Software Design & Construction

(Group Project)

Green Zone Monitoring System

Group members:

Fay AL-Nefaie

Rawan AL-Rehaili

Bshayer Farhan

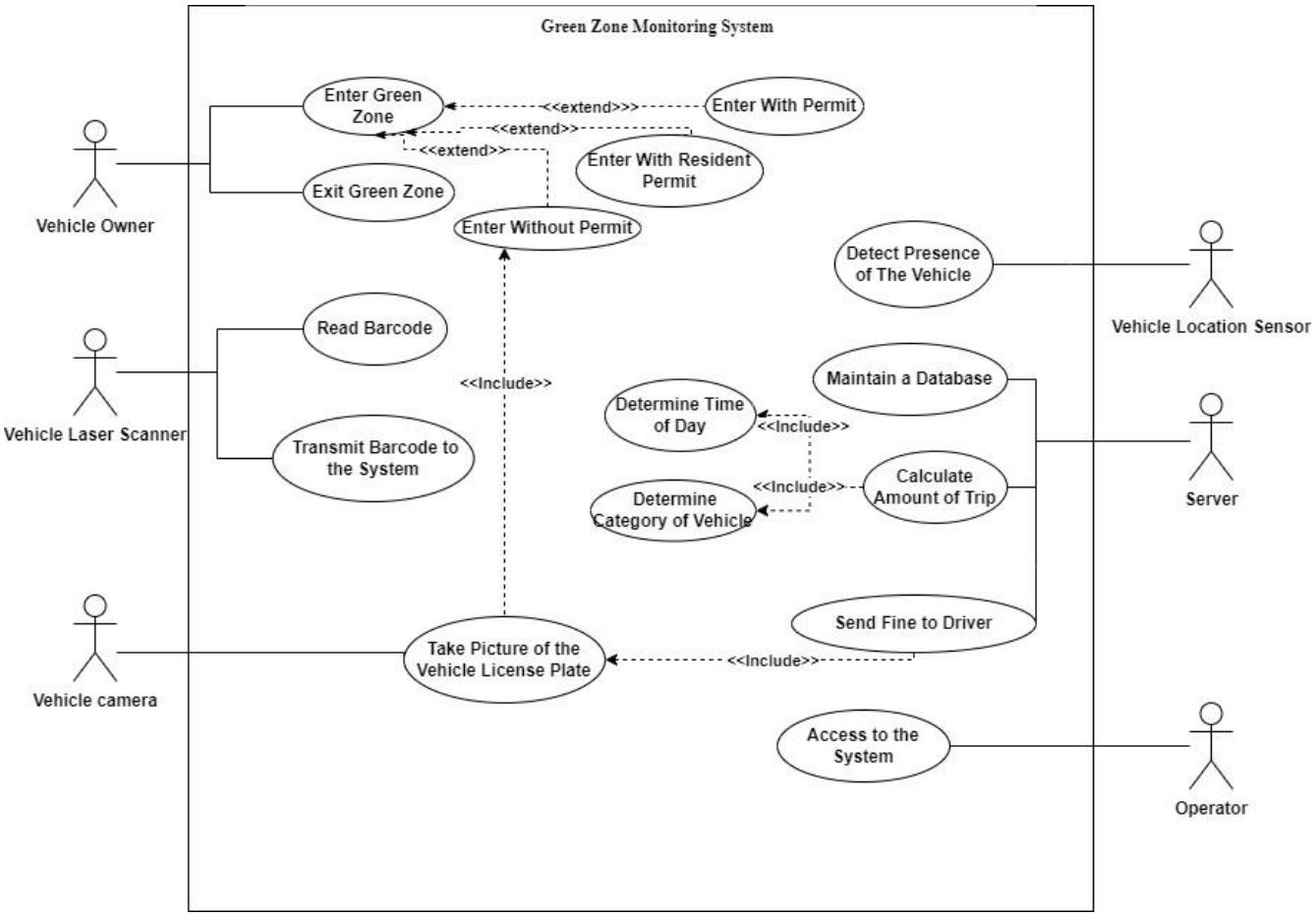
Objective:

This group project involves applying software design principles to a real-world scenario of a Green Zone Monitoring System.

Consider the following scenario:

A modern city has decided to create a green zone. The green zone is an area in the center of the city in which there is restricted access by motor vehicles. Vehicles (such as cars and trucks) are only allowed to enter the green zone if they have a green zone permit. The permit number is encoded on a bar code sticker, which is displayed on the windshield of the vehicle. When the vehicle enters the green zone, a remote laser scanner reads the barcode permit number and transmits it to the Green Zone Monitoring System. When the car leaves the zone, its bar code is also scanned and sent to the system. The system maintains a database of pre-paid green zone permits, from which the owner of the vehicle is billed for each trip and for the duration of the trip. There is a maximum charge for each day. The amount billed varies by time of day: peak-time, off-peak and night, and vehicle category, such as car, SUV, truck, taxi, bus, etc... The amount is deducted from the pre-paid green zone account at the end of each green zone trip. A person that resides in the Green Zone and has a vehicle registered in the same address needs to apply for a resident permit, which allows unrestricted access into and out of the Green Zone. If the car does not have a green zone permit, then a video camera takes a picture of the vehicle license plate. From an external vehicle license database, the address of the vehicle owner is determined and a fine is sent to the driver. The system includes an automated vehicle license recognition capability, which decodes vehicle license photographs taken by the vehicle camera. The system is also accessed by Green Zone operators who may view information about green zone permits and accounts, green zone trips, monitoring points, and vehicle fines. The order of the sensors at the green zone entry and exit points is vehicle location sensor (which detects the presence of the vehicle), vehicle laser scanner, and vehicle camera. For the software design (design model), you may assume that each of these sensors is asynchronous. You may assume that there is a microcomputer at each entry point and each exit point, to which are connected the vehicle location sensor, vehicle laser scanner, and vehicle camera. You may also assume that there is one centralized server, which stores all the system information in a database.

