• Users must be able to register to the system by providing their credentials and payment information. They receive back a password that can be used to access the system.

Register request

Password response

Information verification

Create an account

Password generation

Database update

Driving license

Credit card

Register action

Network communication

G1: For every user who sends a well-formed register request, the PEJ system should generate a log in password automatically and send it back to the user via the contact information provided by the user.

Domain Assumption:

1. All users use their own driving license and credit card for registration; there is no misappropriation of documents. The owner of these two documents must be the same.
2. The information provided by the user is correctly typed without any spelling mistake.
3. The system generates and sends the password through an encryption algorithm, which is safe and secure.
4. The network communication between users and the system is in a good condition; hence all data are accurate delivery.
5. The data base of user is connected in to the data base in ministry of traffic, the system will update the availability of the drive license,and restrict the log in of users who is not able to drive.

Scenario1:

Alice has just download a application of PEJ system on her smart phone, and as a new user, she is briefly notified by the system about the car sharing rules. Before starting using the system, Alice is asked to register to the system. Alice clicks the button “Register Now”, and receives a register form. She inputs carefully the request information, including her driving license ID and credit card number. For the contact information, Alice chooses to insert mobile phone number between two options: mobile phone number and email address. After finishing all the typing work, Alice checks her inputs again trying to find an error. After checking, she clicks the “Confirm” button. The page jumps to a login page. About 3 seconds later, Alice receives a message from the system containing a password.

• Registered users must be able to find the locations of available cars within a certain distance from their current location or from a specified address.

Location info

Available vehicle

User log in

GPS positioning

Address specified

Database query

Car distance sorting

G2: Once registered users position their current location or input a specified address, the PEJ system should send back a list of available vehicles sorted by distance.

Domain Assumption:

1. GPS positioning system is running well, providing accurate location information.
2. The location information provided by the user is complete and identifiable by the system.

Scenario2:

Bob opens the PEJ application on his smart phone and clicks on the “Log in” button. There appears a log in page. Bob inputs his driving license ID as well as the password sent by the system, and then he clicks on the “Confirm” button to access the system. After entering the system successfully, Bob tries to find the available cars around him by clicking the “Positioning” button on the main page. The system gives back a map, which contains Bob’s current location marked as a red flag, as well as several green points to denote the available cars nearby. Under the map there is also a list, which shows the available cars sorted by distance. Bob chooses one of the green points on the map, which seems to be the nearest car in the direction he prefers.

Scenario3:

John is now on a train to the central railway station, he wants to reserve a car via PEJ system and drive it to the airport. He clicks the “Insert an address” button on the main page, and inputs the complete name of the station, which is Milan central railway station. After confirming his input, Bob receives a page with two parts, a map showing the specific address and available cars around, and a list of available cars sorting by the distance to the specific address.

• Among the available cars in a certain geographical region, users must be able to reserve a single car for up to one hour before they pick it up.

Database query

Reservation record checking

Database update

Car reserving request

Car state response

Locking countdown

Car selecting

Picking up a car

G3: Once the user select to reserve a car among the available vehicle list, the system will check the reservation record of this account, and send back the basic information as well as the locking countdown of the single reserved car.

Domain assumption:

1. The vehicle is equipped with a GPS positioning system and is connected to the network.
2. All the users are able to make a reasonable option among the available vehicle according to their current position.

• If a car is not picked up within one hour from the reservation, the system tags the car as available again, and the reservation expires; the user pays a fee of 1 EUR.

User coming late

Credit card

Car state changing

Database update

Reservation expires

Fee payment

G4: Once a reservation is out of time, the system should change the state of the car into available, and charge a fee of 1 EUR from the credit card registered by that account.

Domain assumption:

1. All valid credit cards can be charged a fee.

• A user that reaches a reserved car must be able to tell the system she’s nearby, so the system unlocks the car and the user may enter.

Lock state changes

The user is nearby

Unlock the door

User enters the car

“nearby” confirm

Car unlock

[G5]The system will unlock the car that user ordered by the corresponding user after that user confirm to system that he/she is nearby the car in the valid time.

Domain assumption:

1. The user has a reasonable definition of the distance ”nearby”, so he/she would send the confirmation when enters visual range too make sure no one else can use this car.
2. The GPS of the car can’t be switched off.
3. The cars have no hitch and are maintained on time.
4. If the car is connected with plug,the user knows how to remove the plug in a right way and put it back.

