CAR PARKING PROJECT

Requirement Document

Abstract

Boğaziçi University
Software Engineering Department
SWE522
Term Paper
This document consist of requirements of the Car Parking Project in basic level.

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Contents

Introduction

Main Goal:

The main purpose of this document is to specify the requirements of car parking software system. In this software, I aimed to maximize the efficiency of a parking, increase the income of the garage and create a system that helps users to find available parking in the garage at a reasonable time of parking.

Problem Statement:

The customer has a parking garage that has lots of parking lot. Garage is placed on a very center of the city which has a parking problem continuously. In this circumstances, having a parking garage can be very profitable. However our customer's garage is not working with full capacity since, there are only primitive ways to direct drivers to available parking lots. It makes hard to find empty lots on the garage for drivers. This situation causes profit loose for the owner.

Traffic problems may be occurred while searching empty lots inside of the garage. This traffic problems causes decrease in usage of the garage, since no customer wants to spend time by trying to find an empty lot with an inefficient system.

Also, there can be traffic accidents inside the garage since customers are not being guided to available spots. This causes having a really bad experience for customers and their safety. These kind of incidents makes customers not to choose the garage again in future.

There is no record for the cars with the specific plate number parked to the garage. It causes security issues on the garage.

Proposed Solution:

In order to increase profits and reduce personnel costs, customer decides to implement a computerized system for solving all the problems listed above.

The problem of showing to drivers who want to drive enter the garage and not know if any parking is available will be solved by implementing a display port at the entrance of the garage indicating if a lot is available.

When, a car enters to the garage, a slot will be assigned to the car. After assigning the specific parking lot, a radio broadcasting will be playing on a particular frequency. In this broadcasting, system will give directions to the driver until the car parks to the lot. This will also bring an order to traffic inside of the garage. This can be considered as a solution of traffic in the garage and the traffic accidents

There will a barriers at the entrance and the exit. Also a card system will be placed in front of the barriers.

Cameras will be placed to the entrance, exit and flats, in order to assist the cars to park safely in an efficient time of parking. Also these cameras will be used to keep record of the cars, which flats they are in and which slot they are parked exactly.

The remaining hardware will handle detecting if a vehicle has entered the garage, detecting a vehicle leaving the garage, and determining if a vehicle is occupying a spot in the garage.

It is possible that at some point in the future reservation system can be implemented, however the initial software solution will be kept simple. There will be no reservation system.

Devices:

Our system will implement the following devices:

C-IN

The camera C-IN will be placed in front of the entrance. C-IN will be sending the images of the car while entering the garage. Plate recognition system will process the images and will record the entrance date and time with the plate number to the database. See in Figure 1.

C-OUT

The camera C-OUT will be placed in front of the exit. C-OUT will be sending the images of the car while exit the garage. Plate recognition system will process the images and will record the exit date and time with the plate number to the database. See in Figure 1.

C-F-# (C-F-1, C-F-2…)

The cameras C-F-# will be placed to the flats. C-F-# will be sending the images of the car while parking the garage. C-F-# will also assist to determine where the car exactly is while broadcasting of giving directions. Plate recognition system will process the images and will record the parking lot with the plate number to the database. See in Figure 1.

Figure 1.

S-# (S-1, S-2, S-3…)

There will ultrasonic sensors place on the top of every parking lot in the garage; this will help us determine whether the spot is available or not. See in Figure 2.

L-# (L-1, L-2, L-3…)

There will ultrasonic sensors place on the top of every parking lot in the garage; this will help us determine whether the spot is available or not. See in Figure 2 and Figure 3

D-P-# (D-P-1, D-P-2, D-P-3…)

This display ports allows drivers to check on the availability of the garage. If the garage is full, the display will indicate so. See in Figure 2 and Figure .3

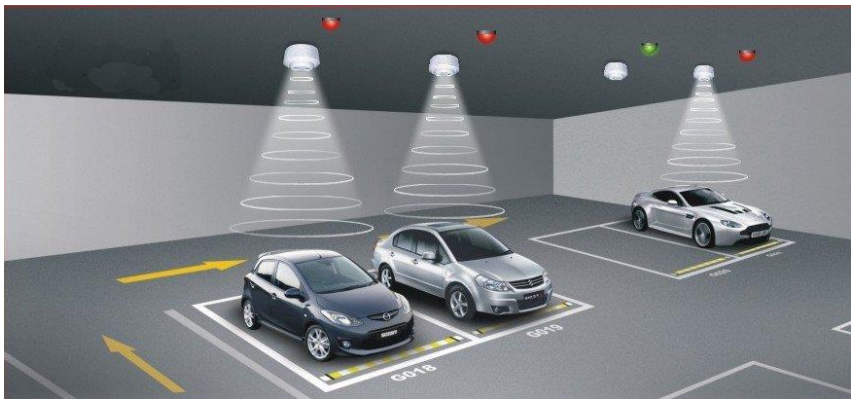

Figure 2.

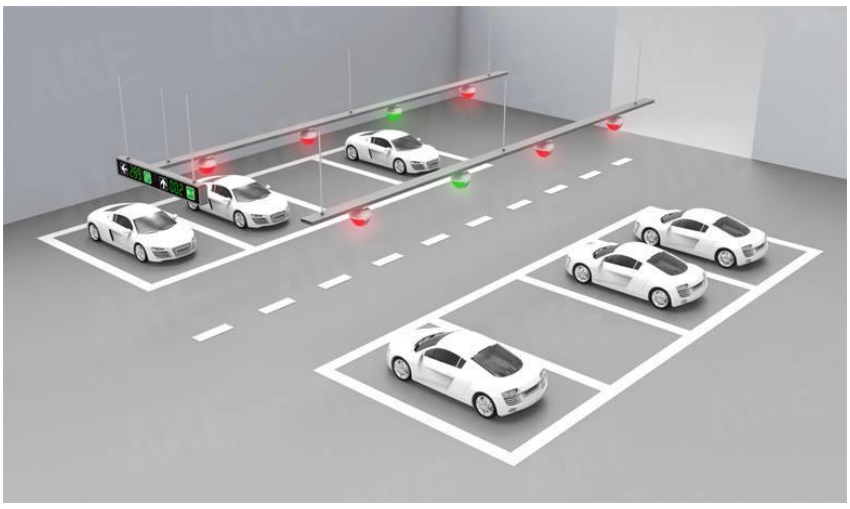

Figure 3.

ENT-B

Entrance barrier will hold the entrances without getting the entrance card. It will open after getting the card. Also it will not open for exits. See in figure 4.

EXT-B

Exit barrier will hold the exits without reading the payment information from the cards. It will open after getting the payment information from the card. Also it will not open for entrances. See in figure 4.

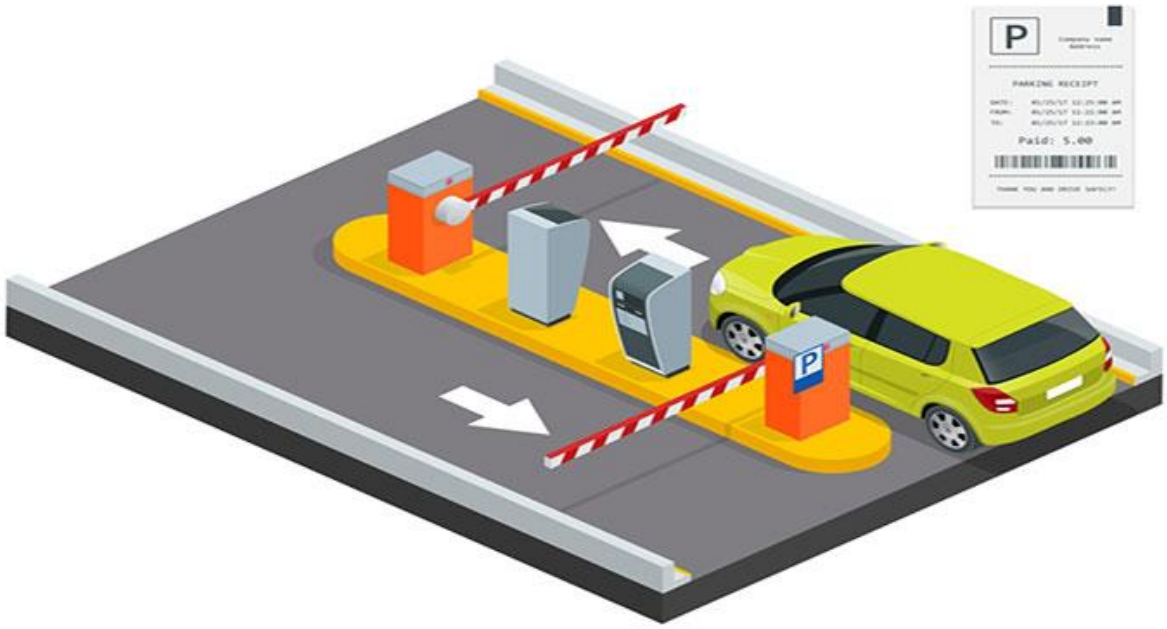

Figure 4.

Assumptions

Although our software solution will attempt to cover as many situations and scenarios as possible, the following general assumptions will be made.

