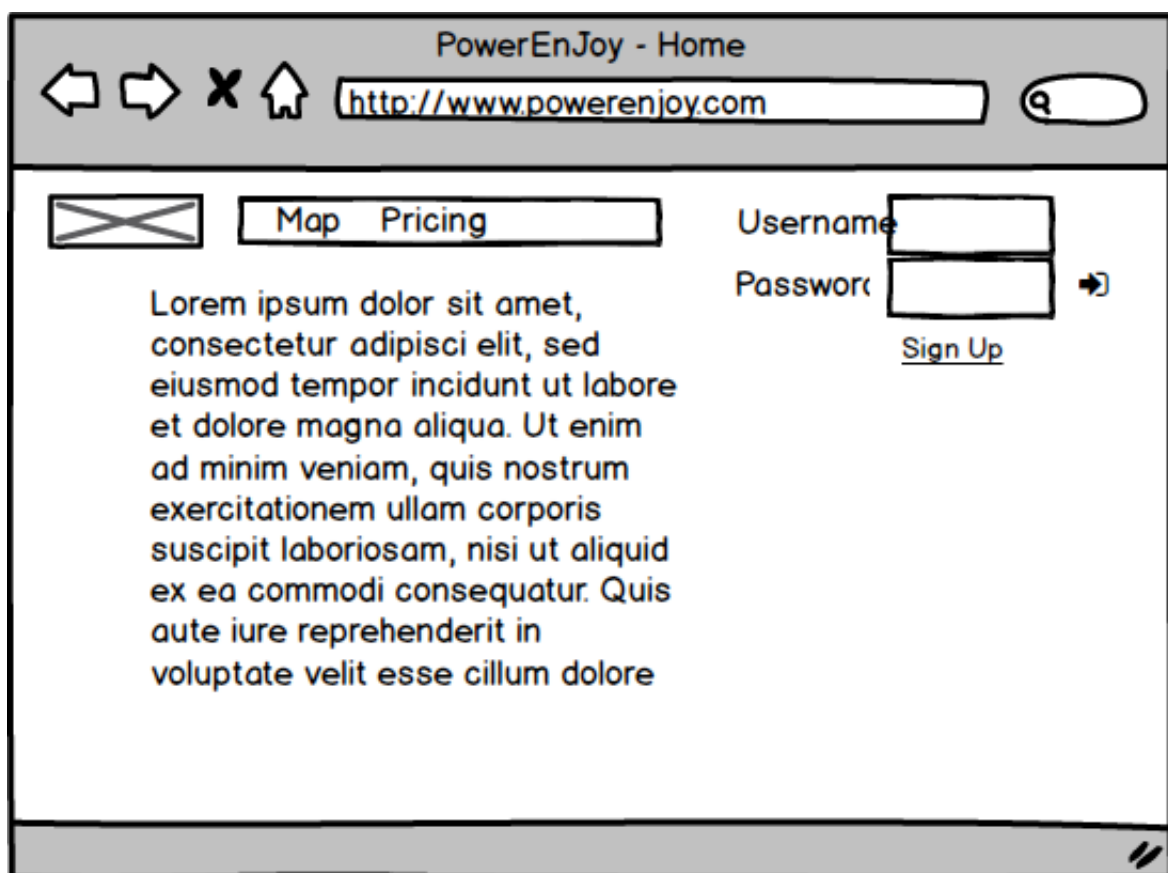


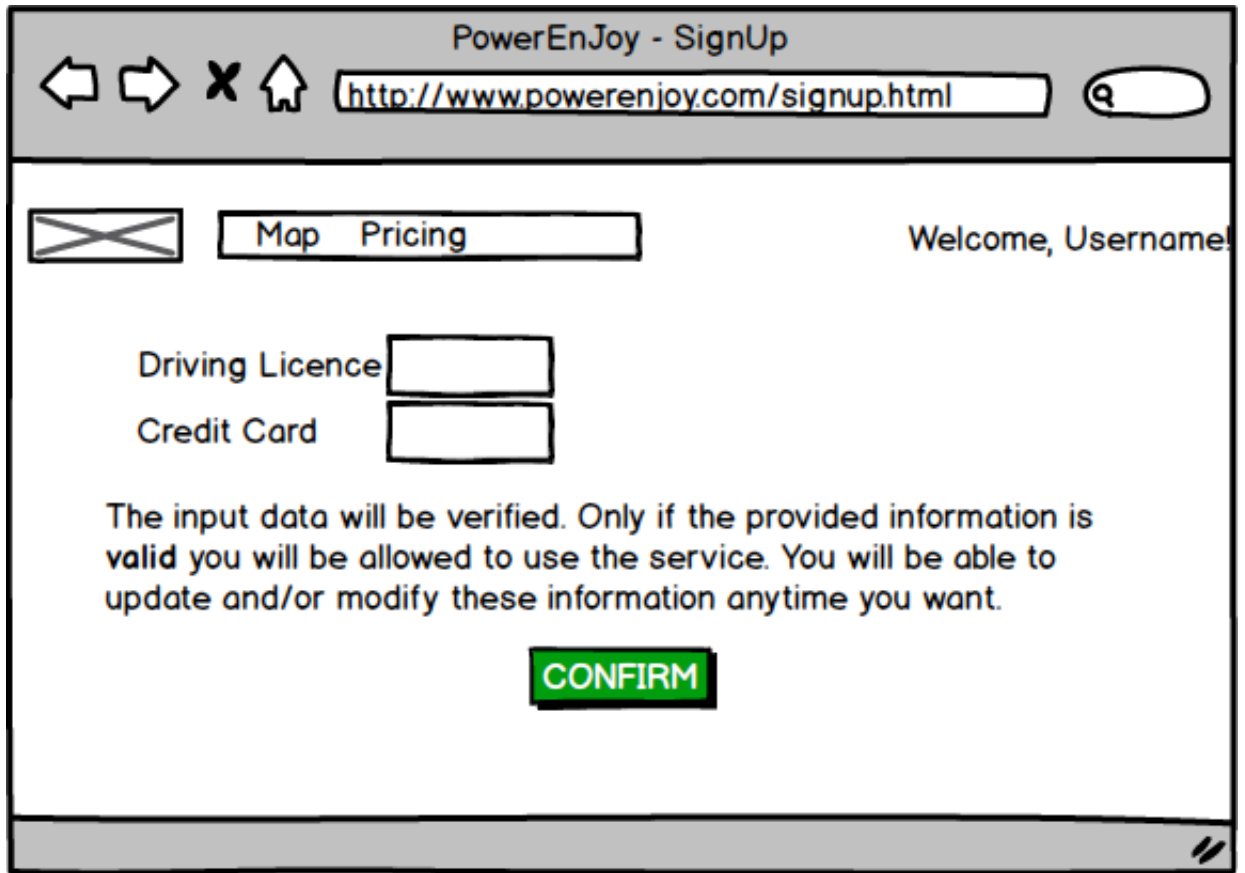
Figure 1: Web Interface - User's Home Page

4.1.1.2 Registration Page (Web) In this page users must input the core informations to register online: name, surname and email address.

The sketch depicts a web browser window with a title bar that reads "PowerEnJoy - SignUp". The address bar contains the URL "http://www.powerenjoy.com/signup.html". Below the address bar, there is a navigation bar with a close button (X), a "Map" button, and a "Pricing" button. The main content area features three input fields labeled "Name", "Surname", and "Email" stacked vertically. A green "SIGN UP" button is positioned below these fields. The browser window has a standard footer bar with a double-slash icon in the bottom right corner.

Figure 2: Web Interface - User Registration

4.1.1.3 Further Information (Web) After having registered and logged in, users must input their Licence and Credit Card in order to use the service.



The image shows a web browser window titled "PowerEnJoy - SignUp". The address bar contains the URL "http://www.powerenjoy.com/signup.html". The page content includes a navigation bar with a close button (X) and a menu with "Map" and "Pricing". A welcome message "Welcome, Username!" is displayed on the right. Below the navigation bar, there are two input fields: "Driving Licence" and "Credit Card". A paragraph of text states: "The input data will be verified. Only if the provided information is valid you will be allowed to use the service. You will be able to update and/or modify these information anytime you want." A green "CONFIRM" button is centered below the text. The browser window has a grey border and a search icon in the top right corner.

PowerEnJoy - SignUp

http://www.powerenjoy.com/signup.html

Map Pricing

Welcome, Username!

Driving Licence

Credit Card

The input data will be verified. Only if the provided information is valid you will be allowed to use the service. You will be able to update and/or modify these information anytime you want.