1) **Develop a Use Case Model, consisting of a description of the actors and use cases that fully define the system. Each use case is described in terms of the actors and their interactions with the system.**



Use Case Name	**Enter Green Zone**
Summary	**Owner enters the green zone.**
Actors	**Vehicle Owner**

Use Case Name	**Enter with Permit**
Summary	**Owner enters the green zone with permit.**
Actors	**Vehicle Owner**

Use Case Name	**Enter with Resident Permit**
Summary	**Owner enters the green zone with resident permit.**
Actors	**Vehicle Owner**

Use Case Name	**Enter without Permit**
Summary	**Owner enters the Green Zone without Permit.**
Actors	**Vehicle Owner**

Use Case Name	**Exit Green Zone**
Summary	**Owner exits the Green Zone.**
Actors	**Vehicle Owner**

Use Case Name	**Read Barcode**
Summary	**Vehicle laser scanner reads barcode.**
Actors	**Vehicle Laser Scanner**

Use Case Name	**Transmit Barcode to the System**
Summary	**Vehicle laser scanner transmits barcode to the system.**
Actors	**Vehicle Laser Scanner**

Use Case Name	**Take Picture of the Vehicle License Plate**
Summary	**Vehicle camera take picture of the vehicle license plate**
Actors	**Vehicle Camera**

Use Case Name	**Detect Presence of The Vehicle**
Summary	**Vehicle location sensor detects presence of the vehicle.**
Actors	**Vehicle Location Sensor**

Use Case Name	**Maintain a Database**
Summary	**Server maintains a database**
Actors	**Server**

Use Case Name	**Calculate Amount of Trip**
Summary	**Server calculates amount of trip.**
Actors	**Server**

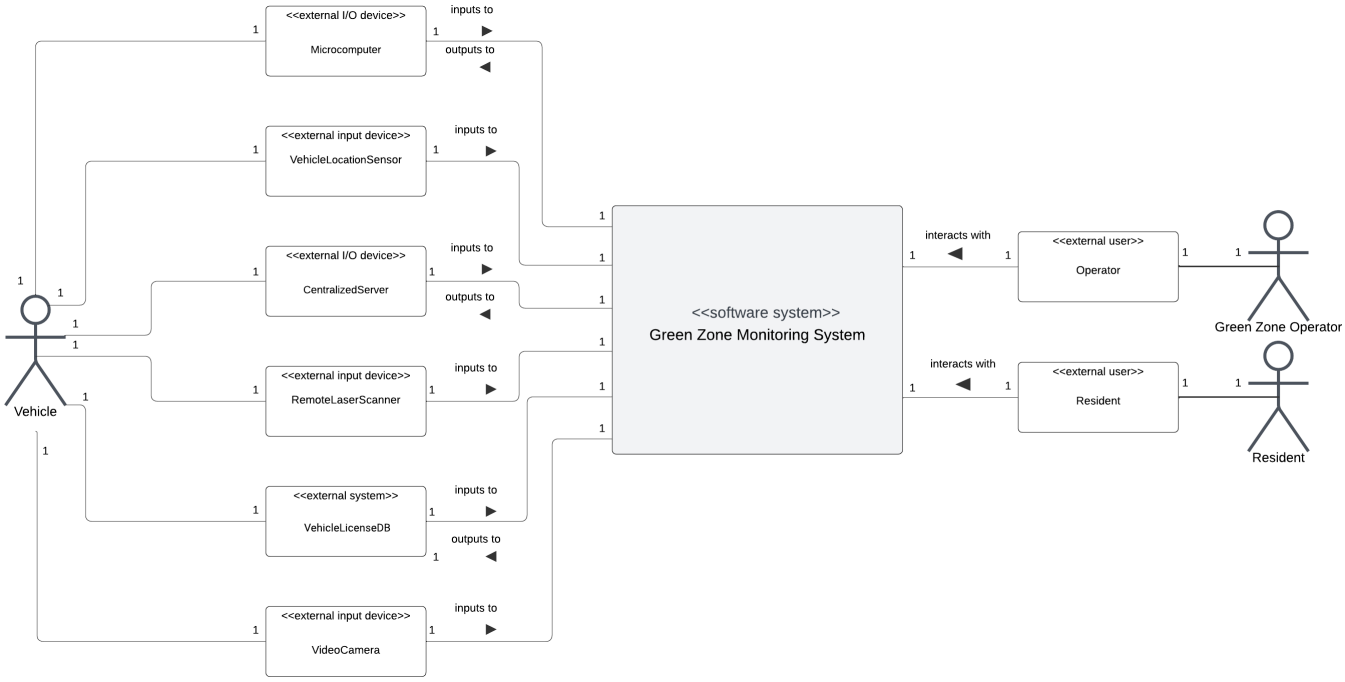
Use Case Name	**Determine Time of Day**
Summary	**Server determine time of day.**
Actors	**Server**