Scenario5

Tom, a user that already made an order on the phone,is walking to the parking lot,he checks the location of the car he ordered in the phone,and also notice that it is less than one hour he arrive the parking lot after he made that order. He finds that specific car, and pushes the button “confirm” on the option “i am nearby the car”.

Car unlock the door by the autonomic control from EPJ system, then Tom opens the door and enters the car.

• As soon as the engine ignites, the system starts charging the user for a given amount of money per minute; the user is notified of the current charges through a screen on the car.

Time counting

Computation of the current charge

Ignite the engine

Car moves

Current charge shows on the screen of the car

Car charging

Notification of the current charge

[G6]the system should charge the car as soon as the engine is ignited and notify the current charges to user by the screen in the car.

Domain assumption:

1. During the waiting before the transaction light, the system will keep charging the car.
2. There are no accident while driving.

Scenario6

Elena,a user that enter the car and want to make a ride,wears the safety belt and starts the engine,she notice that while igniting the engine,the screen in the panel turns on and showing the charging information,the due is increasing with the time, the update frequency is once per minute.

• The system stops charging the user as soon as the car is parked in a safe area and the user exits the car; at this point, the system locks the car automatically.

Park the car

User exit

The door locked automatically

Car positioning

Stop charging

Lock the car

Battery checking

Charge state detection

Passenger state detection

Fee payment

Locate info matching

Countdown for 20 minute

Computation of fee payment

Lock the car

[G7]system stop charging the car and lock the car as soon as user exit the car after parking car in the safe area

Domain assumption:

Scenario7

Twenty minutes latter, Elena arrives a parking lot which is near her office,which is a safe area that pre-defined by the management system.she parks the car in a correct space and turns off the engine,the charge process stops. She exits the car,and while she close the car door, the door locks automatically, Elena can’t enter anymore.

a) 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.

Not less than three passengers

Discount estimation

Not less than three passengers

Discount estimation

Passenger weight detection

Discount applying

[G8]the system should apply a 10% discount after it detected there are at least three passengers on this ride.

Domain assumption:

1. The car is always drive by the passenger who has drive license .
2. The user always charge the car with the plug in the right way
3. There is no car accident while driving .
4. The car will not be overloaded .

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

Discount estimation

No more than 50% battery empty

Credit card

Battery checking

Discount applying

[G9]the system should apply a 20% discount after it detected there are no more than 50% battery empty

Domain assumption

The power supply of GPS is from the battery of the car ,and the electricity GPS consumes can be ignored.

c) If a car is left at special parking areas where they can be recharged and the user takes care of plugging the car into the power grid, the system applies a discount of 30% on the last ride.

Car positioning

Charge state detection

Discount applying

Location info matching

Discount estimation

Parking the car

Plugging into power grid

Credit card

G10: After the user parked and left the car, the system should detect the car position info and charging state. If the parking location matches a special parking area preset in the system and the car is in a charging state, the system will apply a discount of 30% on the last ride.

Domain Assumption:

1. The company has defined a set of special parking areas.
2. Special parking areas are equipped with charging equipment and can plug into the power grid.
3. There exists a charge state detector on each car.

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 last ride to compensate for the cost required to recharge the car onsite.

Search for nearest power station

Parking location verification

Compensation estimate

Car positioning

Battery state detection

Compensation applying

Parking the car

Credit card

G11: After the user parked and left the car, the system should detect the car position info and battery state. If the parking location is 3KM far away from the nearest power station searched the system and the battery state is more than 80% empty, the system will apply a compensation of 30% on the last ride.

Domain Assumption:

1. The company has defined a set of power stations.
2. There exists a battery state detector on each car.

e) If the user enables the money saving option, he/she can input his/her final destination and the system provides information about the station where to leave the car to get a discount. This station is determined to ensure a uniform distribution of cars in the city and depends both on the destination of the user and on the availability of power plugs at the selected station.

Money saving option

Final destination

Credit card

Optimal path computation

Discount estimation

Choose “money saving option”

Input destination

Optimal path response

Battery checking

Discount applying

G12:the system should show the optimal station the user should park according to the destination he/she input and the availability of power plugs

Domain assumption:

1. The final destination can only be set at the beginning of any ride.
2. Users will input the correct destination they want in the first time.

(the path computation will shrink the path or remote the final station to make sure the discount ,so there will be no low battery )