CONFIRM

Figure 3: Web Interface - User Further Information

4.1.1.4 Map (Web) All users can view available maps near their position and choose one if they want more info (see next mockup)

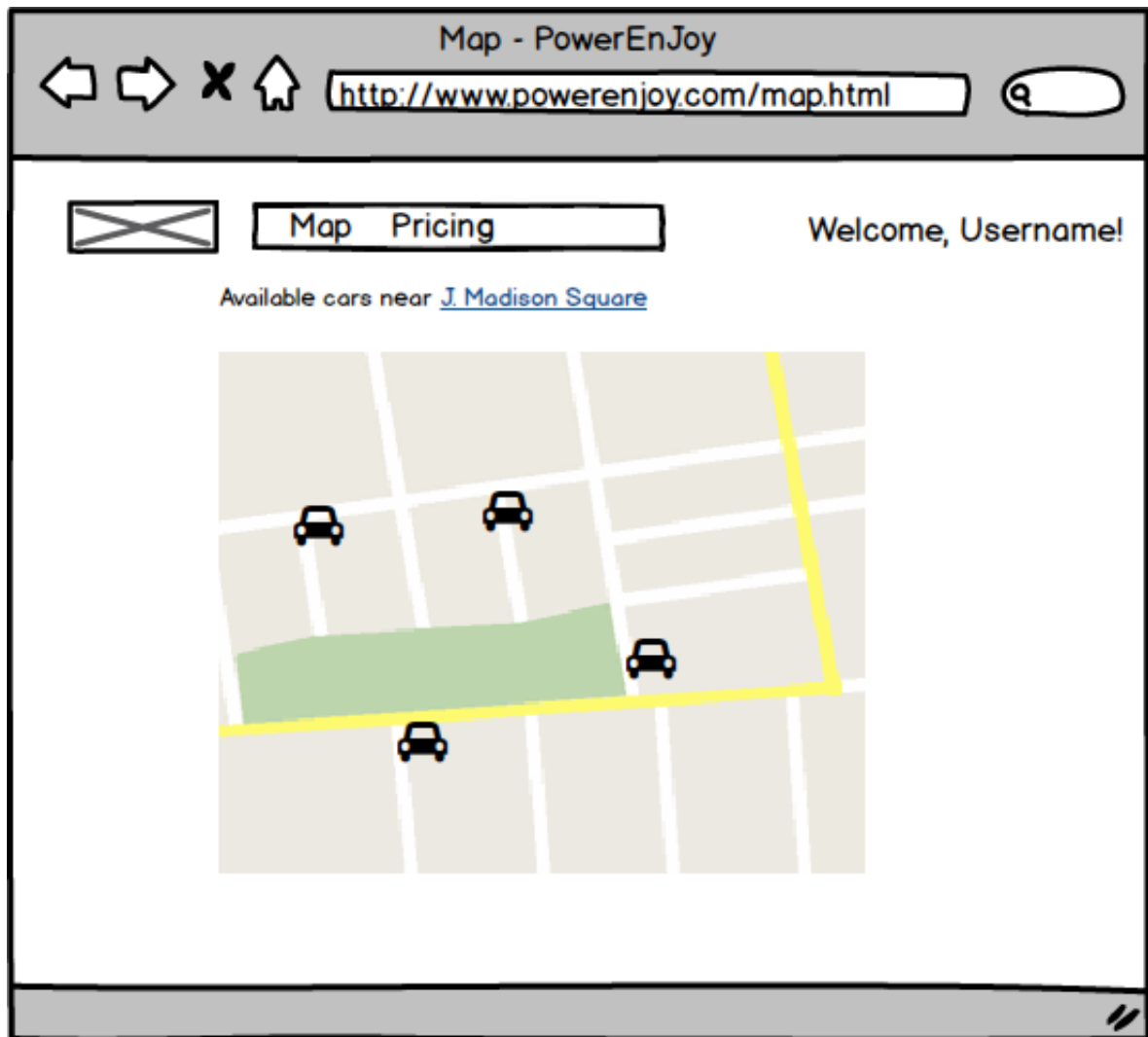


Figure 4: Map

4.1.1.5 Map - Selected Car (Web) Selecting a car provides relevant information about that specific car, in order to give to the user the chance to pick a car that can suit his needs.

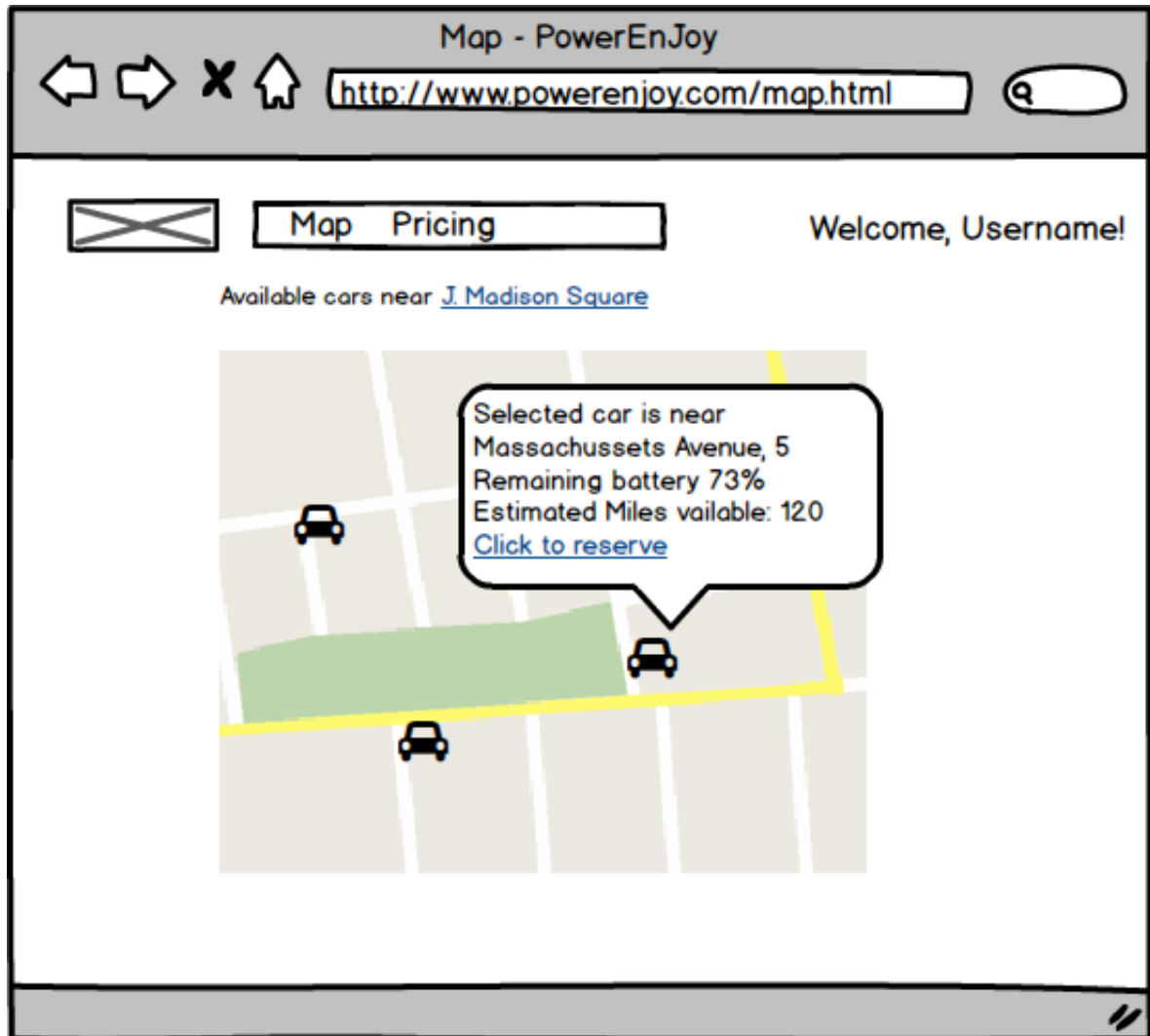


Figure 5: Selected car

4.1.1.6 Selected Car Confirmation (Web) After having selected a car and having pressed “Click to reserve”, users are asked to confirm their choice one last time, to avoid mistakenly pressed links or misread information.