Use Case Name	**Determine Category of Vehicle**
Summary	**Server determine category of vehicle.**
Actors	**Server**

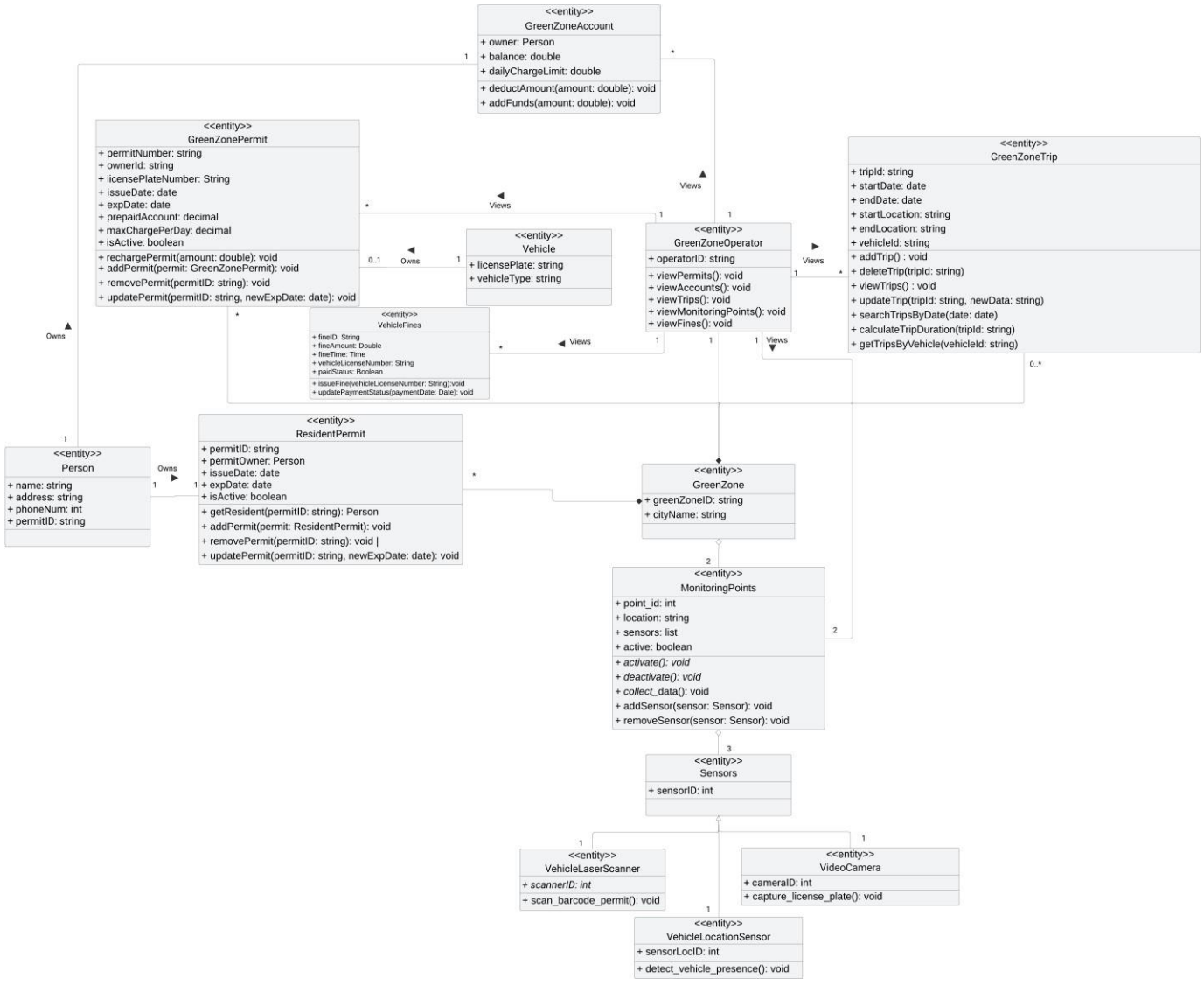
Use Case Name	**Send Fine to Driver**
Summary	**Server sends fine to driver.**
Actors	**Server**

Use Case Name	**Access to the System**
Summary	**Operator access to the system.**
Actors	**Operator**