A 1. The cameras will not fail. Also Plate Recognition System will not fail either. All the data is correct regardless of extreme conditions like dirty plates and etc.
A 2. ENT-B and EXT-B will not fail. It will open after card system send the proper signal to them. They will not open from the counter side.
A 3. All cars that will enter to the garage will have appropriate size.
A 4. Ultrasonic sensors which determines the existence of a car in a spot will work correctly all the time.
A 5. Display ports in front of the garage and in the flats will always show the correct data.
A 6. Lights on the top of the parking lots will always work correct. Green is empty space for everyone. Blue is empty space for disabled. Red is not empty.
A 7. Payment machines will always work correct. It will read the card correctly and get payment correctly and send payment information to the system correctly.
A 8. No power-failure will occur in the building.
A 9. Parking garages are open 24 hours a day.
A 10. Vehicles other than cars such as motorcycles and trucks will not use the garage.

Descriptive Statements:

D S 1. The same spot cannot be used by two cars at the same time
D S 2. The same car cannot be parking at the two spots at the same time

Prescriptive Statements:

P S 1. Cars should always be entering from entrance, exiting from the exit
P S 2. The light indicator above the empty slots for everyone should be green.
P S 3. The light indicator above the empty slots for disabled should be blue.
P S 4. The light indicator above the occupied slots should be red.
P S 5. Entrance must be handled in a safest way possible

Models

Goal Model

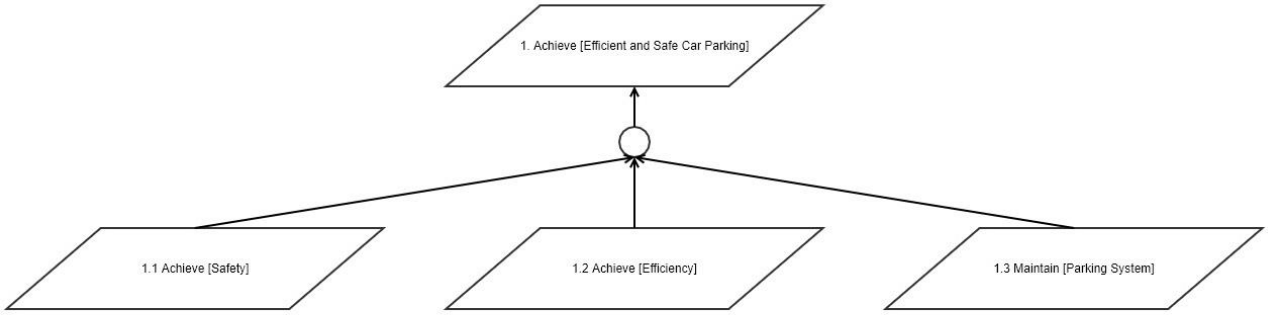

Figure 5. Main Goal and its two sub goals

ID	1
Name	Efficient and Safe Car Parking
Type	Achieve
Definition	Drivers can park their cars to the available lots with no accident in an efficient time of parking

ID	1.1
Name	Safety
Type	Achieve
Definition	During parking time, accidents will be prevented.

ID	1.2
Name	Efficiency
Type	Achieve
Definition	Reaching parking lot should be efficient by the order on traffic inside of the garage.

ID	1.3
Name	Parking System
Type	Maintain
Definition	System have to know which lot is empty or not. Also it should keep the record of the cars and parking lots.

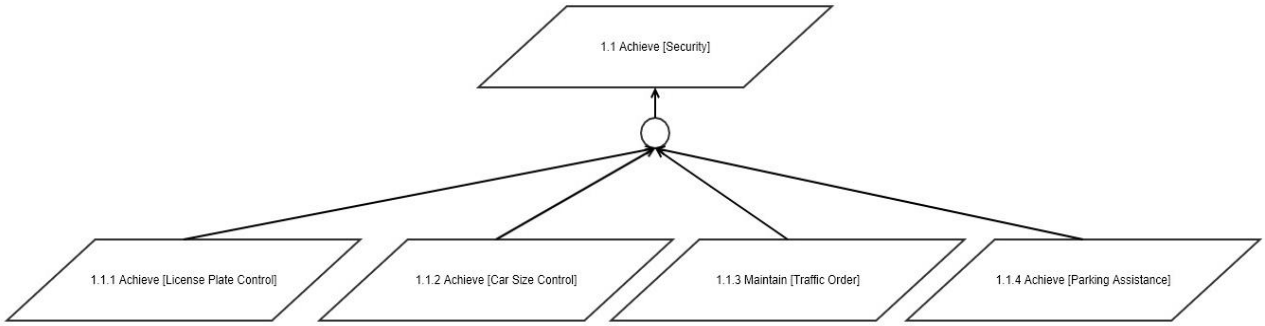

Figure 6. Security Goal and its sub goals

ID	1.1.1
Name	License Plate Control
Type	Achieve
Definition	License Plate of the car must be read. If it is not readable, barriers will not open and driver will be informed.

ID	1.1.2
Name	Car Size Control
Type	Achieve
Definition	Size of the car will be measured. If the size is not suitable for the garage standards, barriers will not open and driver will be informed.

ID	1.1.3
Name	Traffic Order
Type	Maintain
Definition	In order to avoid traffic accidents, Directions and instruction will be given by the radio broadcasting to all cars in the garage.

ID	1.1.4
Name	Parking Assistance
Type	Achieve
Definition	During parking instructions will be given by the radio broadcasting. So car will not hit anywhere while entering the parking lot.

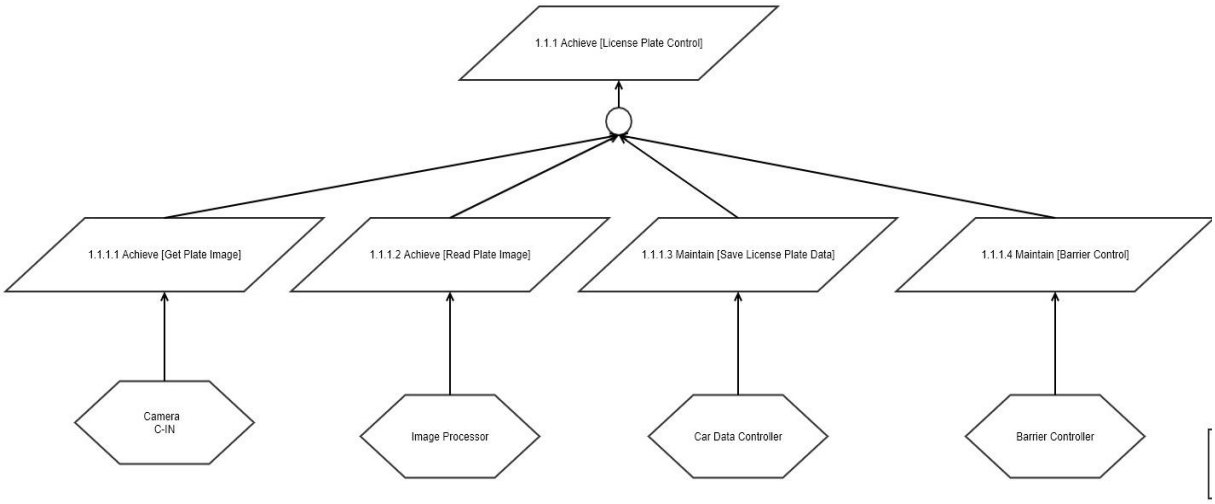

Figure 7. License Plate Control Goal and its sub goals

ID	1.1.1.1
Name	Get Plate Image
Type	Achieve
Definition	Plate image will be taken from Camera C-IN which is defined at Devices sections. Image data will be sent to related component of the system (Image Processor)

ID	1.1.1.2
Name	Read Plate Image
Type	Achieve
Definition	Image data will be processed by the Image Processor software. If It can be converted meaningful text, open signal will be sent Barrier Controller. Also save signal will be sent to Car Data Controller.

ID	1.1.1.3
Name	Save License Plate Data
Type	Maintain
Definition	License Plate data will be recorded to data base with the additional information like date and time and car model etc.

ID	1.1.1.4
Name	Barrier Control
Type	Maintain
Definition	Barriers will open and close according to signal Barrier Controller receives.

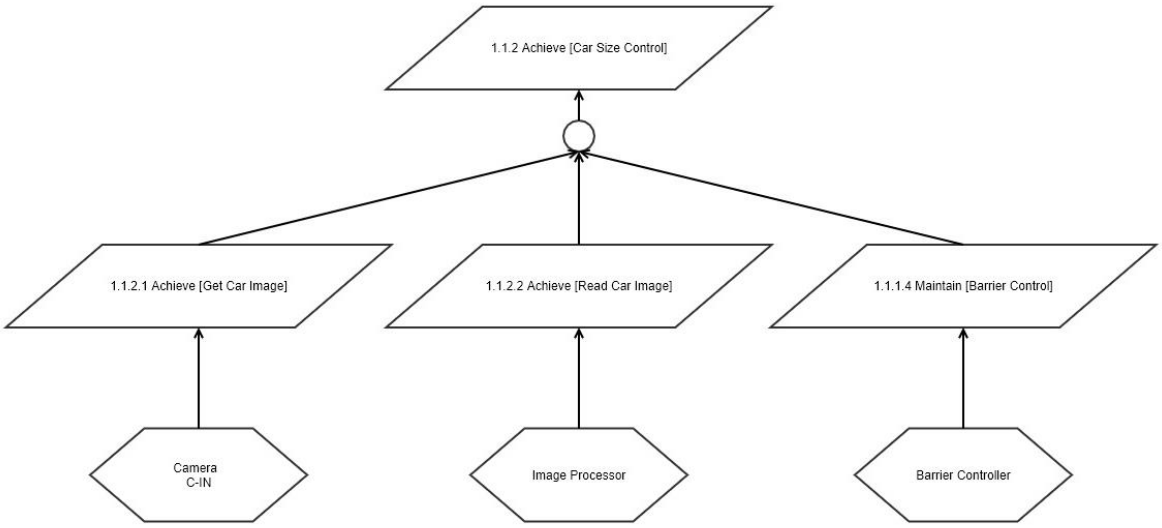

Figure 8. Car Size Control sub goal and its sub goals

ID	1.1.2.1
Name	Get Car Image
Type	Achieve
Definition	Car image will be taken from Camera C-IN which is defined at Devices sections. Image data will be sent to related component of the system (Image Processor)

ID	1.1.2.2
Name	Read Car Image
Type	Achieve
Definition	Car image will be converted meaningful car size information. Size comparison will be done between car size and suitable size of the garage. After that related signal will be sent to Barrier Controller.