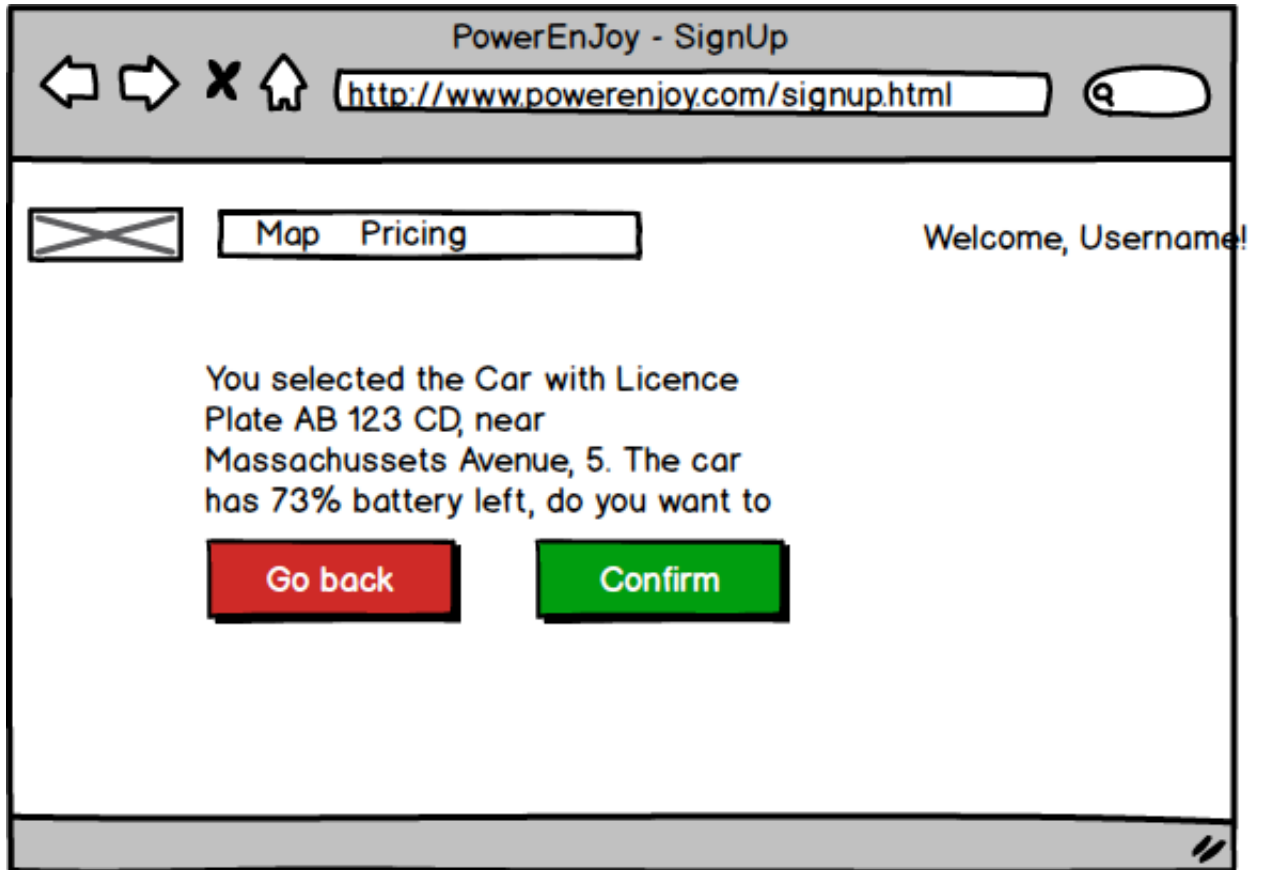


Figure 6: Car Confirmation Screen

4.1.1.7 Reservation Confirmed (Web) Confirming a reservation shows a brief summary containing the address.

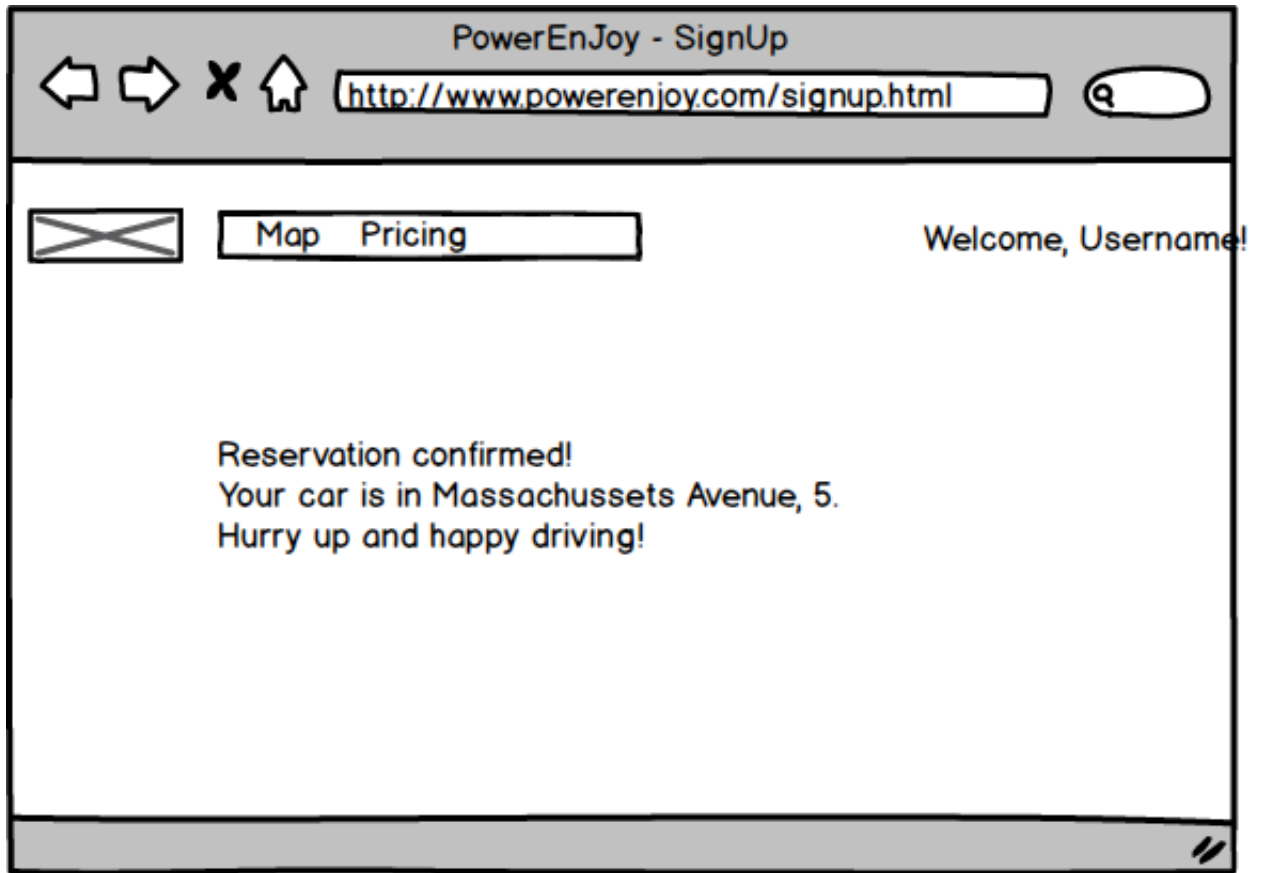


Figure 7: Reservation Confirmed

4.1.2 Mobile Interfaces

4.1.2.1 Home (Mobile) From the App's home page users can either login or create an account. Login is handled inside the app, while to create an account the user is redirected to the website.

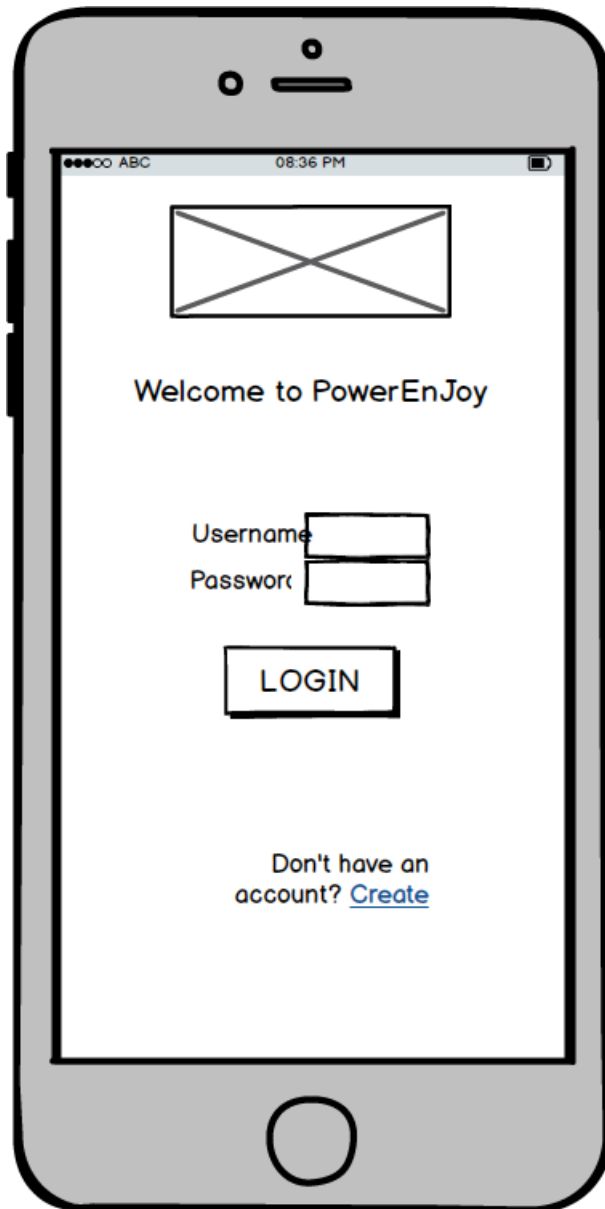


Figure 8: Mobile Home Page

4.1.2.2 Map (Mobile) The user is shown a map displaying all cars that are nearby. His position can be calculated using the built in GPS receiver or can be manually input.

