**Chapter 3**

**Requirements and Design**

The previous chapter provided a technical background in details and pointed out the project objectives. This chapter will provide requirements and design of an application developed for the project. It will illustrate the functionalities of the application in high-level perspective also describes how these functionalities are supposed to be done. Further details will be explicated in the implementation section.

**3.1 Requirements Specification**

This section contains the listing of all requirements for Traffic Simulation Management Application. They are conditions and capabilities to which developed application must conform. Some of these requirements are provided by the project supervisor while other requirements are determined by the team. The list of the requirements is divided into two parts (input requirements and output requirements).

**3.1.1 Input Requirements**

* The application shall allow the user to input number and type of vehicles (car, bus/Coaches or ambulance).
* The application shall allow the user to select one of the available different road networks (straight road, roundabouts or multi-lane junctions).
* The application shall allow the user to indicate individual behaviors (reckless, cautious, or normal).
* The application shall allow the user to decide on particular events (traffic jam or red/green/amber traffic lights).
* The application shall allow the user to run an emergency situation.

**3.1.2 Output Requirements**

* The application shall simulate individual vehicles in different road networks (straight road, roundabouts and multi-lane junctions).
* The application shall record vehicles positions, new entries and exits, number of vehicles currently on the road and timing of journeys.
* The application shall update the overall simulation automatically every 10 seconds.

**3.2 Design**

The focus of the project is to develop a graphical user interface application that visualize and simulate a variety of traffic paradigms. Therefore, the team has decided to build this application in five layers which will allow the team to program more efficiently and in professional manner. Moreover, this approach will ensure that every layer has a strong foundation and has the absolute minimum amount of errors possible.

**3.2.1 Vehicle Layer**

This layer is representing the various types of vehicles given simple movement state (acceleration, slowing down, randomization, and car motion). Vehicles are represented on the graphical interface as one single cell or two cells based on the vehicle size (one cell for cars and two cells for bus/Coaches/ambulance). The vehicles’ states demonstration are decided by the velocity value of the vehicle and available space in front of it. Therefore, the team has agreed to follow the Nagel–Schreckenberg model which is based on cellular automaton model to implement this layer.

**3.2.2 Map Layer**

This layer is representing the road networks (straight road, roundabouts, and multi-lane junction). It is an independent layer which means no vehicles are featured. The road network drawn on the graphical interface in 2D style (X and Y cells) where X and Y are the width and length of the road lane. Number and location of the cells contributed on the layout to draw the road network will be decided when the user select one of the road patterns available.

**3.2.3 Interaction Layer**

This layer is a combination of the vehicle and map layers. It is an implementation of different types of vehicles following specific routes on different road patterns. Vehicles will enter specific road and exit from one of the linked roads based on drawn road network.

**3.2.4 Event Layer**

This layer is designed to add different events. These events could be either road events such as traffic jam and traffic lights or vehicle events such as reckless, cautious, or normal. The user is allowed to insert more than one event at the same time before the simulation of complete collective actions.

**3.2.5 Simulation Layer**

This layer is the final layer where all designed traffic model is animated. Each vehicle will behave in dissimilar mode according to the traffic model. In addition, the simulation will generate results and information for the number of current vehicles, and their position, also the number of vehicles entered the road network and the number of vehicles exit the road network. It will also record the time of journey of vehicles based on the traffic model designed.

The team has decided to choose JAVA programming language using NetBeans Software to build this application. The main reasons behind this decision were:

* JAVA was known and learned to all team members.
* Has powerful and elegant set of APIs.
* It is object oriented which is important for highly modular environment.