**CHAPTER 1**

**INTRODUCTION**

This thesis work is intended to document the bachelor project, whose name is “Traffic control system for cities of Punjab”. It covers the analysis, implementation and user’s guide of the project.

**1.1 Context**

Most of the problems faced by today’s traffic networks are caused by the ever-increasing usage of the traffic system. Traffic congestion is considered to be one of the prominent issues that needs attention. Traffic control and management experts and policy makers have come up with many possible solutions to solve the traffic congestion problem. Some of these solutions focused either on increasing the number of roads or lanes to cope with the demand, or on limiting the traffic demand by levying tolls and raising taxes for using the system. Also, due to political concerns and feasibility constraints, both of these options did not offer a promising solution. Another solution is to use the current system in a more efficient way. This option offers high benefits and potential both on the short term and the long term. This approach is worked out in this thesis, with a particular focus on the long term. In terms of conventional traffic control approaches, efficient utilisation is made possible by controlling and managing the roadside infrastructure intelligently, which in turn can improve the traffic performance.

Currently, this intelligence is introduced in the traffic systems by means of roadside based measures and control handles such as dynamic route guidance panels, ramp metering systems, dynamic speed limits, and also by means of infrastructure equipment such as sensors and actuators. Meanwhile, the other important element in the traffic system — i.e., the vehicles — have become much more intelligent. By this intelligence, we mean that the vehicles are equipped with a number of on-board sensors that help in gathering information such as their position and speed, and with many fast devices that process and present the obtained information in a meaningful and usable form [21]. These techniques can then assist or control the driver actions to sustain a safe and better driving operation.

**1.2 ITS(Intelligent transportation system)**

Road traffic is continuously changing in nature. New vehicle and infrastructure technology creates new traffic conditions. At the moment, Intelligent Transportation Systems (ITS) are becoming an increasingly important element in the traffic system. ITS can be described as telecommunications, computer and automatic control systems that interact with the vehicles in the traffic system and provide support for a more efficient utilization of the available resources. Examples of ITS include applications for traffic management, traveller information, public transport, logistics and driver assistance. The main motivation for changes and standard improvements in the traffic system has traditionally been to increase capacity and the qualityof-service, i. e. to allow increased speed and to reduce the time spent queueing. Today more attention is turning towards other issues such as road safety and the environmental impact of traffic. To remedy congestion, safety and pollution problems, it is important that the measures taken provide real benefits. In addition, scarce resources require prioritisation among alternatives. Impact assessments of proposed changes in the traffic system are therefore necessary. Traffic simulation models that describe operations in a traffic system has proven to be of use for such analyses.

ITS increase the complexity of the interactions between individual vehicles and the surrounding traffic and between vehicles and the infrastructure. Simulation is a powerful method for studies of complex systems. Traffic simulation is therefore likely to become more essential in studies of all road traffic systems. Many traffic simulation studies of the design of urban street networks and motorway operations have been performed. The road mileage is however in most countries dominated by rural roads (European Union Road Federation, 2007). So far, the use of traffic simulation for rural roads has not increased as much as the use of simulation for other road types. Today’s growing awareness of issues such as road safety and the environment has however brought an increasing interest in the performance of rural roads. Since traffic simulation has proven to be a useful tool for other road environments there is also a potential to use traffic simulation for rural roads to a greater extent than today. In addition, to account for the ever changing traffic system there is a need for flexible simulation models capable of describing effects of the ITS-applications of today and of the future. This thesis consider microscopic traffic simulation modelling of rural roads and the use of traffic simulation as a tool for evaluation of driver assistance systems. Various aspects of this wide area are covered by the papers that are included in this thesis. A traffic simulation modelling framework for rural roads is developed and applied for rural road design analysis. Issues in relation to the application of detailed traffic micro-simulation models are explored and requirements imposed on traffic simulation models to be used for analysis of driver assistance systems are analysed.

**1.3 Project Objectives**

The project aims to build the simulation model, show its behavior and present its result in a graphical user interface. The program will provide an interface to edit the traffic network. The program will also provide an interface to specify parameters such as simulation speed and traffic intensity levels before simulation starts or dynamically change during the simulation. Finally, the program will provide statistical results for data gained from simulation.