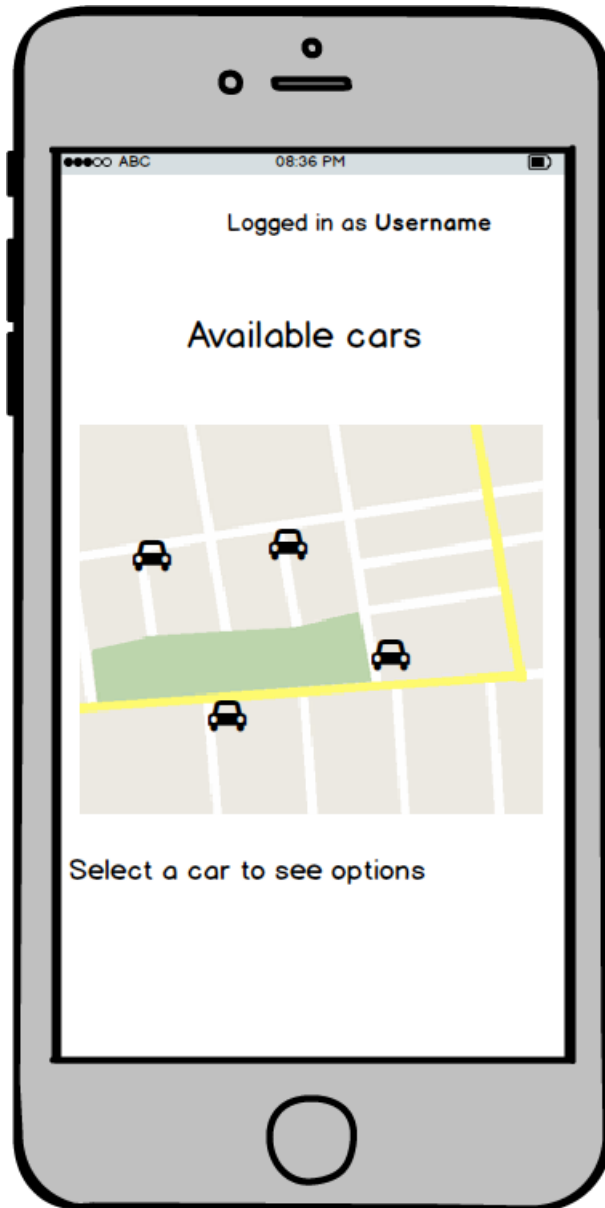


Figure 9: Map Mobile

4.1.2.3 Selected Car (Mobile) Selecting a car on the map shows relevant information, like the web happens.

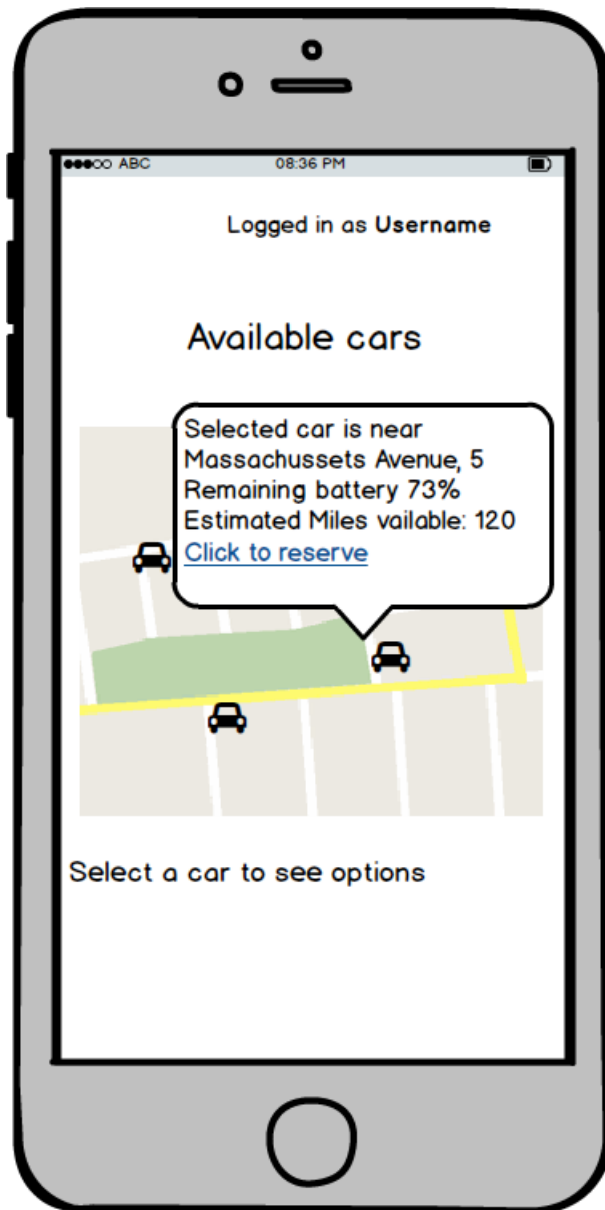


Figure 10: Selected Car Mobile

4.1.2.4 Car Confirmation (Mobile) A user can confirm a reservation or go back if he chose that car by mistake.

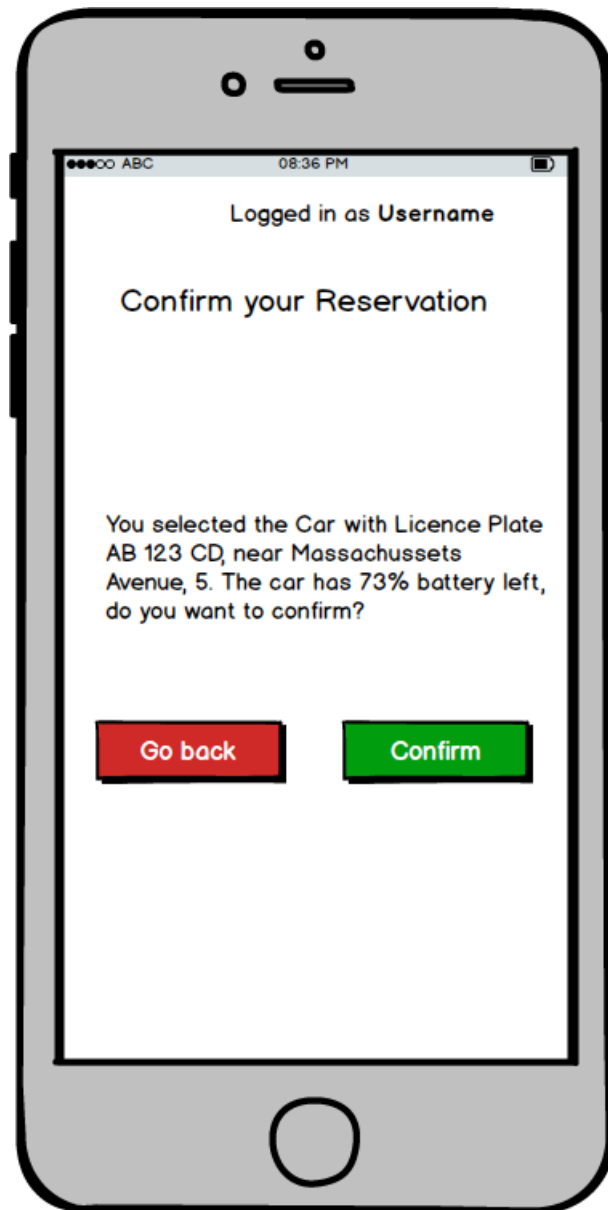


Figure 11: Car Confirmation Mobile

4.1.2.5 Reservation Confirmed (Mobile) When the reservation is confirmed, the smartphone shows a countdown as well as the car's address.

