**Vehicular Traffic Flow Scenario Development Environment (TDE)**

This Proposal is submitted in Partial Fulfillment

of the Requirements for the Degree of

Master of Science

in

Information Technology

By

**Shmeel Ahmad**

**MITF12M019**

Supervised by

**Dr. Waqar-ul-Qounain**

Assistant Professor

Artificial Intelligence and Multidisciplinary Research Laboratory (AIM-RL)

Date: 6 January, 2014

Punjab University College of Information Technology

# Proposal

## Abstract:

Traffic congestions and irregular traffic flow have been problem for long time of industrial and populated countries due to increased air and noise pollution and fuel usage. Computer aided traffic flow simulations help to develop environment for different traffic situations and to analyze related problems. The proposed Vehicular Traffic Flow Scenario Development Environment (TDE) is implemented with different models like driver models with different vehicle types. Road parameters like interjections, T-junctions, roundabouts, squares and ramps are integrated in road network model. Traffic controllers like light signals, ramp metering, routing policies etc. are modifiable in road traffic. Environments can be developed graphically and analyzed graphically as well as in text form results. In later case results are in form of facts and figures for mathematical estimations and comparisons.

Another aspect of the system is it can not only simulate traffic flow but if possible it can suggest different solutions to regulate traffic flow like changing timing policies for traffic signals, road infrastructures or routing policies.

**Keywords**: Microscopic, traffic simulation, traffic planning, traffic flow, traffic control, road planning

## Introduction

Computer simulation has helped in many science domains simulating real world scenarios and providing basis for analysis of different aspects of the systems. It has solved many problems of real world systems. It is used in different fields like aviation for pilot training, games like tennis and in many other fields. In general, simulation is defined as dynamic representation of some part of the real world achieved by building a computer model and moving it through time [1]. The proposed application is a type of simulator which simulates different traffic scenarios and present them visually to the user. Models implemented might be modified to represent as real world objects as possible. In addition application shows results in text format for mathematical interpretations. TDE is based on microscopic simulation, objects are individually modeled and simulated independently.

End users of the application are traffic engineers, transportation planners and organizational transportation network administrators. Users can interact with scenarios for changes dynamically. TDE allows users to work with different types of roads, types of traffic among other choices to develop interesting scenarios without interfering real world traffic, road network can be generated manually or it may be imported from existing road network file.

Any traffic simulator can be divided into 4 basic parts [3]. First part is transportation supply which is capacity of road infrastructure to flow traffic in specific area. It consists of roads, sign boards, footpaths, interchanges and junctions. Transportation supply can be raised, taking some measures like by increasing aggregate length of roads, widening roads, placing controlling sign boards on roads.

Second part is transportation demand, it is demand for the contents of traffic supply, more the traffic vehicles more the demand is. Demand can change in different times of the day. A rush hour is a specific period of a business day during which traffic load is at peak due to same time scheduling. So during rush hours transportation demand increases and if there is more demand than supply there will be traffic congestions such type of congestions are developed mostly due to commuters. Supply and demands are the most important traffic parameters which can be adjusted to make traffic flow smooth and continuous. Demand can be reduced by restricting heavy duty traffic like commercial trucks and container carriers in those specific periods of time and places. High-Occupancy Vehicle lane (HOV) is another technique used to reduce transport demand, a specific lane is marked with in other lanes or separate otherwise, for vehicles which carries generally two or more occupants. It reduces the need for more vehicles reducing demand and air pollution as well. By restricting a vehicle on road on specific hour of a specific day in week is another technique to control demand, a vehicle is given a color code on the number plate so that traffic wardens can issue tickets at prohibited times for that color.

Third part is control like traffic light signals, CCTV cameras, traffic cones and traffic warden. They don’t change transport supply or demand rather they are used to make efficient use of transport supply and regulate the demand to avoid traffic congestions. They are not part of supply because they can be changed and managed according to traffic situation while fixed milestones or sign boards are not changed according to traffic situation so these are part of supply.