In summary, there will be two parts to the project.

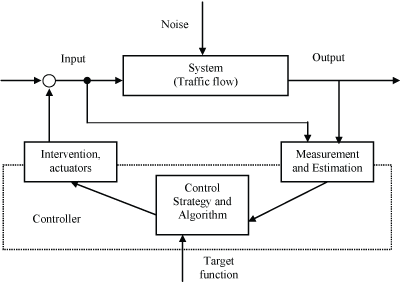
1. An interface to build any traffic network.

2. A simulation displaying the model run on the data supplied and producing statistical results.

**1.4 IRS advanced traffic management system**

IRIS is an [open source](http://www.opensource.org/docs/osd) advanced traffic management system. It provides an integrated platform for transportation agencies to manage traffic monitoring and control devices. The software is written in [Java](http://www.java.com/) and licensed for anyone to use under the [GPL](http://www.gnu.org/licenses/old-licenses/gpl-2.0.html). In addition, all dependencies required to install and operate an IRIS system are available as free software. IRIS stands for Intelligent Roadway Information System.

The IRIS software presents an intuitive map-based interface to system operators. This user interface has been refined over many iterations by getting feedback from operators to streamline their workflow.



**1.5 Functional area of intelligent traffic management**

Information technology (IT) has already revolutionized many industries, including transportation systems by bringing information to bear on the transportation network. IT will significantly help to solve surface transportation challenges over the next several decades, as an “infostructure” gets built alongside countries’ physical transportation infrastructure. Intelligent Transportation Systems focus on developing and deploying data solutions for traffic problems. The term Intelligent Transport Systems (ITS) has been introduced in transport and traffic engineering during the 1990s, and can be defined as holistic, control, information and communication upgrade to classical transport and traffic systems enabling significant improvement in the performance, traffic flow, efficiency of passenger and goods transportation, safety and security of transport, reduction of pollution, etc. [2].

The scenarios describe applications of ITS which deploy communications, control, electronics, and computer technologies to improve the performance of highway, transit (rail and bus), and even air and maritime transportation systems as seen on figure 1. Intelligent transportation systems include a wide and growing suite of technologies and applications such 4 as real-time traffic information systems, in-car navigation (telematics) systems, vehicle-toinfrastructure integration (VII), vehicle-to-vehicle integration (V2V), adaptive traffic signal control, ramp metering, electronic toll collection, congestion pricing, fee-based express (HOT) lanes, vehicle usage based mileage fees, and vehicle collision avoidance technologies.

**1.5.1 Special function areas**

1. Traffic guidance,

2. Incident management,

3. Demand management,

4. Meteorological information,

5. Road maintenance.

**1.5 Organization of Thesis**

The structure of the rest of the Thesis is as follows:

Chapter 2 presents the background of various IRS approaches for various systems and it covers the detail about. It also includes literature review of study.

Chapter 3 Tells about the present work, methodology in detail. It explains the algorithm and flowchart of present study.

Chapter 4 presents the results of study and compares this with existing techniques on the basis of different output parameters.

Chapter 5 contains the conclusion and future work. In the end references are marked.

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**CHAPTER 2**

**LITERATURE SURVEY**

Automated guided vehicles (AGVs) are used for the internal and external transport of materials. Traditionally, AGVs were mostly used at manufacturing systems. Currently, AGVs were also used for repeating transportation tasks in other areas, such as warehouses, container terminals and external (underground) transportation systems. This paper discussed literature related to design and control issues of AGV systems at manufacturing, distribution, transshipment and transportation systems. It was concluded that most models can be applied for design problems at manufacturing centres. Some of these models and new models already proved to be successful in large AGV systems. In fact, new analytical and simulation models developed for large AGV systems to overcome large computation times, NPcompleteness, congestion, deadlocks and delays in the system and finite planning horizons (2006). The article summarizes the hardware and strategies of the Bus Priority System, describes the second and third generation software systems, evaluates the various strategies, and presents research in traffic simulation and vehicle detection (1979). The Iris/ARTES 10 programme of the European Space Agency (ESA) aims to develop a satellite system for air traffic services (ATS) and aeronautical operational control (AOC) complementing the existing and future aeronautical communications infrastructure. This paper presented the approach to and the results of the Iris communication capacity assessment conducted in the first phase of the programme. The approach discussed within this paper was based on a combination of the message exchanges defined in the ldquo communications operating concept and requirements for the future radio systemrdquo document (COCR) of EUROCONTROL and FAA and realistic air-traffic scenarios. The generated voice, data and air traffic was intended for two major purposes: first to identify capacity and protocol requirements for the design of the Iris communication system and secondly as input for the system performance evaluation (2008).