ID	1.1.2.3
Name	Barrier Control
Type	Maintain
Definition	Barriers ENT-B defined at Devices will open and close according to signal Barrier Controller receives.

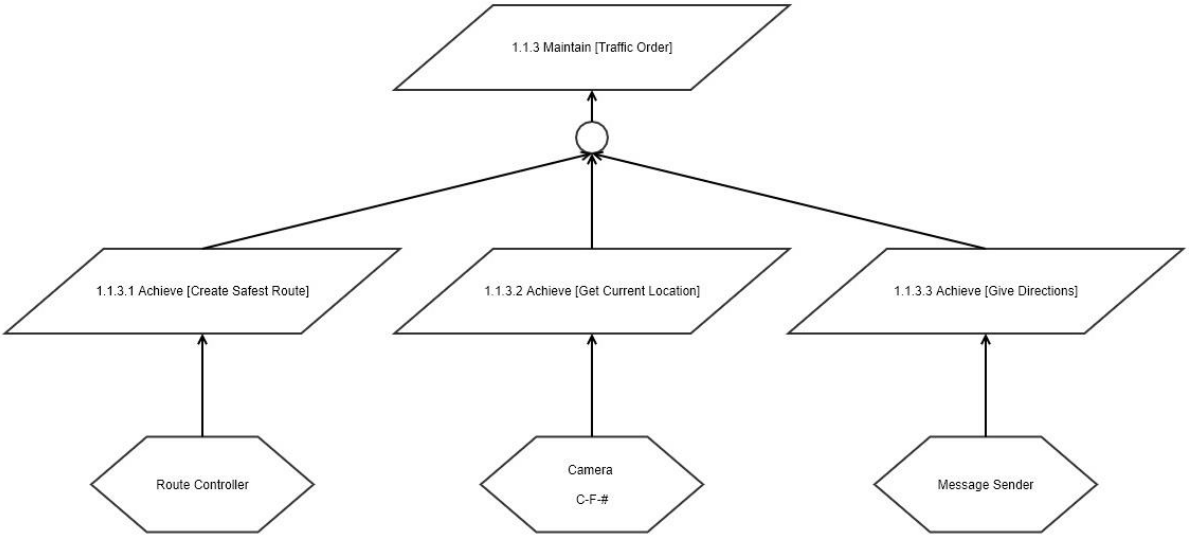

Figure 9. Maintain Traffic Order sub goal and its sub goals

ID	1.1.3.1
Name	Create Safest Road
Type	Achieve
Definition	According to assigned parking load and the other moving car routes 'route controller' software will decide the safest road to the related parking load for every each car. When car starts to move, Route Controller receives the position information from the cameras on the floors. In case of yawing, software will create a new route instantly.

ID	1.1.3.2
Name	Get Current Location
Type	Achieve
Definition	Current Location will be sent to Route Controller instantly by the cameras on the floors.

ID	1.1.3.3
Name	Give Directions
Type	Achieve
Definition	According to route that decided by the system, message sender will send the directions according to its position

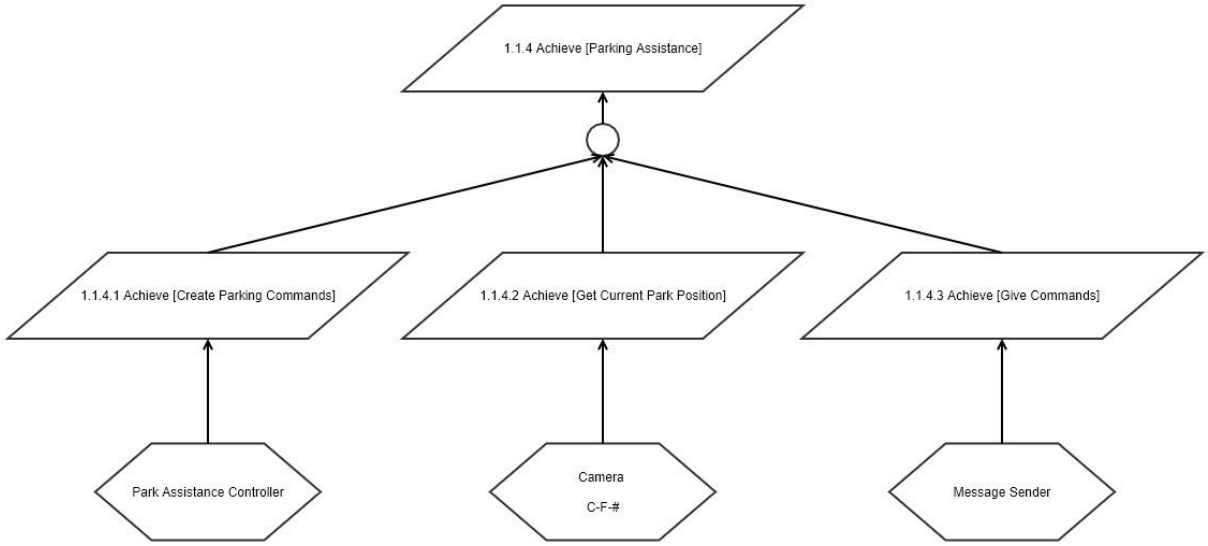

Figure 10. Parking Assistance sub goal and its sub goals

ID	1.1.4.1
Name	Create Parking Commands
Type	Achieve
Definition	According to current position of the car, the commands that driver must execute will be determined by the Park Assistance Controller software.

ID	1.1.4.2
Name	Create Safest Road
Type	Achieve
Definition	Current position of the car will be sent to Park Assistance Controller instantly by the cameras on the parking lots

ID	1.1.4.3
Name	Create Safest Road
Type	Achieve
Definition	According to commands that decided by the system, message sender will send the commands to the cars.

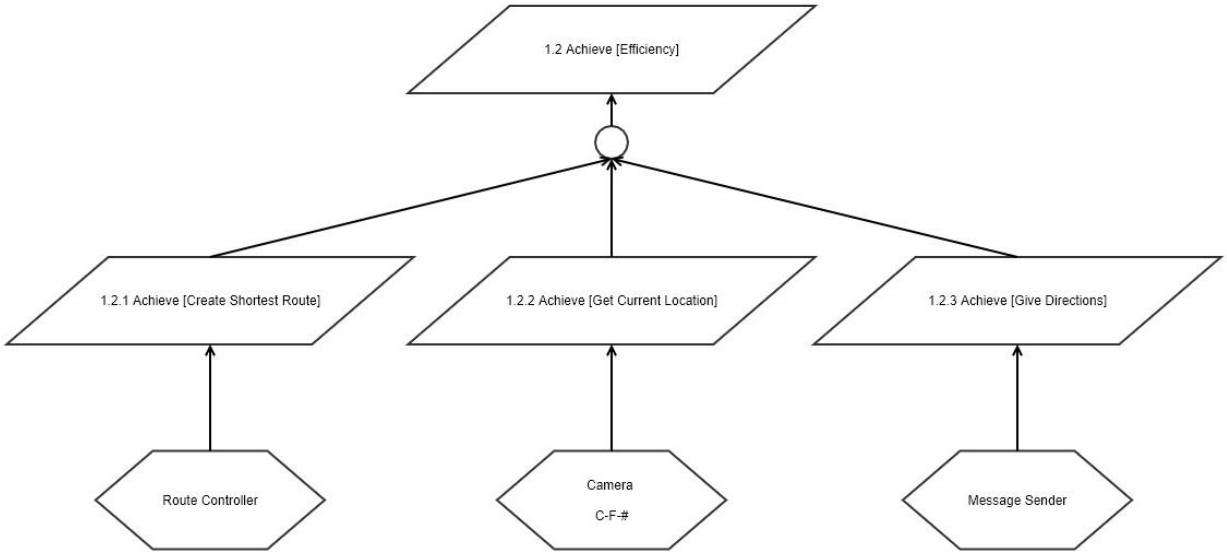

Figure 11. Efficiency sub goal and its sub goals

ID	1.2.1
Name	Create Shortest Route
Type	Achieve
Definition	According to assigned parking load and the other moving car routes 'route controller' software will decide the shortest road to the related parking load for every each car. When car starts to move, Route Controller receives the position information from the cameras on the floors. In case of yawing, software will create a new route instantly.

ID	1.2.2
Name	Get Current Location
Type	Achieve
Definition	Current Location will be sent to Route Controller instantly by the cameras on the floors.