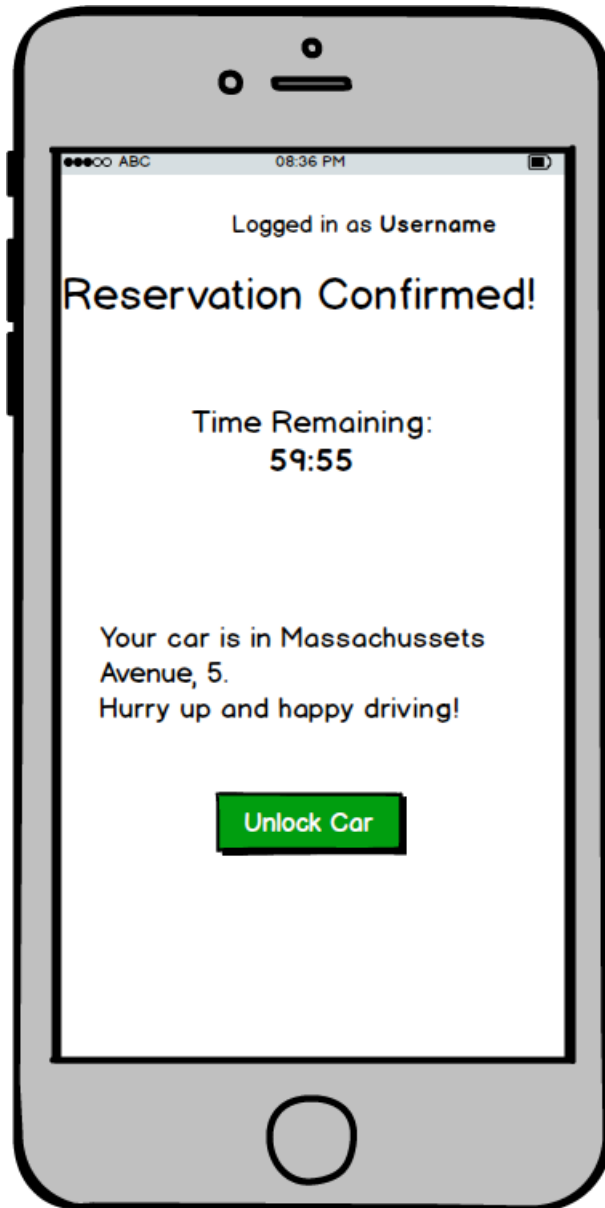


Figure 12: Reservation Confirmed Mobile

4.1.2.6 Car In Use (Mobile) While using the car, Users can decide to park it — which signals the system that the car will be picked up by the same user and that the rental is not to be terminated — or to end the rental.

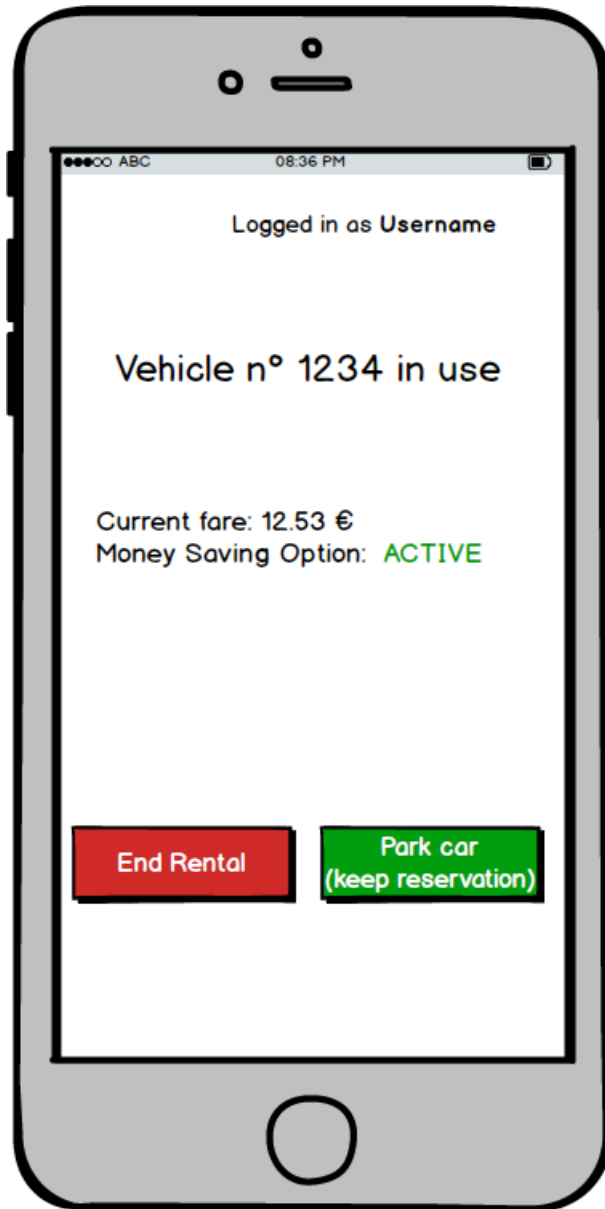


Figure 13: Car in Use

4.1.2.7 Car Parked (Mobile) If the car is already parked users can decide to end the rental using the app. In case they want to continue their journey, they only have to jump back on the car.

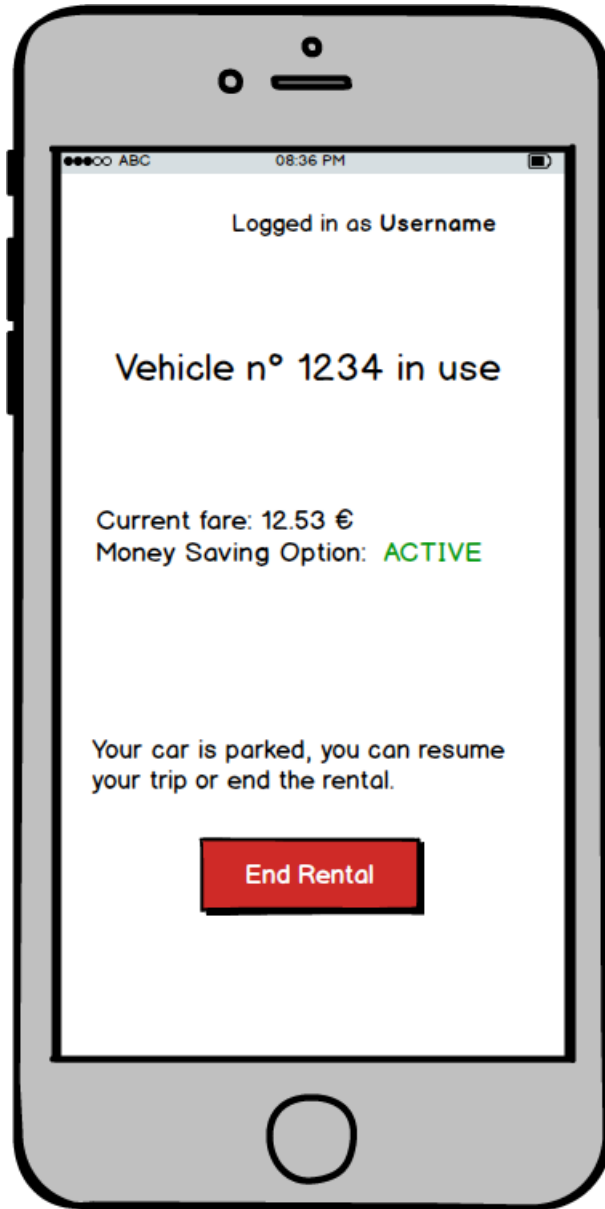


Figure 14: Car Parked

4.1.2.8 Rental Ended (Mobile) Ending a rental shows the total as well as whether the Money Saving Option was active for the trip.

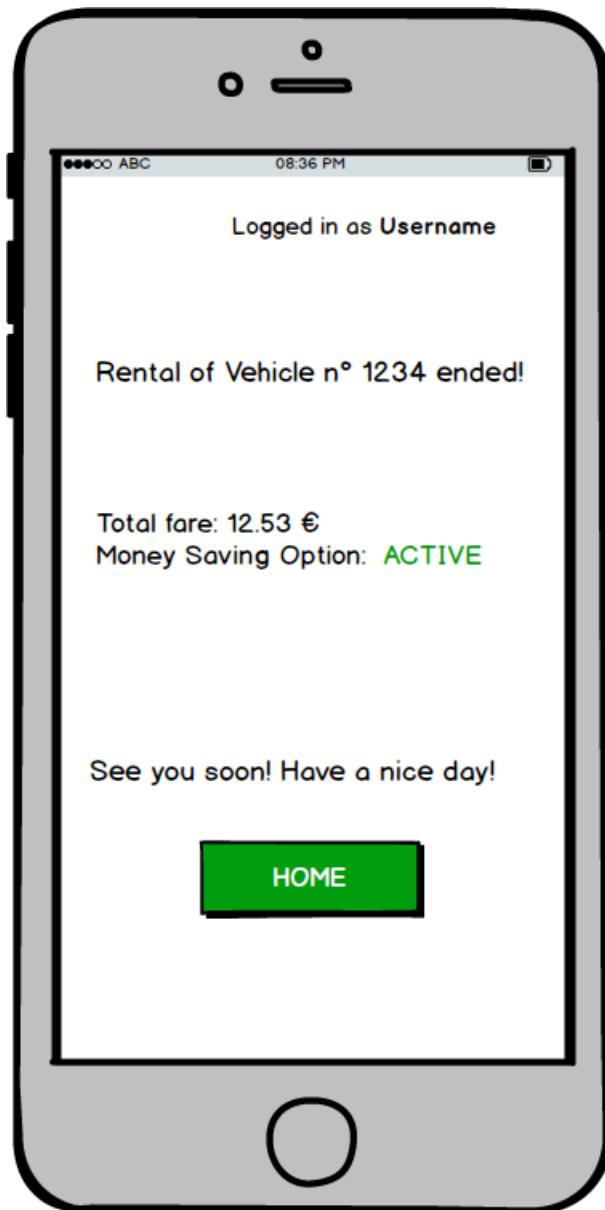


Figure 15: Rental Ended

4.2 Operator Interfaces

4.2.1 Web Interfaces

4.2.1.1 Operator Main Page (Web) Operators can choose between performing a pending task (a “Todo”) or managing a specific car.