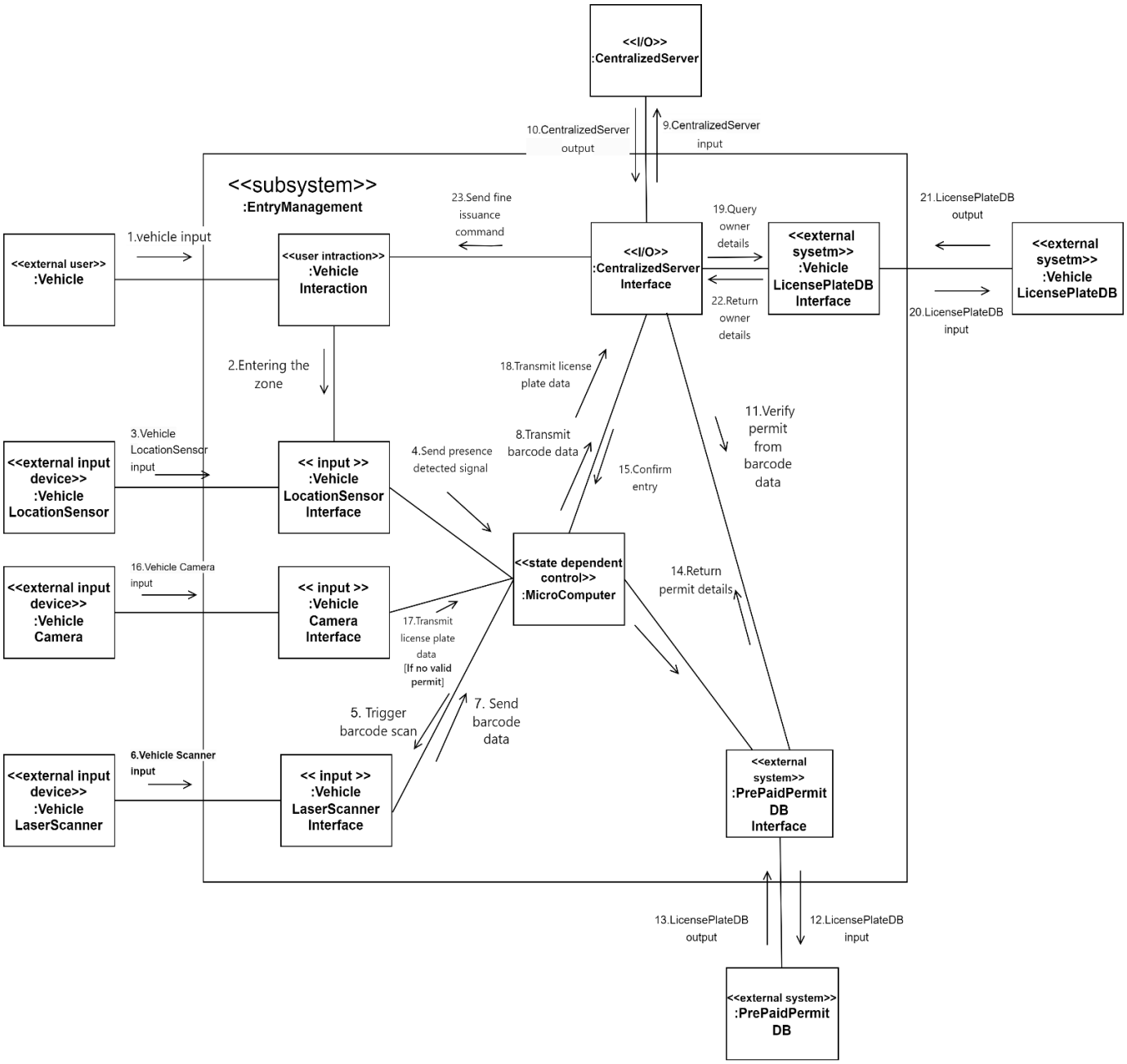
2) Develop a System Context Class Model depicted on a class diagram showing how the system interfaces to the external environment.