ID	1.2.3
Name	Give Directions
Type	Achieve
Definition	According to route that decided by the system, message sender will send the directions according to its position

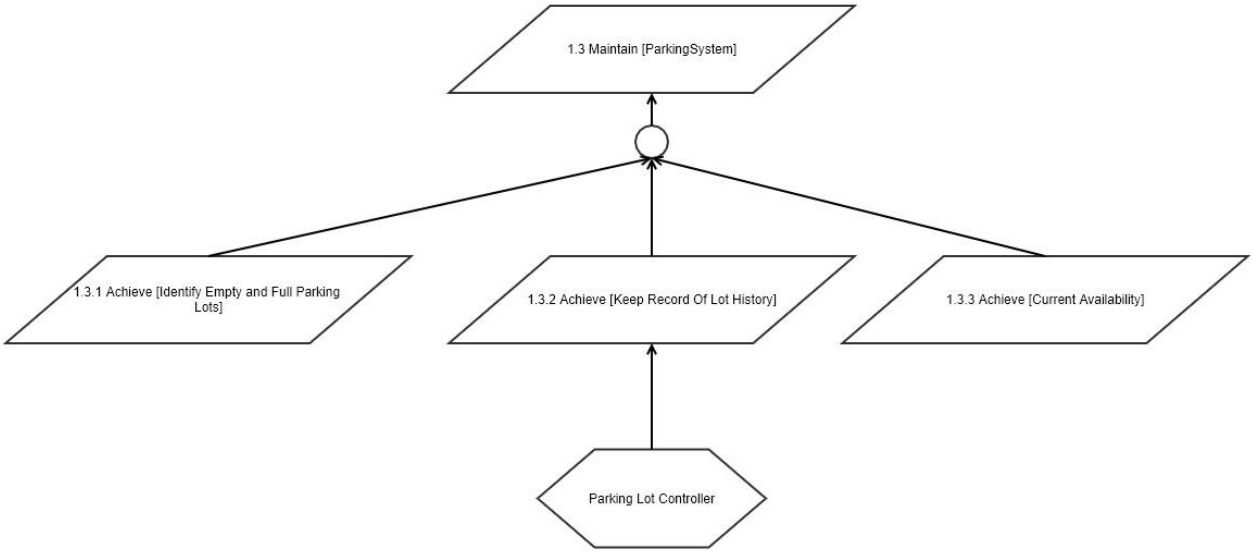

Figure 12. Parking System sub goal and its sub goals

ID	1.3.1
Name	Identify Empty and Full Parking Lots
Type	Achieve
Definition	System should know which parking lot is empty or not.

ID	1.3.2
Name	Keep Record Of Lot History
Type	Achieve
Definition	In order to keep record of lot history Parking Controller software will save the date to the parking data base.

ID	1.3.3
Name	Current Availability
Type	Achieve
Definition	In the first place current availability have to been shown from outside of the garage.

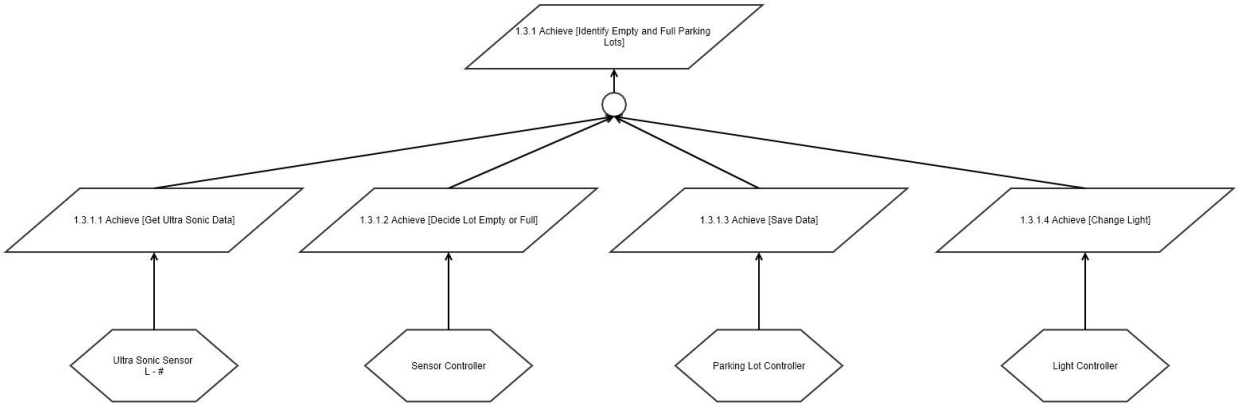

Figure 13. Identify Empty and Full Parking Lots sub goal and its sub goals

ID	1.3.1.1
Name	Get Ultrasonic Data
Type	Achieve
Definition	S - # defined at Devices sensors will send data instantly to Sensor controller

ID	1.3.1.2
Name	Decide lots Empty or Full
Type	Achieve
Definition	Sensor Controller converts the data to meaningful text as empty or full. After identifying the data it is sent to Parking Lot Controller and Light Controller to be processed.

ID	1.3.1.3
Name	Save Data
Type	Achieve
Definition	Parking Lot Controller saves the empty or full.

ID	1.3.1.4
Name	Change Light
Type	Achieve
Definition	Light Controller changes the light L - # of the lot defined at Devices according to data it receives. Empty is green, res is full.

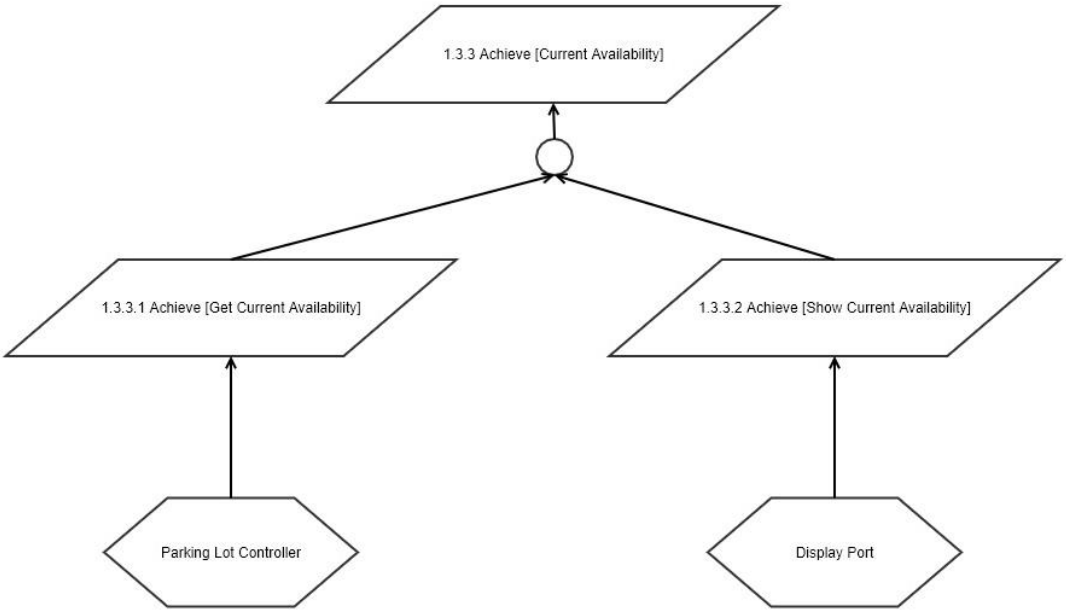

Figure 14. Current Availability sub goal and its sub goals

ID	1.3.3.1
Name	Get Current Availability
Type	Achieve
Definition	Current availability will be get from database by Parking Lot Controller instantly. After that information will be sent display port in front of the garage.

ID	1.3.3.2
Name	Show Current Availability
Type	Achieve
Definition	Display port defined at Devices will show availability of the garage instantly in the first place.