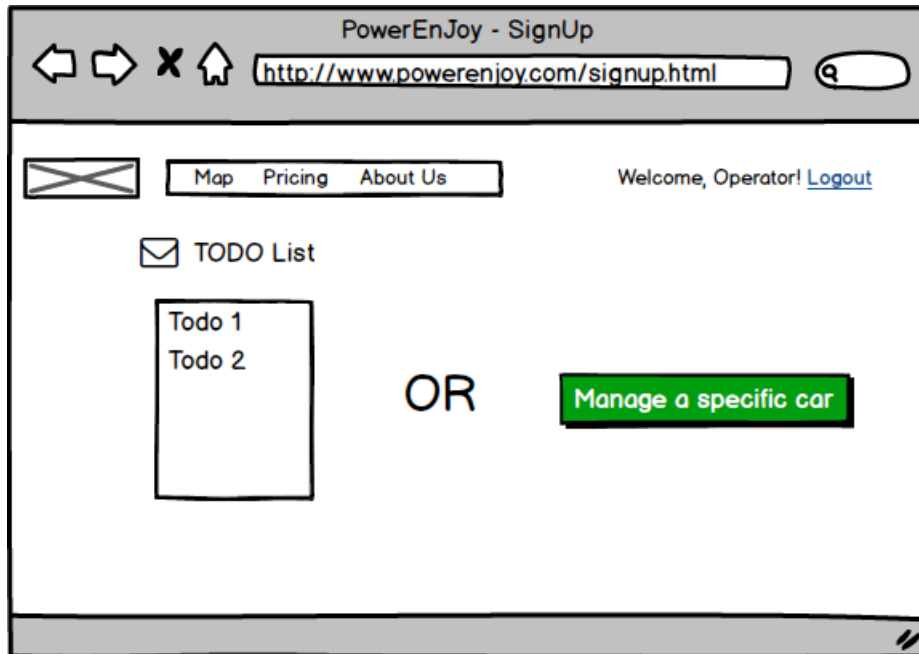


Figure 16: Operator Main Page

4.2.1.2 Operator chose TODO (Web) Choosing a pending operations brings up relevant information about it: its type, the position (if relevant), a short summary and a map. The operator can confirm the task if he will take care of it or go home (the logo links to the home).

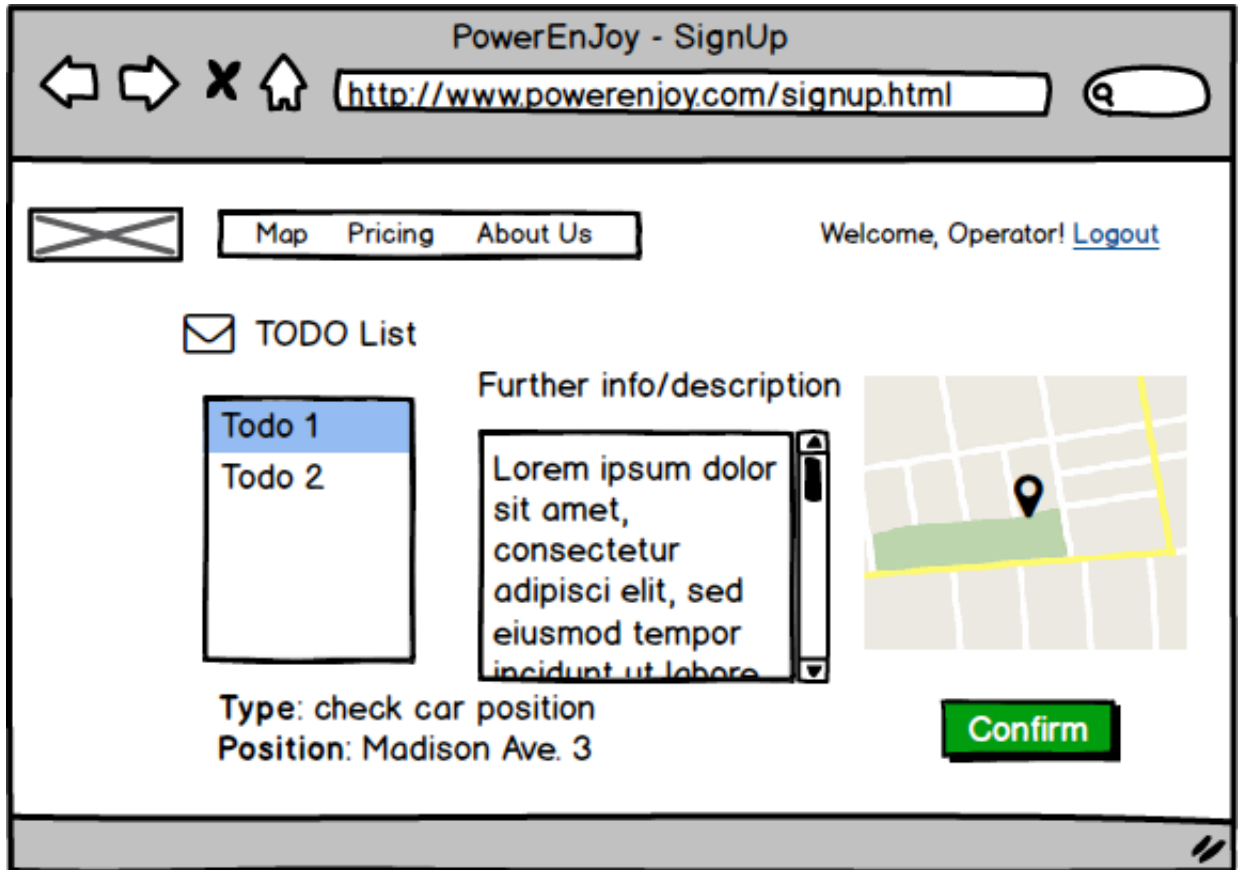


Figure 17: Chosen TODO

4.2.1.3 Operator Searched Car (Web) Choosing to manage a specific car allows the operator to search among all cars, by car Licence Plate or by Current Driver (User) if in use.

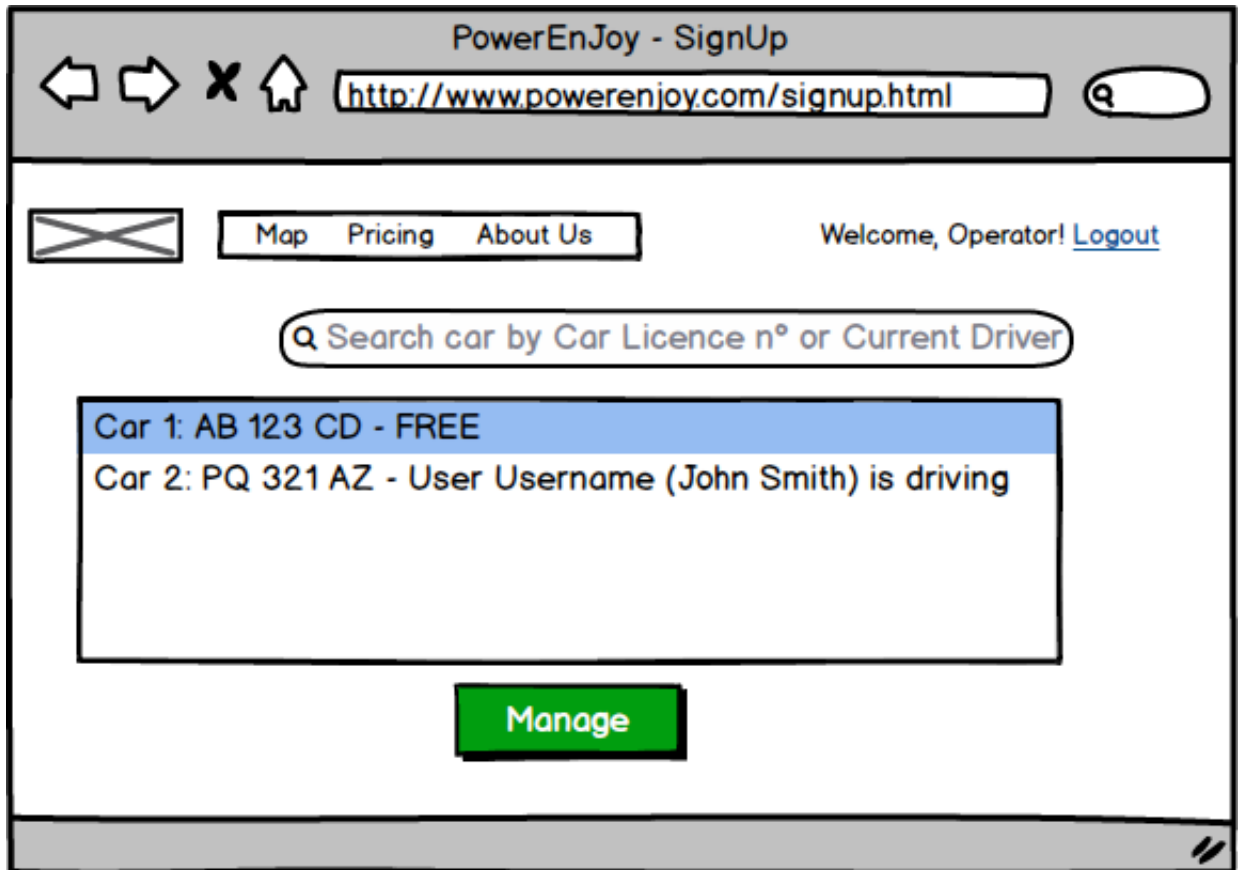


Figure 18: Car Search

4.2.1.4 Car Details (Web) The Car Details page shows all informations available for the chosen car as well as providing buttons to change all editable parameters (for instance the car's status)