Due to the limitations of the previous research the comprehensive introduction of all

related methods is not possible, therefore only those of greater importance shall be

discussed to give the reader an overview on the currently applied procedures.

**2.1 Vehicle Detection and Counting**

Automatic detecting and counting vehicles in unsupervised video on highways is a very challenging problem in computer vision with important practical applications such as to monitor activities at traffic intersections for detecting congestions, and then predict the traffic /of which assists in regulating traffic. Manually reviewing the large amount of data they generate is often impractical [44].

H.S. Mohana [45-47] et.al., developed a new approach in detecting and counting vehicles in day environment by using real time traffic flux through differential techniques. Counting object pixel and background pixel in a frame leads to the traffic flux estimation. The basic idea used is variation in the traffic flux density due to presence of vehicle in the scene. In this paper a simple differential algorithm is designed and tested with vehicle detection and counting application. Traffic flux estimation will play vital role in implementing vehicle detection and counting scheme. Real time dynamic scen analysis has become very important aspect as the increase in video analysis. The technique developed is having simple statistical background. Dynamic selection of images from the sequence is implemented successfully in order to reduce the computation time. The designed technique are evaluated such a 20 different video sequences and weighed thoroughly with simple confidence measures. To make the design illumination invariant, a section of the background is taken as reference, which will not be affected by the traffic flow. Threshold is fixed and used to discriminate the low, medium and high traffic flux. There is a plot for traffic flux density; it’s basically 1% flux density versus number of frames. Basically vehicle detection is carried out by using this plot. Suppose if there is vehicle in the scene, then there is a flux change according to vehicle size. Obviously if there is big vehicle (or object), there is maximum or if there is small vehicle (or object), there is minimum amount of flux (white pixels).

For online learning, incremental algorithm of the SVM was previously proposed in [48], and the approach was adapted to other variants of kernel machines [49]. When a single data point is added and/or removed, these algorithms can efficiently update the trained model without re-training it from scratch. Although these algorithms were developed in different context, they can be considered as instances of parametric programming or path-following [18].

Laura Munoz *ET.AL.,* [50] proposed a system to estimate traffic density with the cell transmission model. This uses cell densities as state variables instead of cell occupancies, and also accepts non uniform cell lengths, and allows congested condition to be maintained at the downstream boundary of a modeled freeway section. Using cell densities instead of cell occupancies permits to include uneven cell lengths, which leads to greater flexibility in partitioning the highway.

Tomas Rodriguez *ET.AL.,* [51] proposed a system on real-time traffic monitoring; the system is self-adaptive and is able to operate autonomously for long periods of time, i.e. no hidden parameters to be adjusted. It performs in all weather condition and automatically selects the appropriate algorithm for day, night and transition periods. The system is robust against fast and slow illumination changes and is able to cope with long broken shadows, and shadows from parallel roadways. Ordinary camera movements (i.e. wind vibrations) hardly affect its performance because the system is tolerant against temporal tracking errors and strict constraints are used to identify the vehicles. They also provide an adequate treatment of occlusions and heavy vehicles, and obtained reasonable results in dense traffic. An exhaustive analysis of the operational environment; an effective calibration and image rectification method; an original segmentation approach, complemented with an innovative method for the automatic selection of the segmentation parameters; a detection and tracking approach specially designed for traffic environments;

a robust shadow removal method; specific provisions for heavy vehicle detection and the treatment of occlusions; and finally, semantic testing and benchmarking methodology. Here the system segments the video by extracting the moving objects of the scene and performing a preliminary classification (i.e. it will not attempt to identify shadows). Once the work image has been created the image is segmented by extracting the moving objects using an adaption of well-known back-ground suppression techniques. The system uses detection and tracing steps to make an abstraction of physical objects implicit in the segmentation mask for every incoming image and then track those objects in the sequence until all vehicles and shadows present in the scene is identified.