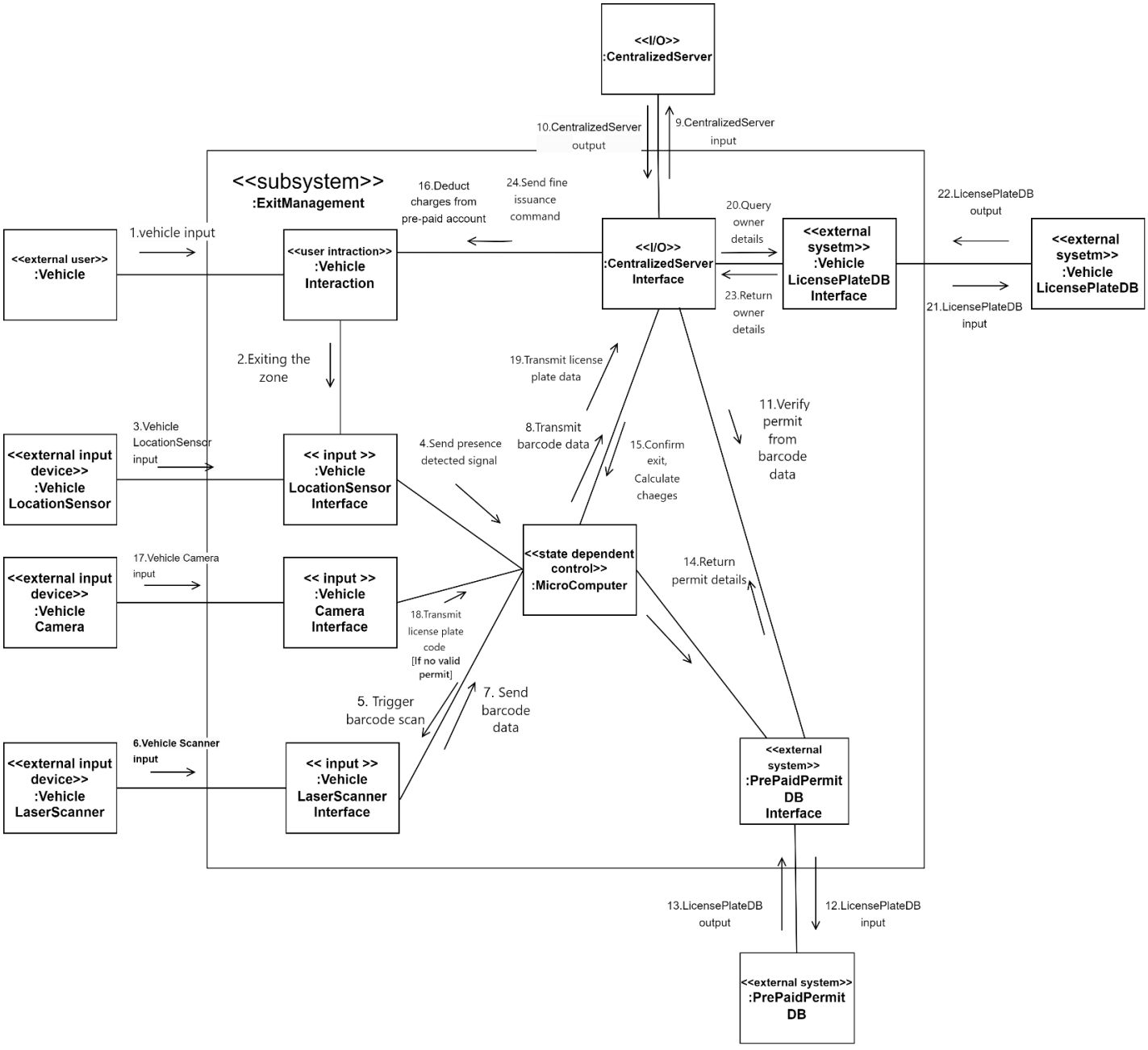


3) Develop a static model showing the classes in the system, attributes and operations of the classes, and the relationships between them.