## Background and Literature Review

The use of traffic simulation dates back to 1955 when D.L. Gerlough published his dissertation: "Simulation of freeway traffic on a general-purpose discrete variable computer" at the University of California, Los Angeles [2]. After that a lot of progress has been made different models have been developed like pedestrian, driver models, road infrastructure models, lane selection/changing models, intersections and junction models, traffic controller models etc.

All parts of the system need to be modeled, car following model [4] is one of oldest models and is being used in this field, for vehicles moving in a single lane. This is type of microscopic model, leading car and following car interact and maintain the inter space. In this model

C= (1000) V/S

Where C is Capacity of a single lane in number of vehicles/hour, velocity of each vehicle is assumed to be equal in this model and is represented by V in Km/h and S is the space between vehicles. Similarly roads, traffic signals, drivers and other parts of the system are modeled.

S = α+βV+γV2 (Minimum distance between vehicles without collisions)

Where α is effective length of a vehicle, β is reaction time of the driver (βV is the distance covered during driver’s reaction time) and γ is reciprocal of 2 times of deceleration of vehicle (γV2 is the distance covered while stopping the car, if leading car stops instantly, without collision). Among others different models exist like intelligent driver model, Gipps’ Model and macro-simulation models.

There are still some complexities not modeled in simulator like driver’s behavior is difficult to predict in different situations, how weather affects traffic flow, changes in external parameters like fuel prices and vehicles’ prices (lower the prices higher the traffic load) and government’s changing policies/rules and regulation also affects transportation demand.

## Research Questions and Objectives

The objectives include to modify models used in TDE to depict as real world scenarios as possible, providing implementable solutions to different problems detected in traffic system and making TDE user friendly and integrating most of customizable traffic features. An effort will be put to eliminate current shortcomings and lacking features in existing simulators.

Research questions are as following:

* What is the significance of models being used in current traffic simulators?
* What changes need to be made in order to depict realistic traffic scenarios?
* How different models affects the efficiency of simulators?

## Research Methodology

Different models will be reviewed in literature and from currently open-sourced related projects. Open source API’s will be extended as needed, codes will be reviewed and adopted. Results of modified models and current models will be compared. Apache’s Log4j API can be used for communicating current situation of the simulation [5]. OpenGL API might be used for rendering 2D or 3D objects graphically.

Different tests with same scenarios on existing traffic simulators and proposed TDE will be performed in terms of efficiency, simulation reality etc. Traffic data from transportation ministry will be fetched as required to be compared with data generated by proposed TDE. Prototypes will be developed to test parts of TDE and on satisfactory performance will be integrated. For designing UML (Unified Modeling Language) and incremental, iterative and agile processes will be used. JAVA will be used as primary language, Dot net technologies can also be used if required.

## Conclusion

An application will be developed to simulate real world traffic flows which will be used by traffic engineers and traffic planners to predict and solve different traffic problems in different scenarios. An effort will be put to overcome the shortcomings of existing traffic simulators. This will save many costs of interaction with real world systems and will provide different solutions to the users. Currently used models will be modified to meet objectives and to improve reality in traffic simulation. Car following models, Gipps models etc. are being used currently. Traffic controls, transportation supply and transportation demand are the major components of TDE. For development purposes JAVA will be used as primary programming language.

# Research work:

## Idea product:

Idea of the project is to develop a tool to help users to develop different traffic and road network scenarios and configure the scenario according to requirements. Scenarios can be saved in 2 output files of extension .xprj and .xodr (Open )

## References

**[1] Drew, D.R.**

(1968) *Traffic flow theory and control*

**[2] Daniel L. Gerlough**

(1955) Simulation of Freeway Traffic on a General-purpose Discrete Variable Computer

**[3] Martin Fellendorf and Peter Vortisch**

Microscopic Traffic Flow Simulator VISSIM

**[4] Richard W. Rothery**

Car Following Models [University of Texas, Austin]

**[5]** www.logging.apache.org/log4j/