P.F Alcantarilla *ET.AL.,* [52] proposed a automatic road traffic control and monitoring system for day time sequence using a black and white camera. Important road traffic information such as mean speed, dimension and vehicles counting are obtained using computer vision methods. Firstly, moving objects are extracted from the scene by means of a frame-differencing algorithm and texture information based on grey scale intensity. However, shadows of moving objects belong also to the foreground. Shadows are removed from the foreground objects using top hat transformations and morphological operators. Finally, objects are tracked in a Kalman filtering process, and parameters such as position, dimensions, distance and speed of moving objects are measured. Then, according to these parameters moving objects are classified as vehicles (trucks or cars) or nuisance artifacts. For counting vehicles, moving objects must be extracted from images.

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M. Vargas *ET.AL.,*[54] proposed a system for video based traffic density estimation. Successful video-based systems for urban traffic monitoring must be adaptive to different conditions. They should include algorithms for detection of moving vehicles and short-term stood-still vehicles (especially important in urban environments). Therefore, foreground/background discrimination or feature tracking. An adaptation of sigma-delta background subtraction algorithm has been presented. This adaptation tries to keep the simplicity and computational efficiency of the original method, while providing more robustness to the achieved background model in typical urban traffic scenes. Starting from the basic sigma-delta algorithm, a confidence measurement has been included, taking into account not only the intensity variance on each pixel but also the estimation of the traffic flow over that pixel.

Some heuristics have been established for updating the confidence of each pixel and for making a decision about the convenience of updating the background model value at that pixel. Some experimental tests have been done on a typical urban traffic scene, where this algorithm is compared with the basic sigma-delta method and more elaborate existing versions. These tests demonstrate that a more stable background model is obtained without being polluted with slow moving vehicles of vehicles which are stopped for a time gap. Besides, the proposed algorithm avoids the complex spatiotemporal processing or the combinations of multiple frequency background models used in the previous advanced versions of the sigma-delta algorithm. This background-model estimation algorithm has been successfully implemented on an ARM-based embedded multimedia processor.

Yi-Hsien Chiang *ET.AL.,* [55] proposed a system which devises a freeway controller that is capable of stabilizing traffic flow when the traffic system is in the unstable (congested) phase, in which a shock wave is likely to occur in the presence of any in

homogeneity and where the system is on the verge of a jam condition. Two types of traffic controllers are developed through the use of either a speed command approach that can be implemented in an intelligent transportation system (ITS) or ramp metering that is a typical way of preventing a freeway from overloading. By means of the feedback linearization technique, the discretized macroscopic traffic flow model is reformulated, in which the desired change of volume in each section is treated as a virtual input. By exploring the casual relations among density, speed, and flow change, the corresponding speed commands can be determined. The traffic flow control problem is formulated as an

1. control design problem so that uncertainties that are associated with the macroscopic model can be taken into account. Simulations show that the devised controller can effectively stabilize the traffic flow in the unstable phase. The traffic state is in the unstable phase when the traffic density exceeds a critical threshold value. In this phase, any in homogeneity is likely to result in a buildup of a shock wave that propagates upstream and may lead the system to a congestion condition. One method to keep traffic from reaching the unstable condition is to balance traffic demand and supply. Alternatively, the phenomena can be avoided by properly coordinating all vehicles speed and distance headway. The latter serves to attenuate unexpected shock wave propagation and to regulate the state to the desired equilibrium condition according to the upstream and downstream situations. By the shock wave theory, the traffic response is affected by the downstream condition, as well as the upstream condition. In this paper, they focus on the design of the traffic flow control system described by a macroscopic discrete-time model.