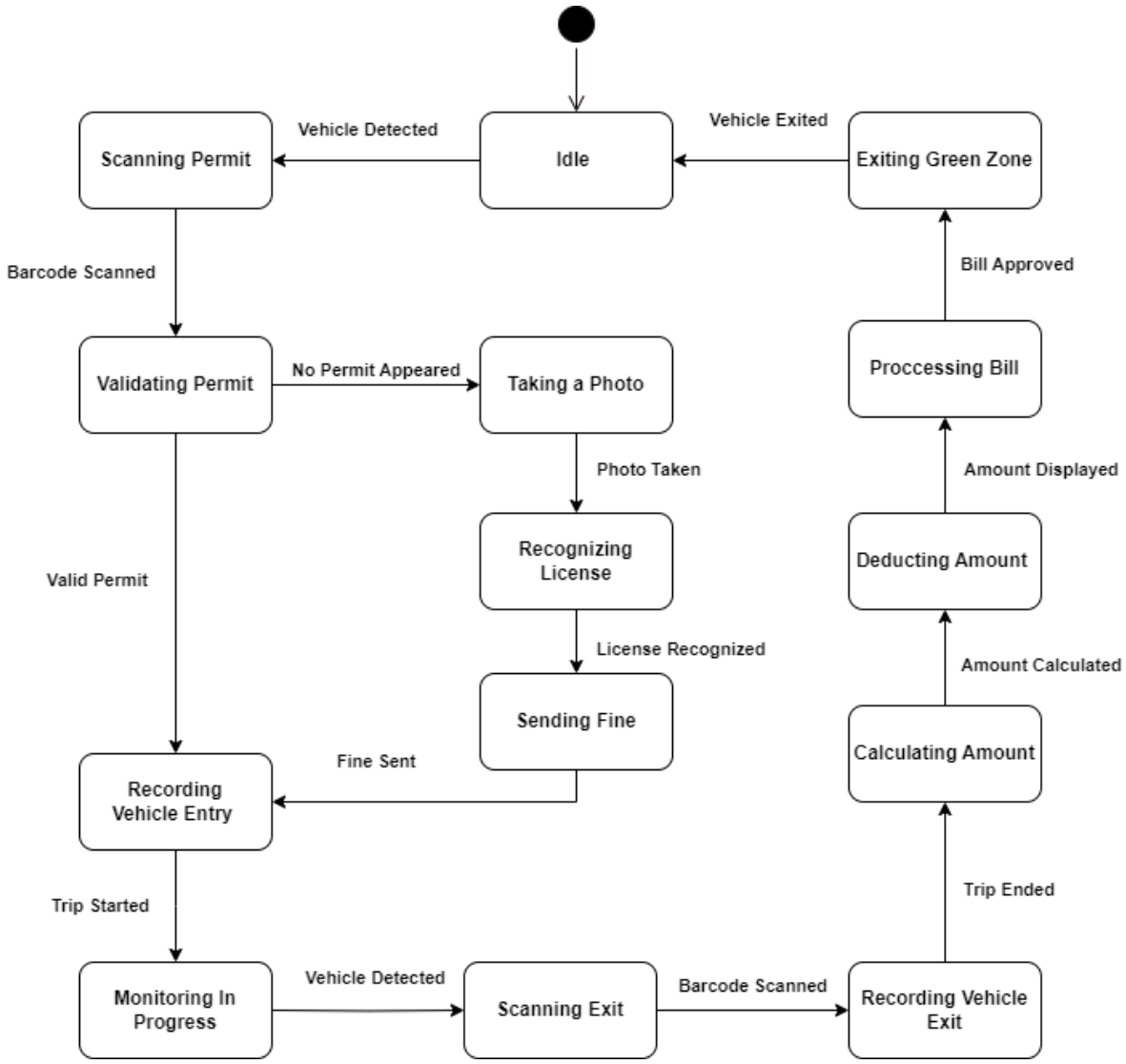


4) Develop an integrated Communication Diagram depicting interactions among the objects participating in use cases.