Obstruction Model

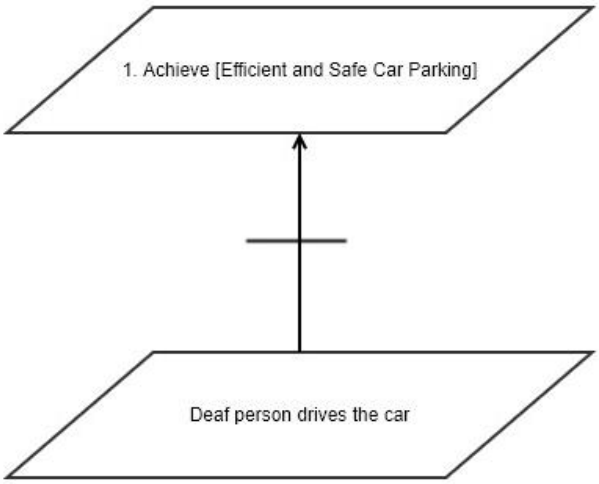

Figure 15. Obstruction Model

Agent Model

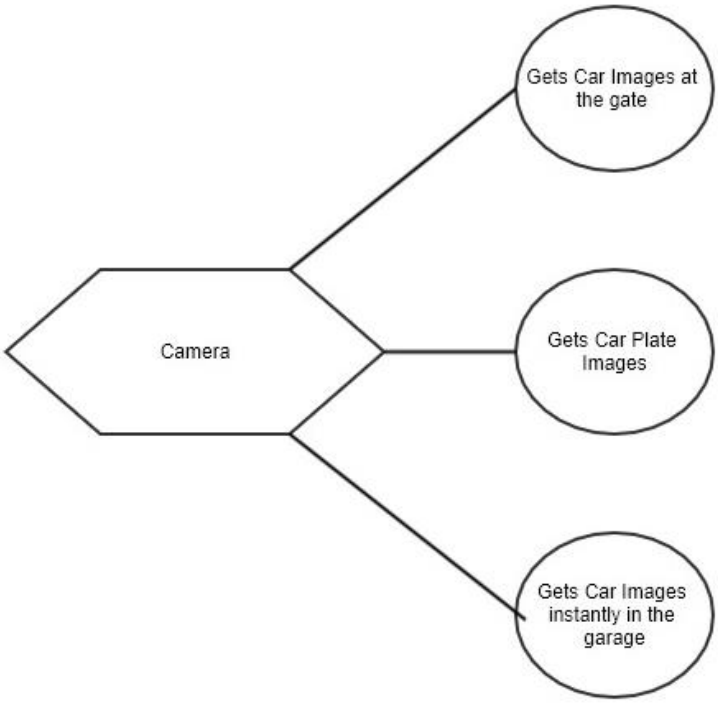

Figure 16. Camera Agent Model

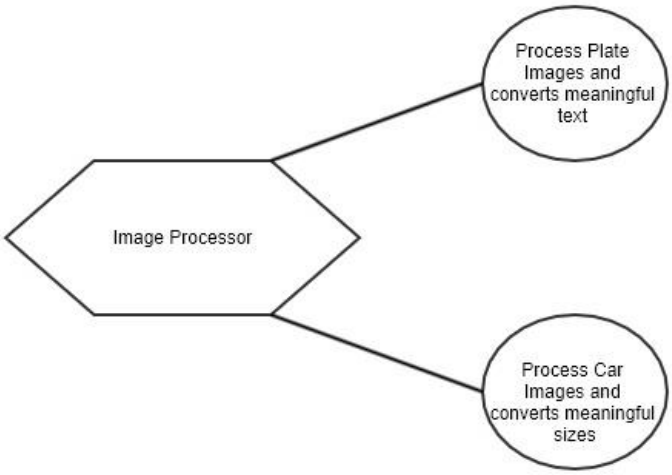

Figure 17 Image Processor Agent Model

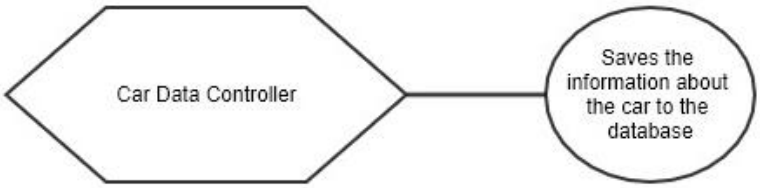

Figure 18 Car Data Controller Agent Model

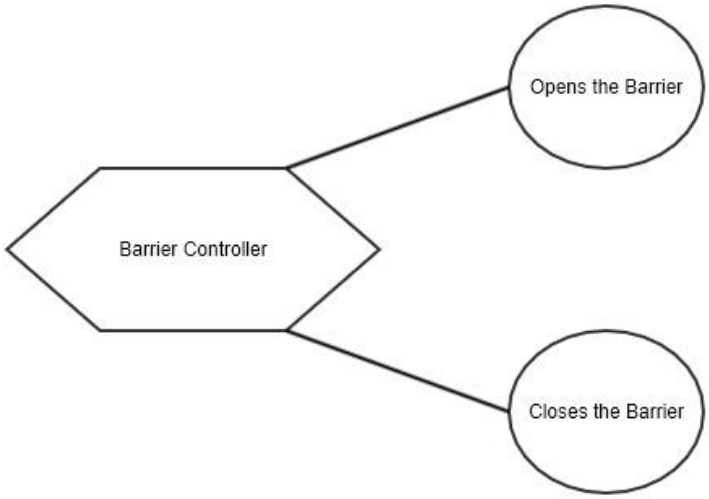

Figure 19 Barrier Controller Agent Model

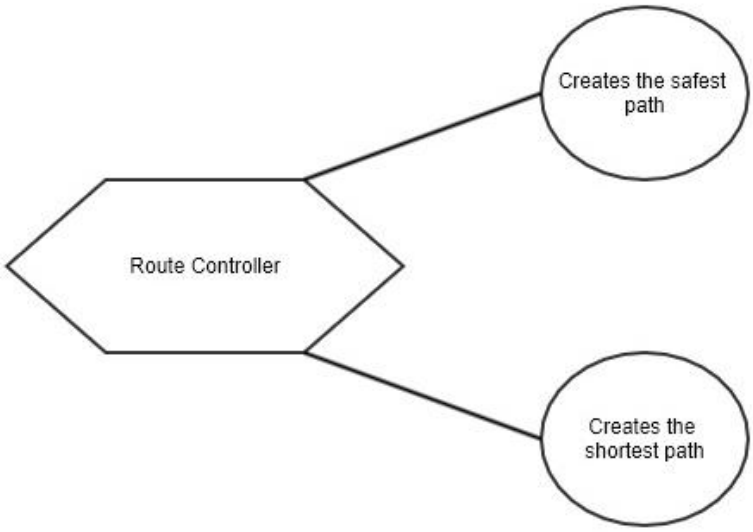

Figure 20. Route controller Agent Model

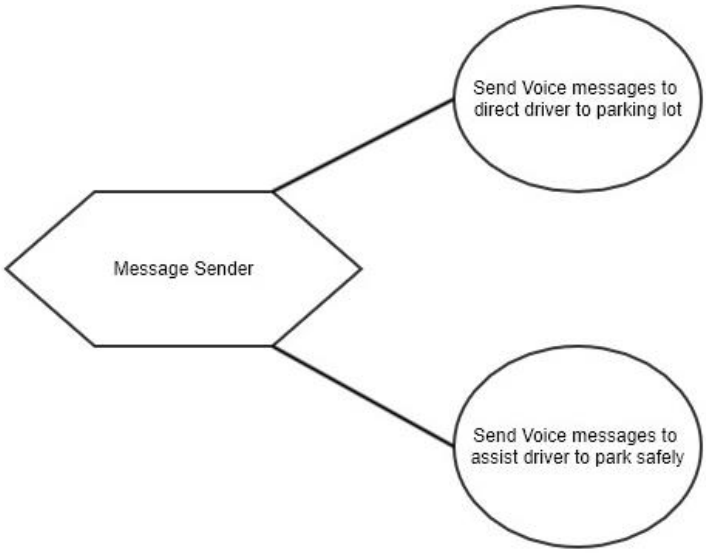

Figure 21. Message Sender Agent Model

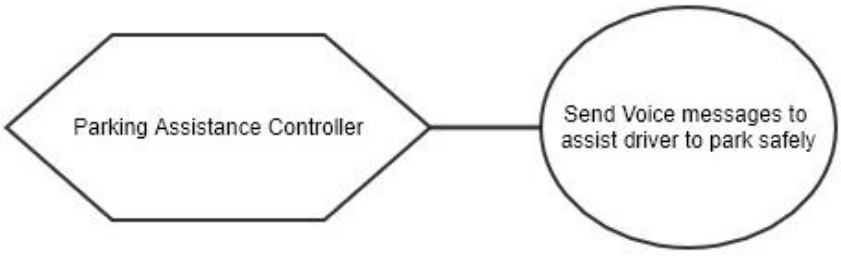

Figure 22. Parking Assistance Controller Agent Model