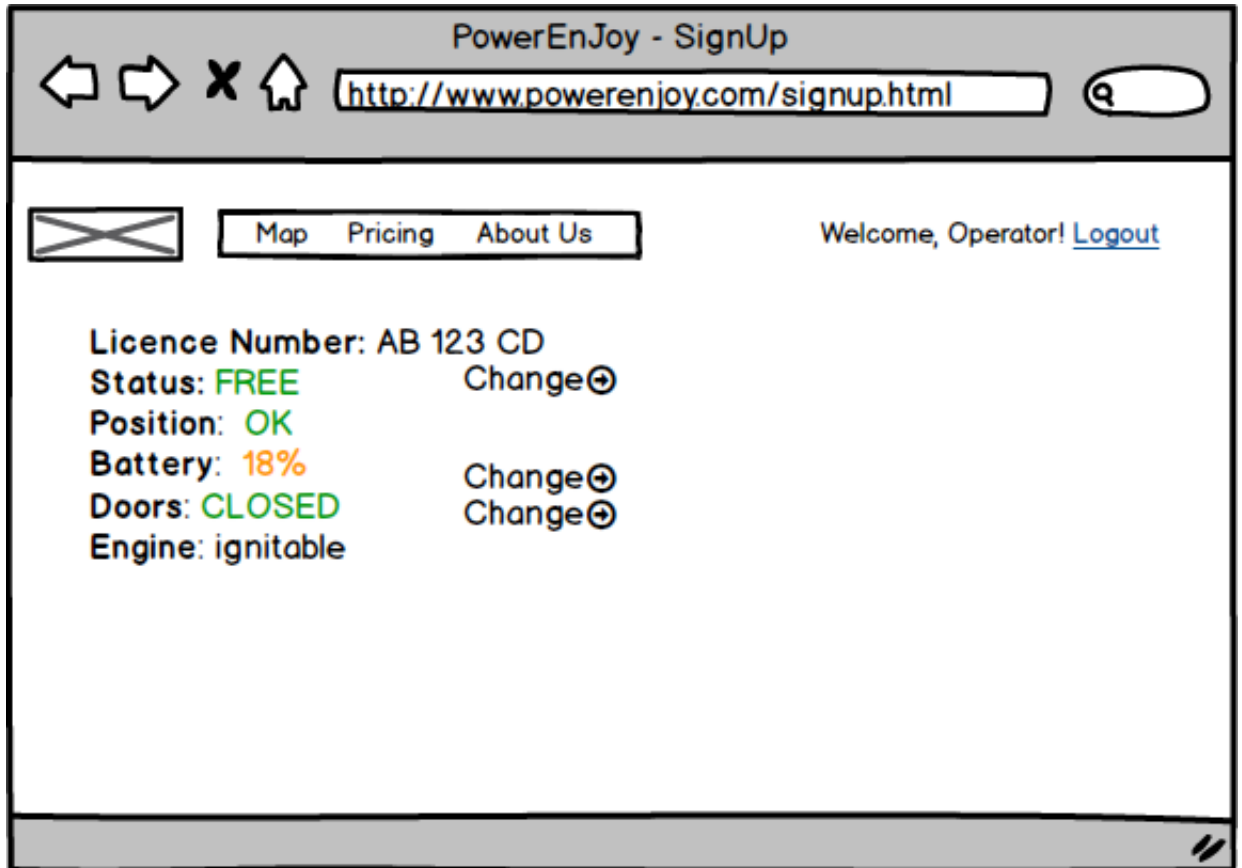


Figure 19: Car Details

4.2.1.5 Changing a Car parameter - Sample (Web) Choosing to edit a parameter brings up a “pop-up” providing the needed options to edit.