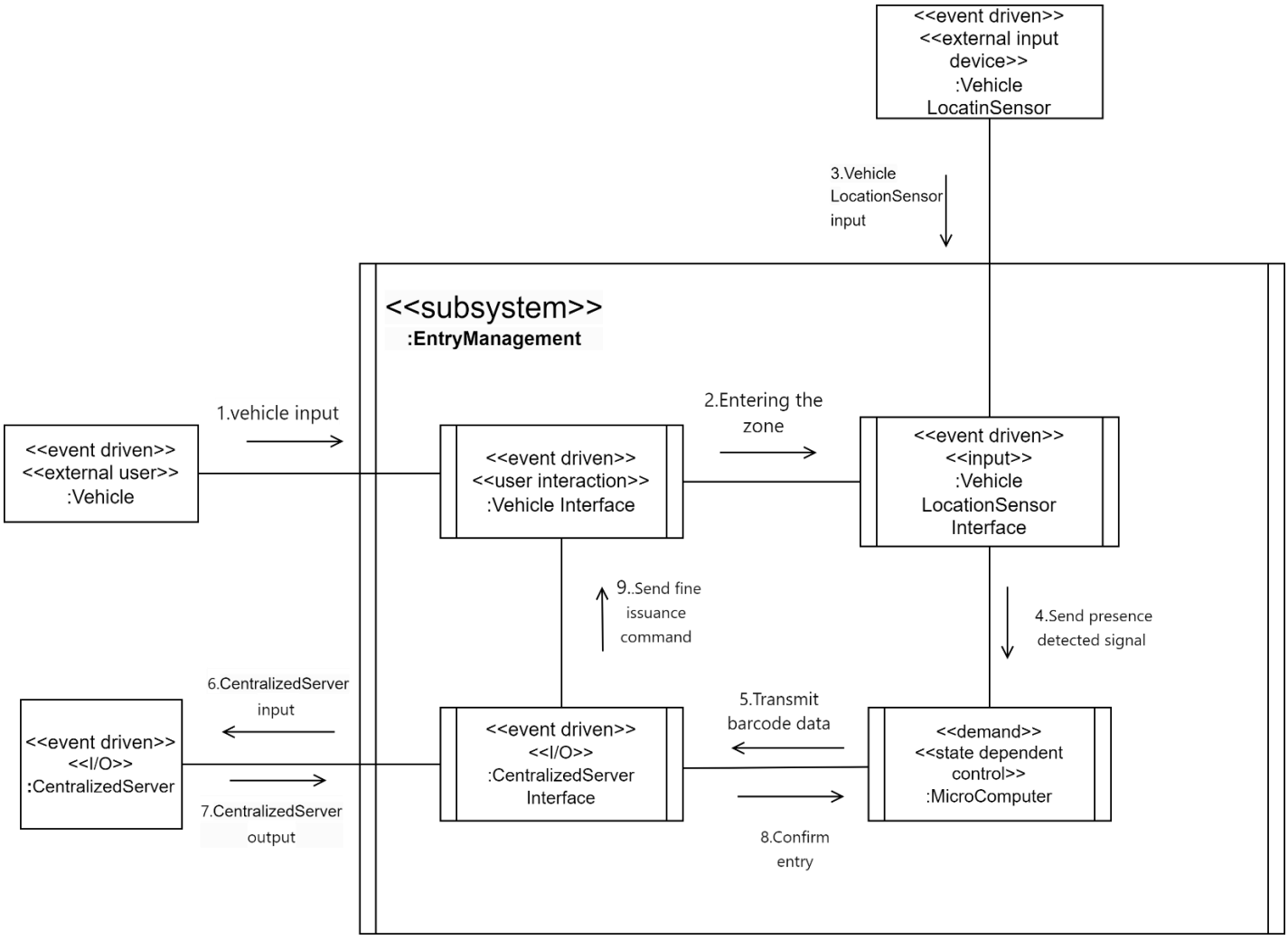

<<I/O>>
:CentralizedServer
10.CentralizedServer output
9.CentralizedServer input
<<subsystem>>
:ExitManagement
16.Deduct charges from pre-paid account
24.Send fine issuance command
20.Query owner details
22.LicensePlateDB output
<<external user>>
:Vehicle
1.vehicle input
<<user intraction>>
:Vehicle Interaction
<<I/O>>
:CentralizedServer Interface
<<external sysetm>>
:Vehicle LicensePlateDB Interface
<<external sysetm>>
:Vehicle LicensePlateDB
23.Return owner details
21.LicensePlateDB input
2.Exiting the zone
19.Transmit license plate data
11.Verify permit from barcode data
3.Vehicle LocationSensor input
<<external input device>>
:Vehicle LocationSensor
<< input >>
:Vehicle LocationSensor Interface
4.Send presence detected signal
8.Transmit barcode data
15.Confirm exit, Calculate chaeges
<<state dependent control>>
:MicroComputer
14.Return permit details
17.Vehicle Camera input
<<external input device>>
:Vehicle Camera
<< input >>
:Vehicle Camera Interface
18.Transmit license plate code [If no valid permit]
5. Trigger barcode scan
7. Send barcode data
6.Vehicle Scanner input
<<external input device>>
:Vehicle LaserScanner
<< input >>
:Vehicle LaserScanner Interface
<<external system>>
:PrePaidPermit DB Interface
13.LicensePlateDB output
12.LicensePlateDB input
<<external system>>
:PrePaidPermit DB

5) Develop a statechart for use cases involving entering and leaving the green zone. Make sure that statechart is consistent with the appropriate interaction diagram.