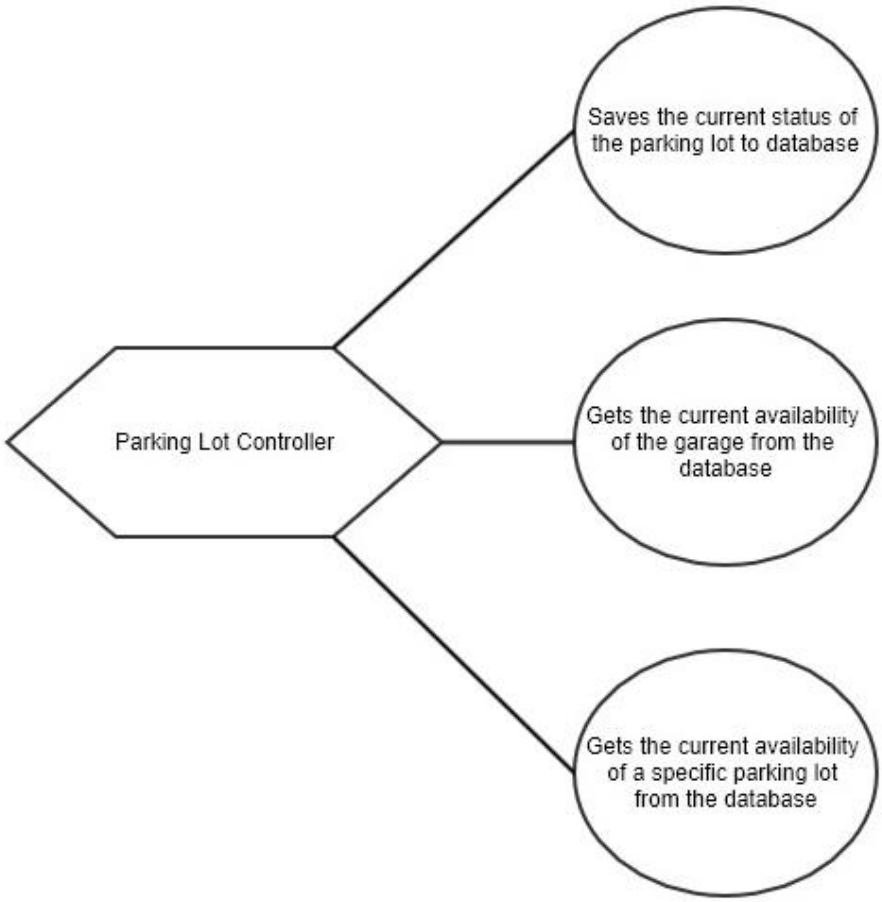

Figure 23 Parking Lot Controller Agent Model

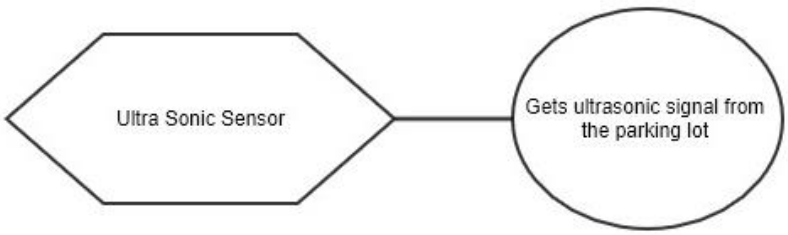

Figure 24. Ultrasonic Sensor System Agent Model

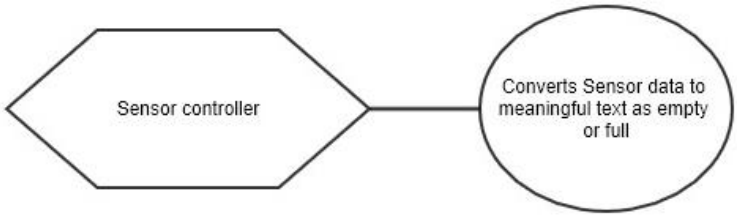

Figure 25. Sensor Controller Agent Model

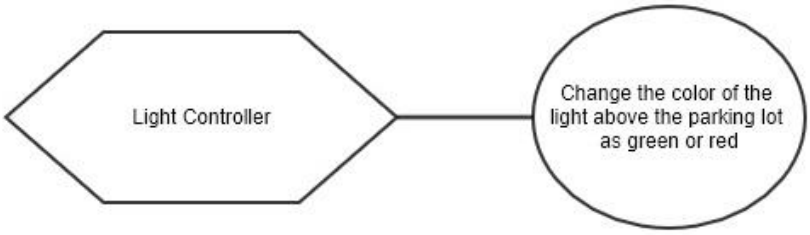

Figure 26. Light Controller Agent Model

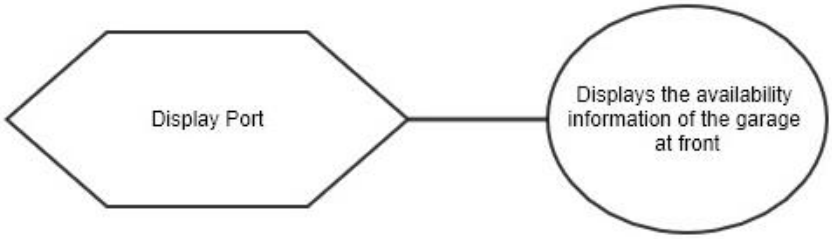

Figure 27. Display Port Agent Model

Operational Models

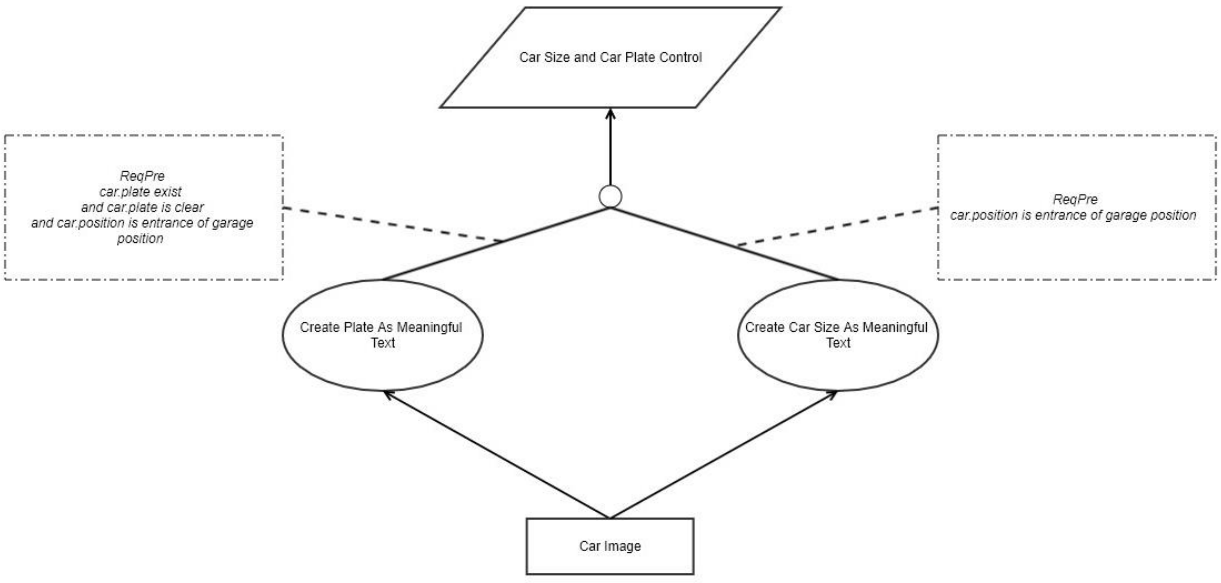

Figure 28. Operational Model for Image Processor

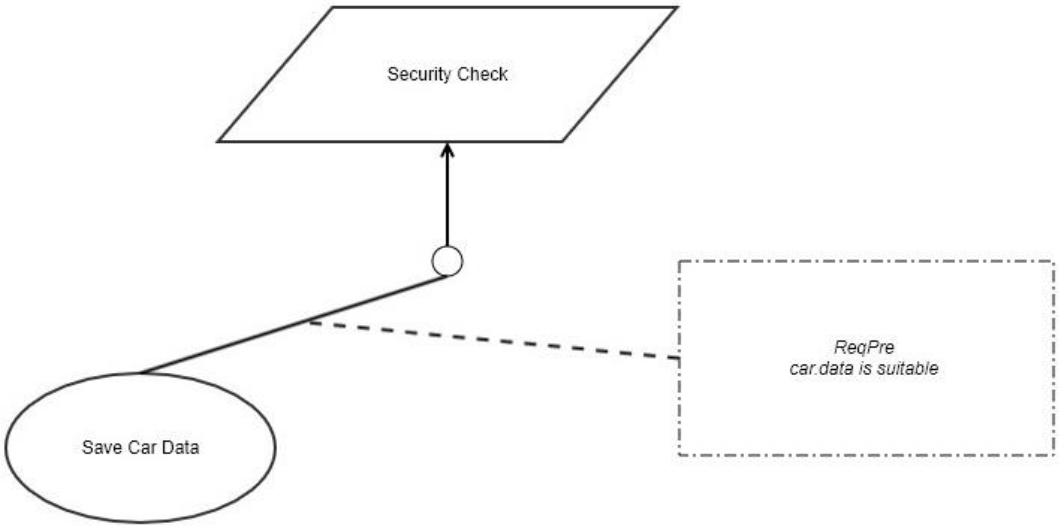

Figure 29. Operational Model of Car Data Controller

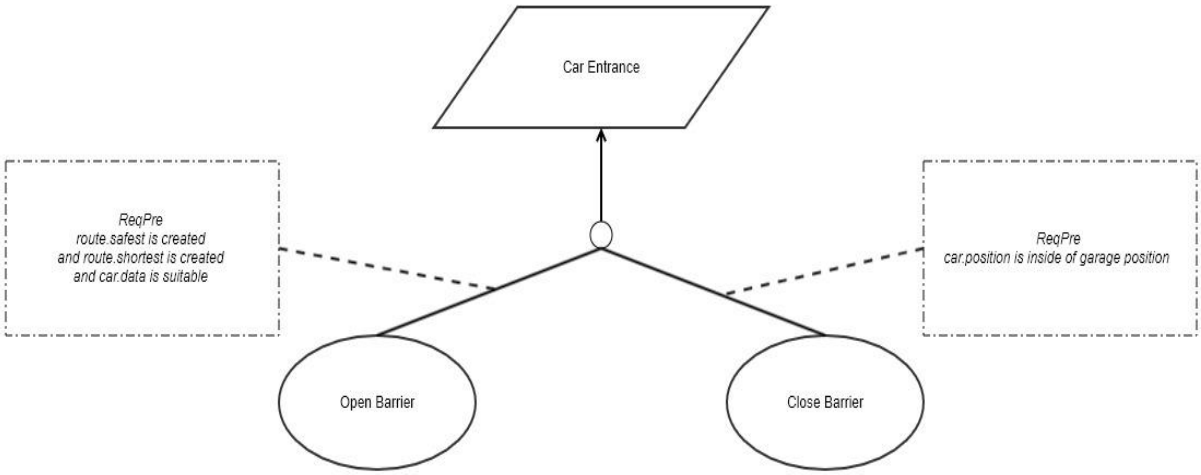

