

FILS

Course: Software Design Techniques

Laboratory: homework assignment

Problem Statement

In a highway traffic taxation information system, drivers are automatically charged when exiting the highway. For a car to be allowed to leave the highway, it must have been registered when entering the highway in a location placed before the exit location, taking into consideration the direction of the car. Both the entry and exit barrier from the system should receive the car number from where, if necessary, the system can reach the brand, model and owner. There are various ways the system receives this information: 1) TELEPASS (a device installed on board the vehicle that transmits wireless the car data to the system, 2) scanning and interpreting the license plate with a camera or 3) by manually inserting the license plate number by an operator (an operator or even the driver).

The received number is transmitted to a processing center which records the car both at entry and at exit, adding each time the date and time of the recording, computes the tax the driver must pay and presents the bill to the driver in real time, when exiting the highway. The tax is computed in respect to the distance and to the local tariff per highway km. To this value the VAT is added.

The bill contains the following data: bill number, license plate number, entry/exit date, entry/exit point and the value of the tax. For privacy reasons, information regarding the driver and the brand of the car are not printed.

Domain model

To be done.

Main scenario

The system is distributed, having a terminal at each entry/exit barrier. Each terminal is connected to the processing center. When a car enters the highway, the terminal sends the car data to the processing center where they are stored until the car exits the highway. To prevent data loss in case of system failure, the entry record are stored in a persistent storage (database or files).

When a car exits the highway, the information collected by the terminal is used to identify the record of that car in order to determine the distance it has travelled. For that purpose the exit terminal accesses the processing center, supplying the car data and receiving the billing information.

The exit terminal prints the bill and presents it to the car driver. The driver can pay either by credit card, or cash, in the latter case the terminal also provides the change. The car is allowed to pass, the terminal confirms the payment and the car data record is deleted from the collection.

Sequence diagram of the main scenario

To be done.

The first draft of the design class diagram

To be done.

The first draft of the application software architecture

To be done.

Requirement 1

The object collection for storing the car data is used by all the terminals. Also, its content is unique for all the client objects. In this case, the collection resides on the processing center server.

Use the appropriate patterns to design the solution of this requirement. Redo the class and sequence diagrams.

Requirement 2

The car data received at an entry barrier is sent to the system, stored in a file called carIX, where I comes from IN and X represents how many cars have passed through that barrier.

Similar, the car data from an exit barrier is stored in a file called carOX.txt where O comes from OUT and X represents how many cars have passed through that barrier.

To store the car data the system reads the file and extracts the license plate number. Once a file is sent, the terminal notifies the system by generating an event.

Use the appropriate patterns to design the solution of this requirement. Redo the class and sequence diagrams.

Requirement 3

We suppose the highway passes through 2 countries: France and Italy, and maybe it can be extended in other countries. Each of the 2 countries charge taxes computed in different ways. In some countries the tariff can vary from one car brand to another. Even the VAT can vary from one country to another.

We suppose that in France the VAT depends on the brand of the car. If the car is Mercedes then the VAT is 5% and for the rest of the cars it is 4%.

This means that in France we need more data about the car, the brand and the model, to compute the tax.

Use the appropriate patterns to design the solution of this requirement. Redo the class and sequence diagrams.

Requirement 4

In France the system outputs a receipt, not a bill. This receipt also contains data about the owner, brand and model.

Use the appropriate patterns to design the solution of this requirement. Redo the class and sequence diagrams.

Requirement 5

We suppose the document issued for payment to the driver also contains the name of the country and advertisements regarding to the country where it is issued. For example, the bills issued in Italy contain touristic sights near the exit point on the highway, while the receipts in France contain the most important cities which are found on the followed road. At the border between the two countries, both advertisements can be used.

Use the appropriate patterns to design the solution of this requirement. Redo the class and sequence diagrams.

Requirement 6

We suppose that at the border between the two countries there are two green lanes with an exit gate and an entry gate, Each time a driver passes through one of these gates, the system notifies (by email) the Police departments in the two countries. The notification contains the license plate number and the date and time of exit/entry.

Use the appropriate patterns to design the solution of this requirement. Redo the class and sequence diagrams.

Requirement 7

A car can enter the highway in Italy (not at the border) and can exit in France. The driver will be issued a receipt (because he is in France) in which the tax has been computed in two steps: applying the tariffs from Italy (for the distance between entry and border) and the applying the tariffs from France (from border to exit). Similar for the case a car enters in France and exits in Italy.

Use the appropriate patterns to design the solution of this requirement. Redo the class and sequence diagrams.

Requirement 8

If the driver has made an agreement with the Highway Authority, he can go through the barrier without stopping by using a special lane, and the charged sum is added to the precedent ones, and the total is extracted monthly from an agreed-upon bank account .

Use the appropriate patterns to design the solution of this requirement. Redo the class and sequence diagrams.