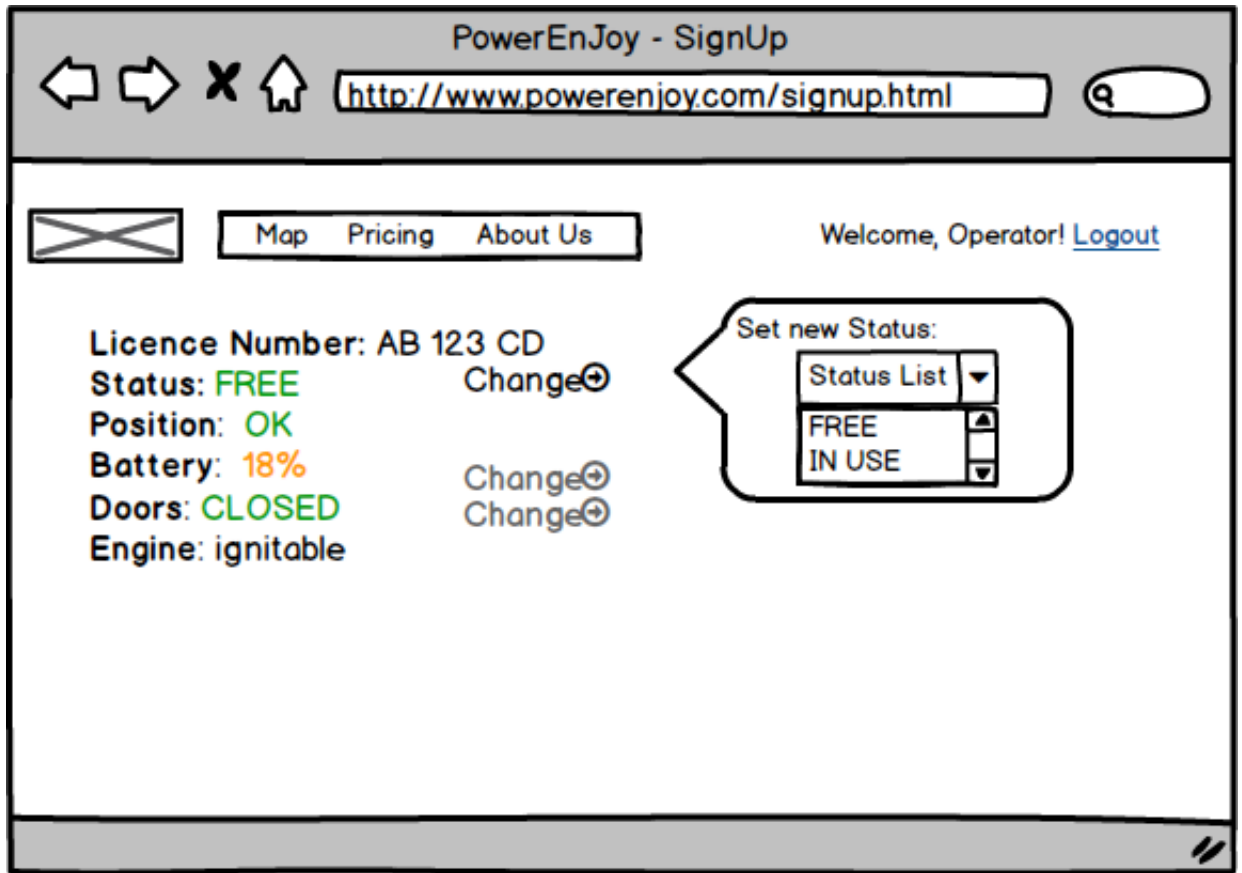


Figure 20: Changing a detail

4.2.2 Mobile Interfaces



Figure 21: Operator Main Mobile

4.2.2.1 Main Page (Mobile)

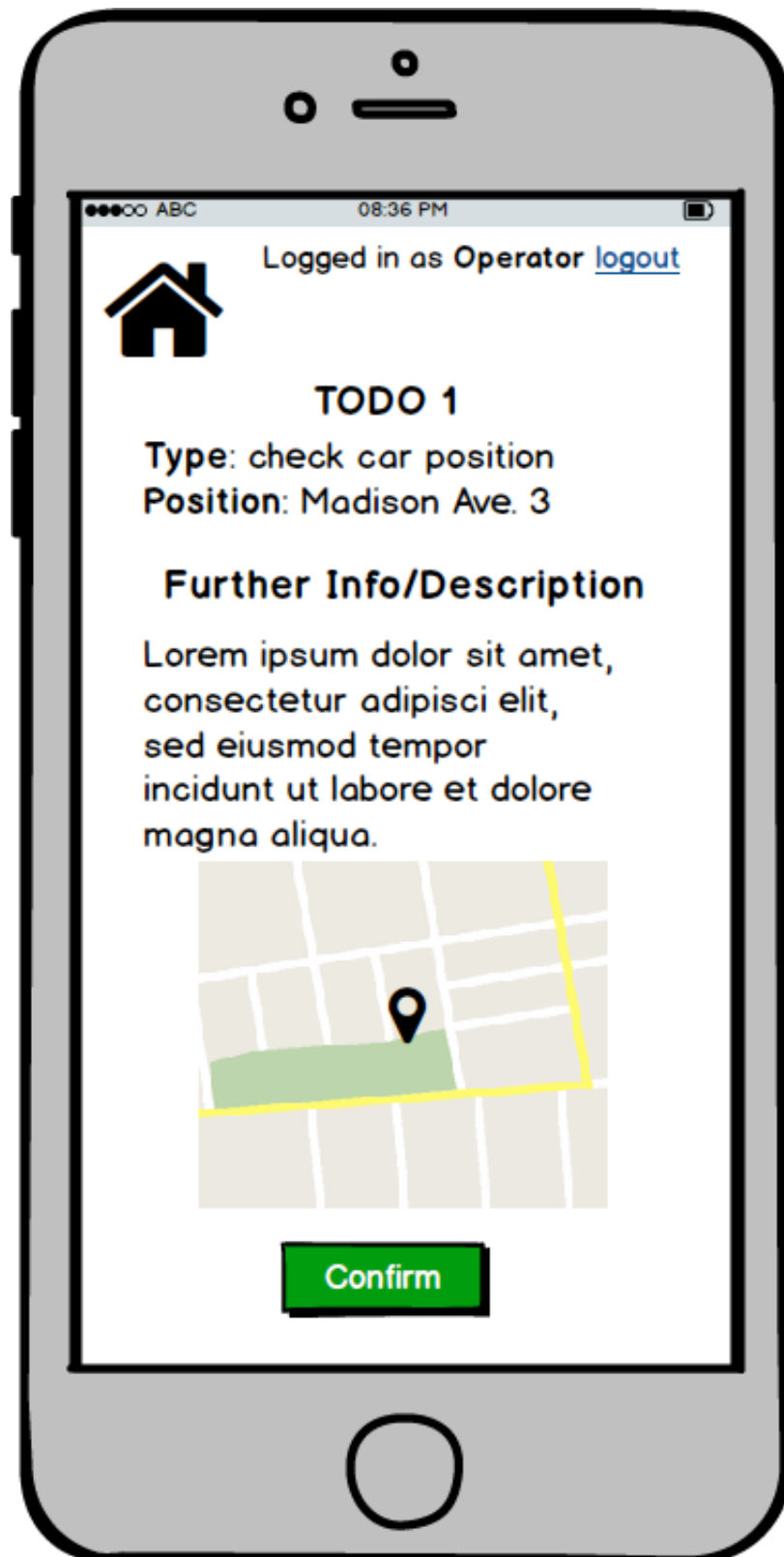


Figure 22: Chosen Todo

4.2.2.2 Operator chose TODO (Mobile)

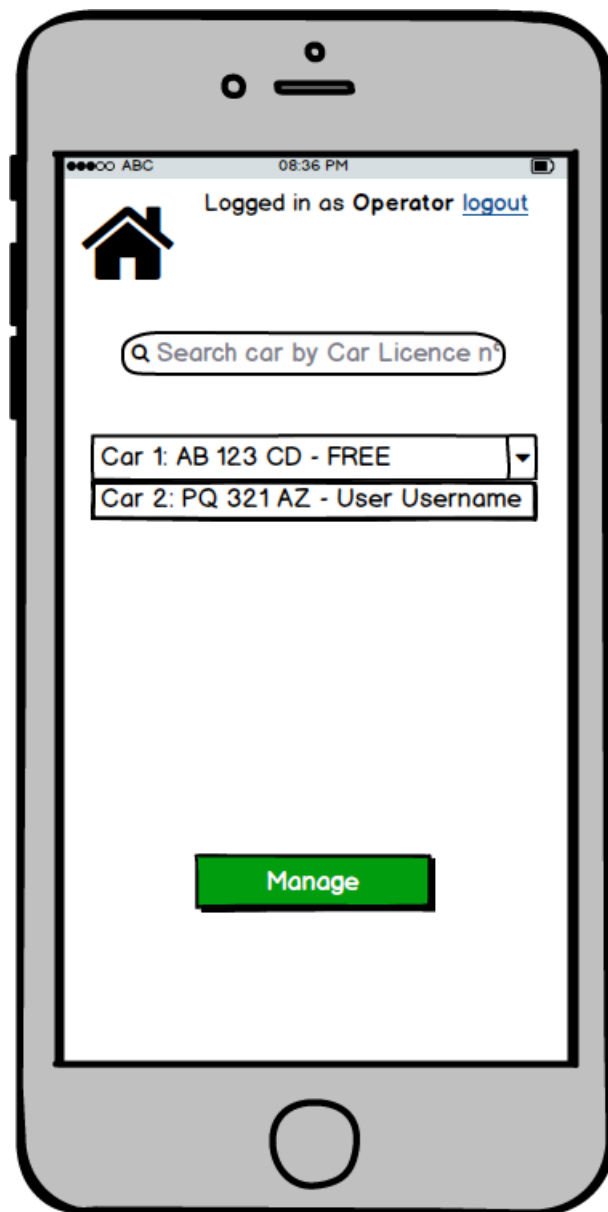


Figure 23: Car Search

4.2.2.3 Operator Searched Car (Mobile)

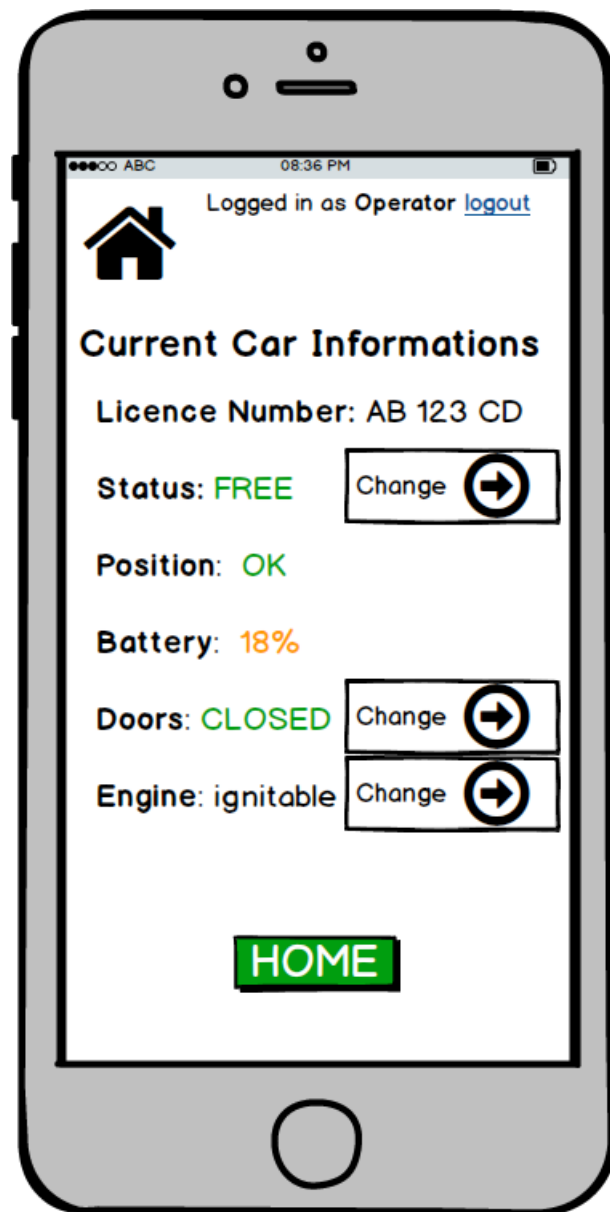


Figure 24: Car Details

4.2.2.4 Operator Car Details (Mobile)



Figure 25: Changing a Car's parameter

4.2.2.5 Changing a Car parameter - Sample (Mobile)

5 Requirements traceability

6 Effort spent

Component	Time spent (in hour)
Philippe Scorsolini	23
Lorenzo Semeria	18
Gabriele Vanoni	24.5