Figure 30. Operational Model of Barrier Controller

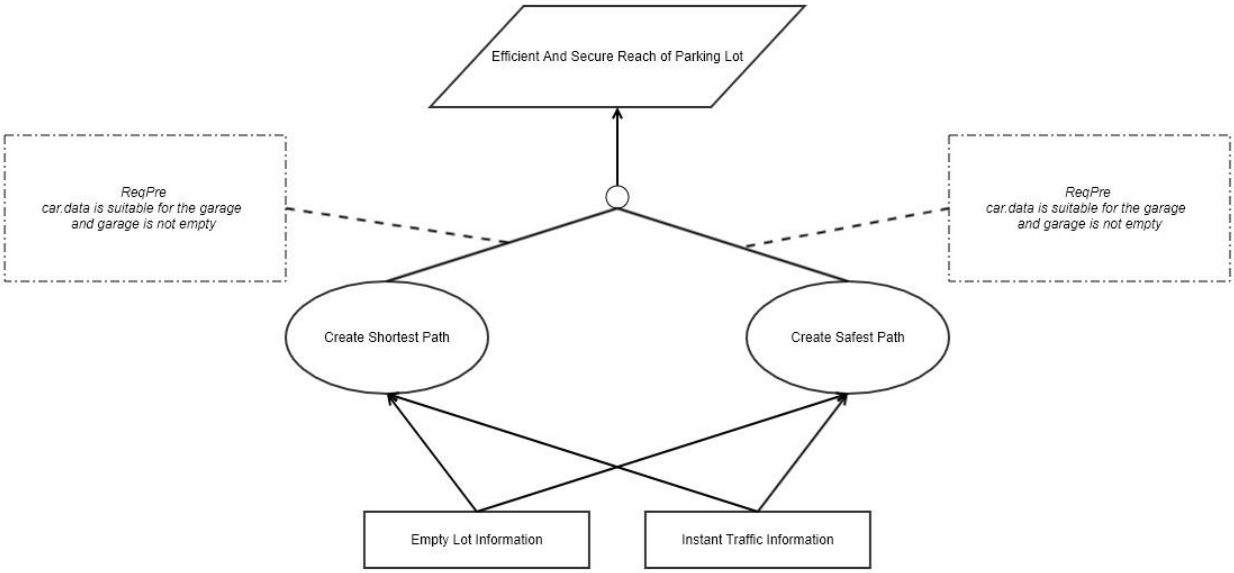

Figure 31. Operational Model of Route Controller

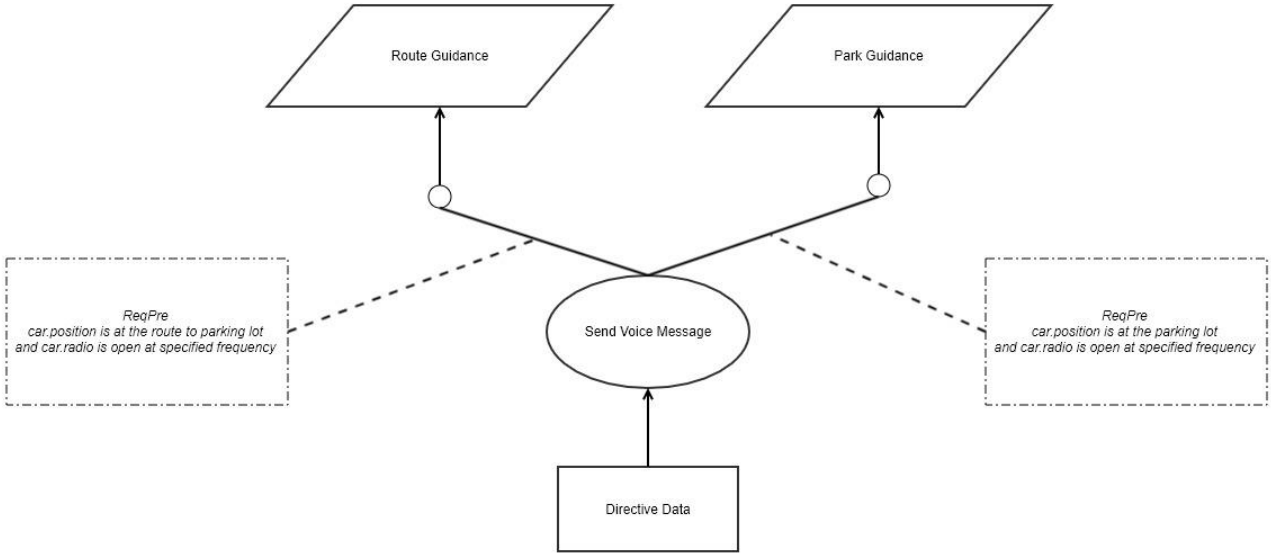

Figure 32. Operational Model of Message Sender

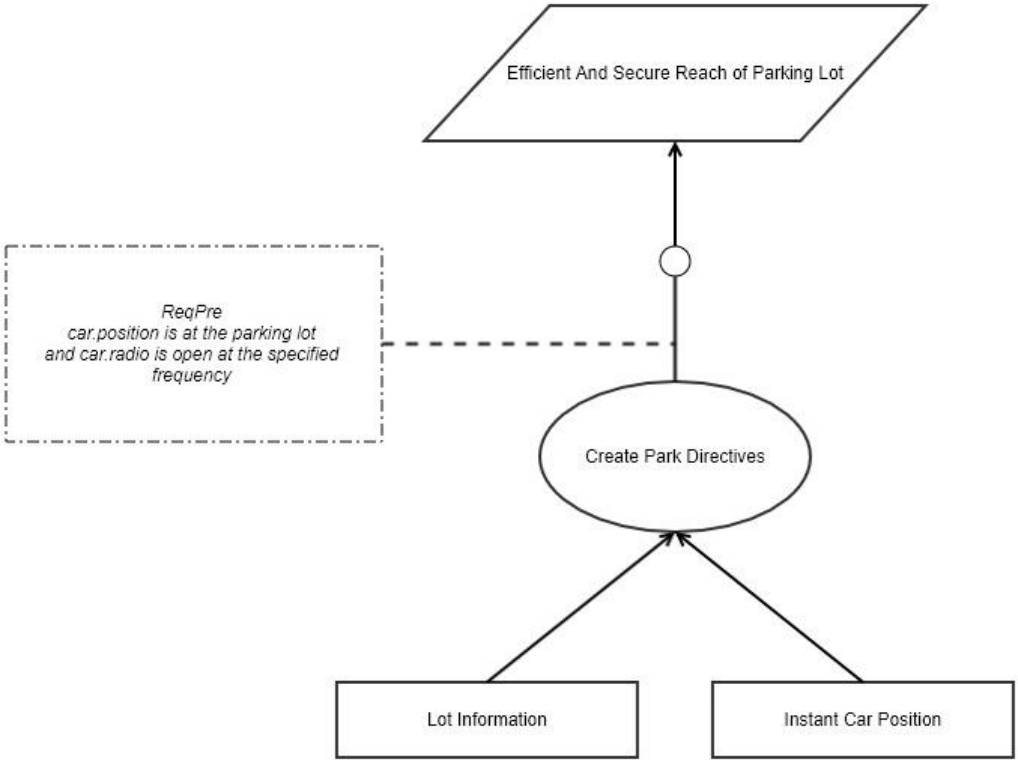

Figure 33. Operational Model of Parking Assistance Controller

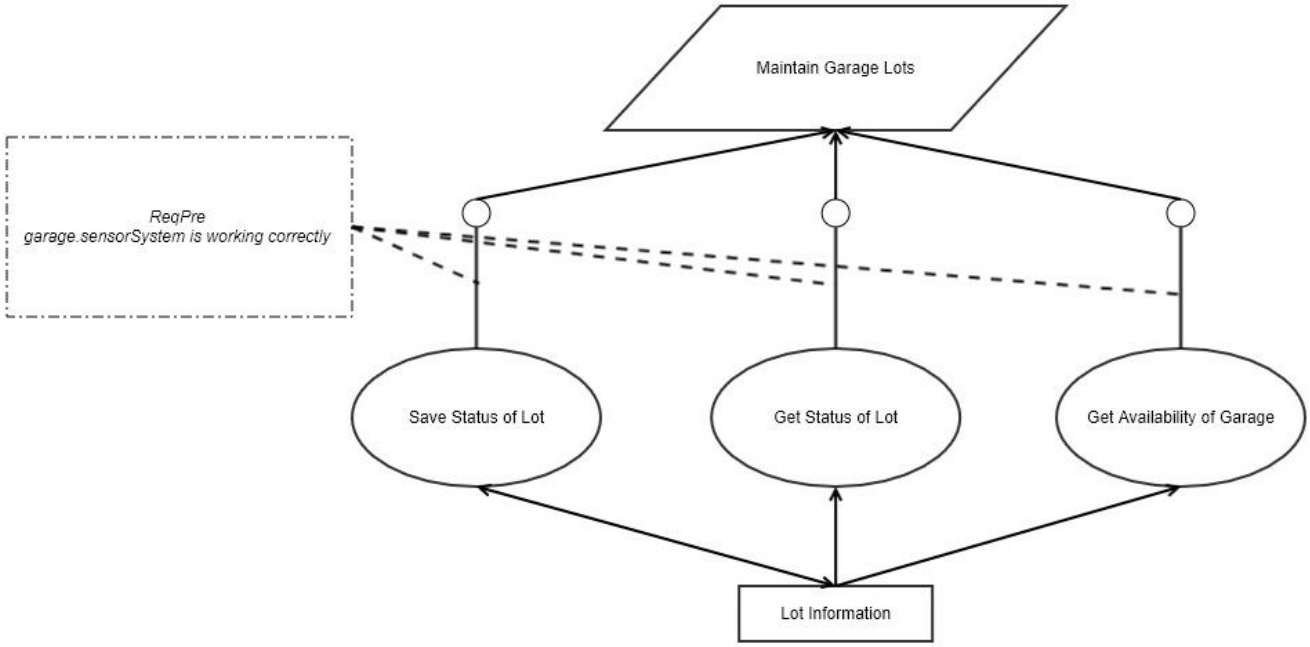

Figure 34. Operational Model of Parking Lot Controller

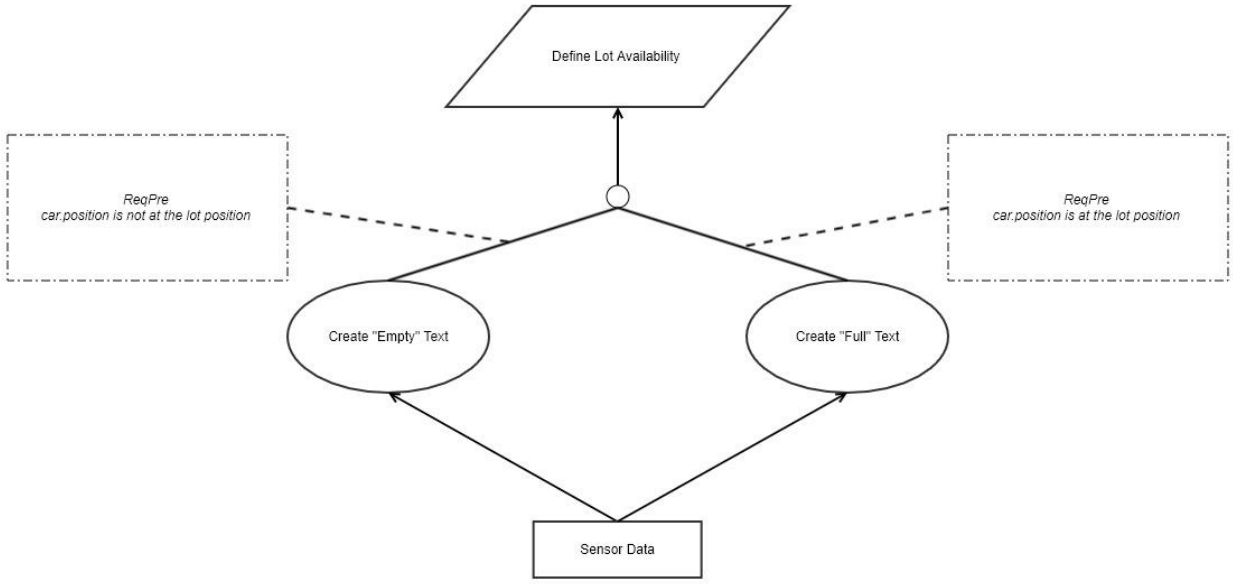

Figure 35. Operational Model of Sensor Controller

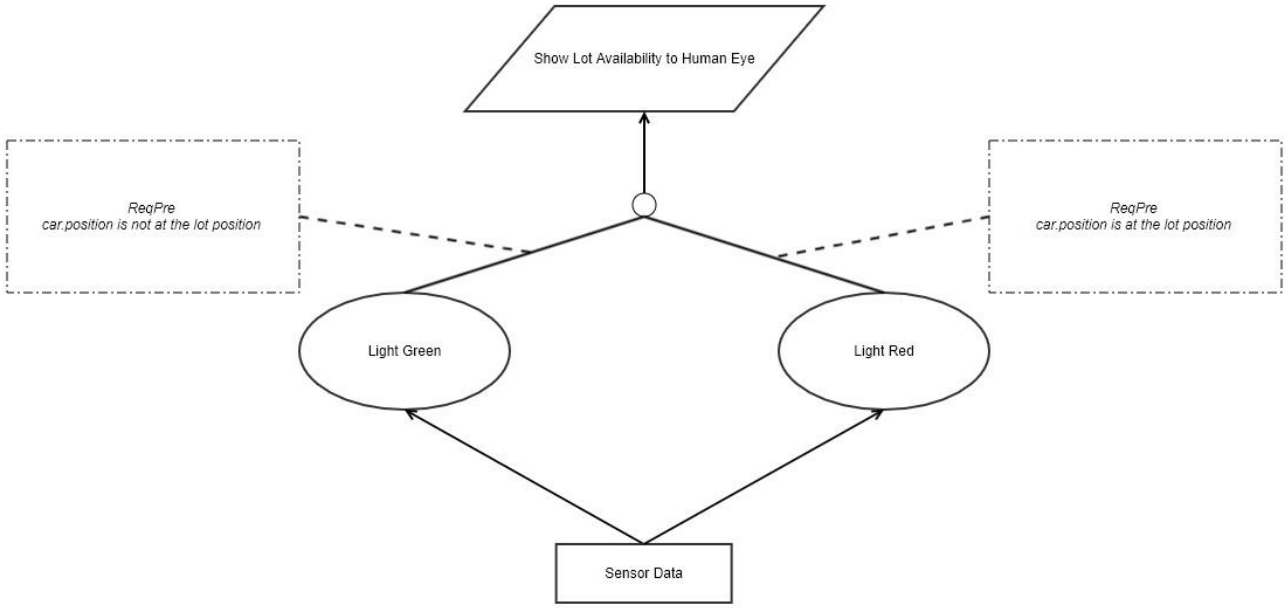

Figure 36. Operational Model of Light Controller

Object Model

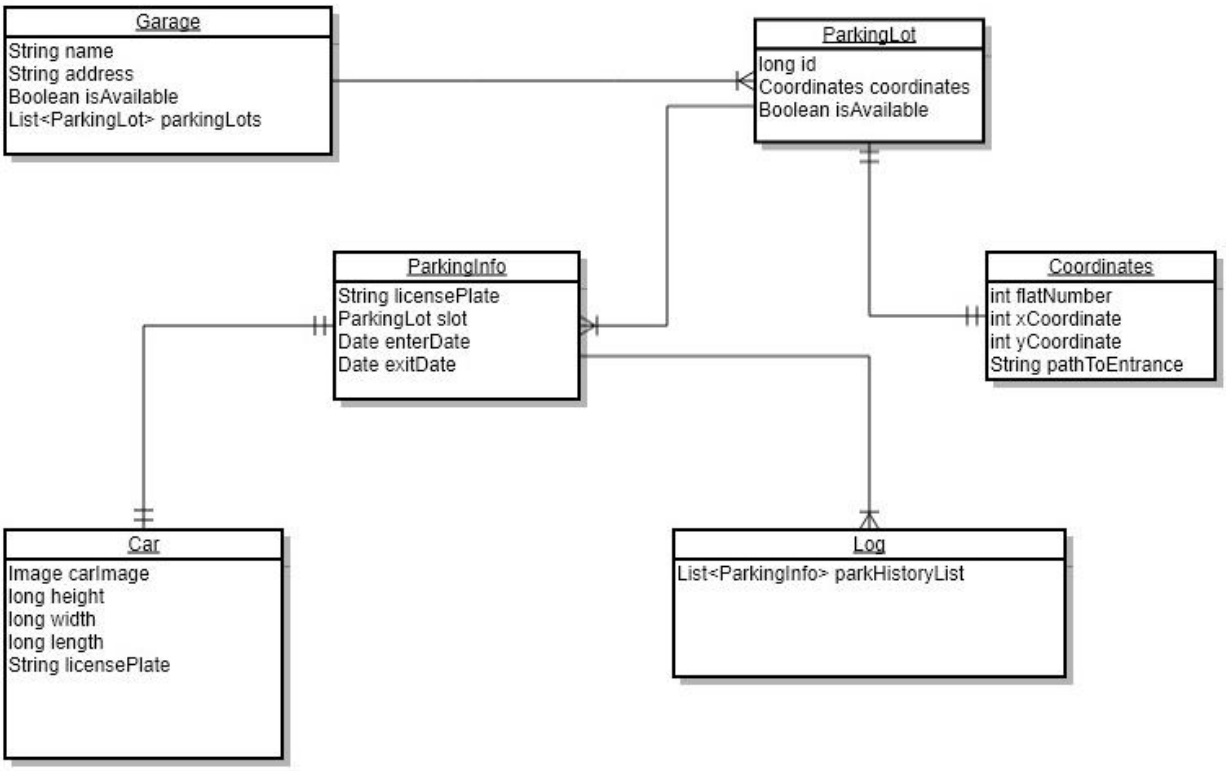

Figure 37 Object Model of Parking System

Conclusion

As a conclusion, the requirements of a system consisting of an efficient and safe parking management system is investigated. The goal oriented approach is used in this study, and proven to be powerful.

There is many room to expand the project, as the system is rather smaller than the real life applications as there are only one intersection in this system. For example, there is no requirements for the exit from the garage. It should be also a safe and efficient for the drivers. Otherwise they do not choose this garage.

In any case, this could be used to expand into a real life application, with more complexity, width and depth added to the tree.