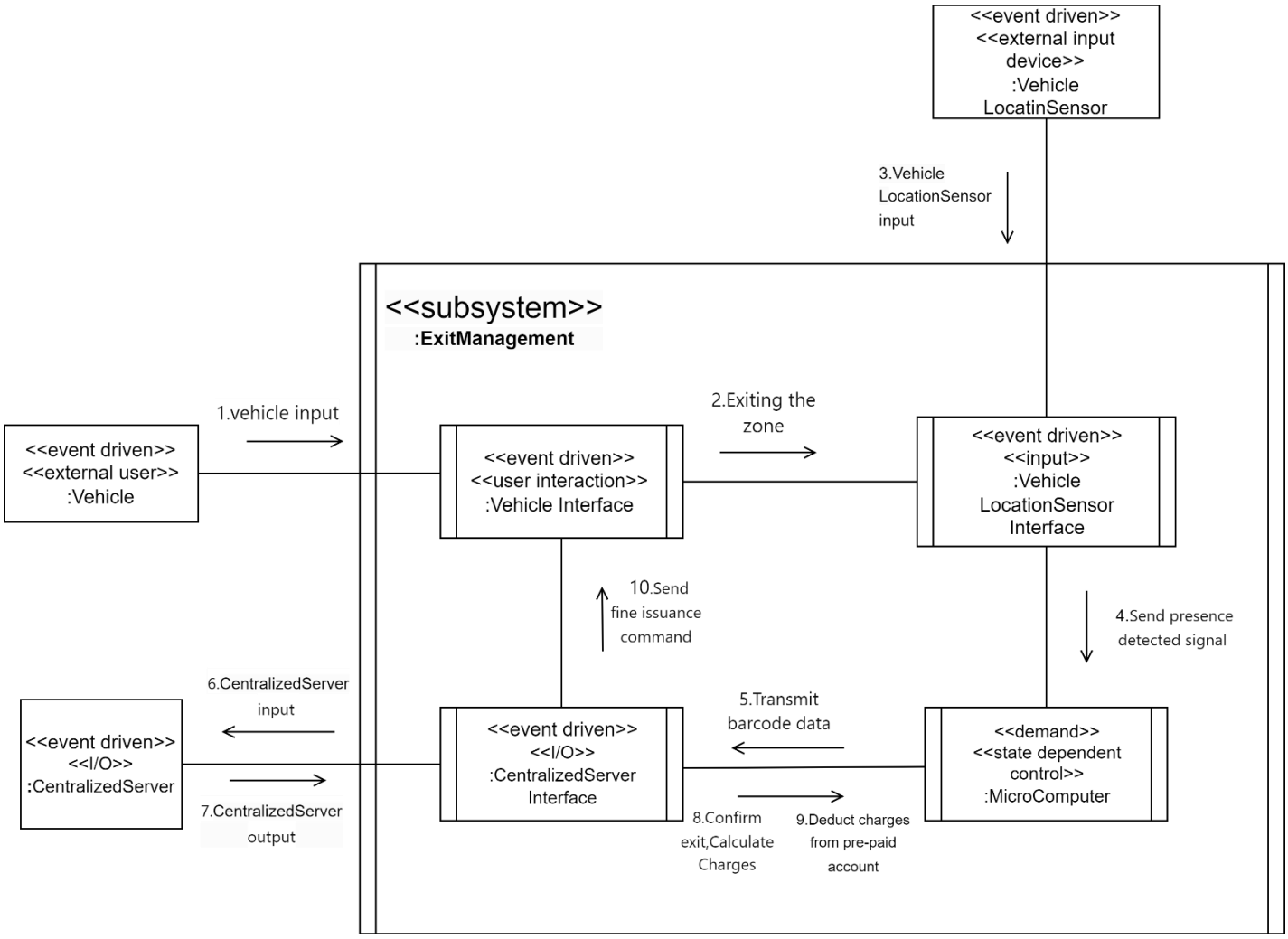


6) Develop a task architecture (depicted on concurrent communication diagrams) showing the concurrent tasks in subsystems and the interfaces between them. Define the message communication interfaces.

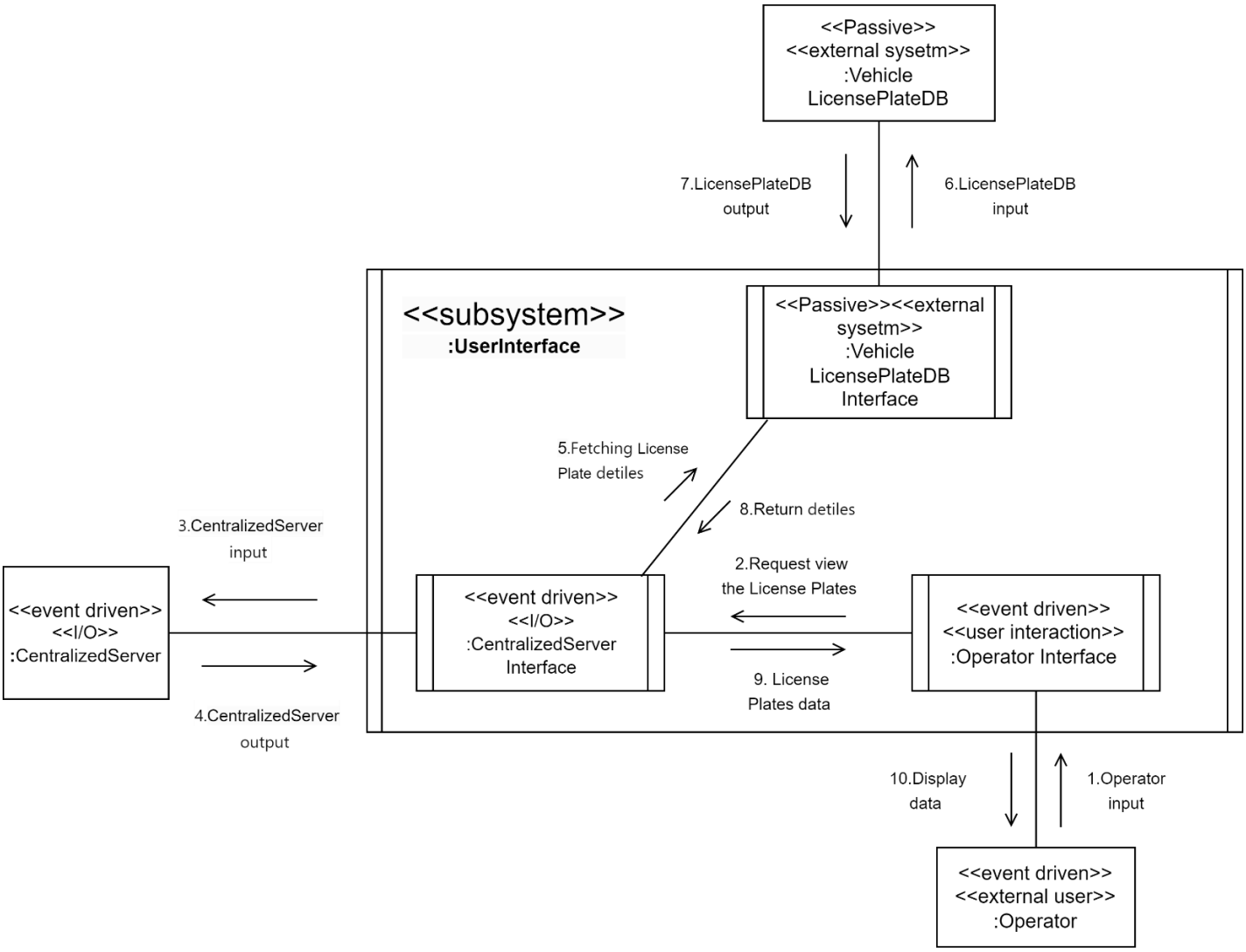
- **Entry Management Subsystem:**



- **Exit Management Subsystem:**



- **User Interface Subsystem:**



- **Database Management Subsystem:**