Long Chen, C. L. ET.AL., [56], proposed a system for image segmentation using fuzzy c-means algorithm. Image segmentation is a central task in many research fields including computer vision and intelligent image and video analysis. Its essential goal is tosplit the pixels of an image into a set of regions such that the pixels in the same region are homogeneous according to some properties and the pixels in different regions are not similar. Clustering, particularly fuzzy C-means (FCM)-based clustering and its variants, have been widely used in the task of image segmentation due to their simplicity and fast convergence. By carefully selecting input features such as pixel color, intensity, texture, or a weighted combination of these data, the FCM algorithm can segment images to several regions in accordance with resulting clusters. Recently, the FCM and other clustering-based image-segmentation approaches are improved by including the local spatial information of pixels in classical clustering procedures. For example, an additional term about the difference between the local spatial information and the cluster centers is attached to the traditional objective functions of FCM algorithms. Because of the embedded local spatial information, the new FCM has demonstrated robustness over noises in images.

In addition to the incorporation of local spatial information, the kernelization of FCM has made an important performance improvement. The kernel FCM (KFCM) algorithm is an extension of FCM, which maps the original inputs into a much higher dimensional Hilbert space by some transform function. After this reproduction in the kernel Hilbert space, the data are more easily to be separated or clustered. Previous research on transformation to the kernel space has already been studied.

Recently, developments on kernel methods and their applications have emphasized the need to consider multiple kernels or composite kernels instead of a single fixed kernel. With multiple kernels, the kernel methods gain more flexibility on kernel selections and also reflect the fact that practical learning problems often involve data from multiple heterogeneous or homogeneous sources. Specifically, in image-segmentation problems, the inputs are the properties of image pixels, and they could be derived from different sources. For example, the intensity of a pixel is directly obtained from the image itself, but some complicated texture information is perhaps gained from some wavelet filtering of the image. Multiple-kernel methods provide us a great tool to fuse information from different sources. It is necessary to clarify that, in this paper, the author have used the term “multiple kernel” in a wider sense than the one used in machine learning community. In the machine learning community, “multiple-kernel learning” refers to the learning.

Mohamed Ben Salah *ET.AL.,* [57] proposed system for Multiregional Image Segmentation by Parametric Kernel Graph Cuts. Many studies have focused on variation formulations because they result in the most effective algorithms. Variation formulation seeks an image partition which minimizes an objective functional containing terms that embed descriptions of its regions and their boundaries. The literature abounds of both continuous and discrete formulations. Continuous formulations view images as continuous functions over a continuous domain. The most effective minimizes active curve functional via level sets. The minimization relies on gradient descent. As a result, the algorithms converge to a local minimum, can be affected by the initialization and are notoriously slow in spite of the various computational artifacts which can speed their execution. The long time of execution is the major impediment in many applications, particularly those which deal with large images and segmentations into a large number of regions. Discrete formulations view images as discrete functions over a positional array. Combinatorial optimization methods which use graph cut algorithms have been the most efficient. They have been of intense interest recently as several studies have demonstrated that graph cut optimization can be useful in image analysis. Very fast methods have been implemented for image segmentation motion and stereo segmentation tracking and restoration.

Thanes Wassantachat *ET.AL.,* [58] proposed a system to find the traffic density Estimation with On-line SVM Classifier according to the system. Traffic congestion has significant impacts on both the economy and environment. Reducing traffic congestion can improve traffic flow, reduce travel times and the environmental impact. Automatic determination of traffic congestion status is thus introduced to reduce the cost of human resource and the traffic congestion delay. This automatic determination can also establish an effective traffic solution to the traffic light controllers.

In recent research, the Hidden Markov model was used in classifying the traffic congestion state automatically. Even though the performance was considerably good, some restrictions still remain. One key issue was that the HMM approach required segmented video shots as inputs to both its training and testing processes, with frames in each segmented shot representing an identical traffic density state. This possibly makes it difficult to perform an accurate and practical shot segmentation in a video sequence. Furthermore, this introduced a certain delay to the real-time process, making a HMM approach impractical for a real-time implementation.

Chung-Cheng Chiu *ET.AL.,* [32] proposed the probability-based background extraction algorithm to segment objects from surveillance videos. With the proposed algorithm, the initial background can be extracted accurately and quickly by calculating the color probabilities of each pixel to decide the background pixel color. After the initial background extraction, the intrusive objects can be segmented correctly and immediately. Meanwhile, the color background images can be updated in real time to overcome any variation in illumination conditions.

Ren *ET.AL.,* [60] proposed a background extraction method that involved calculating the mean of the background Gaussian distribution in the background map. Thongkamwitoon *ET.* *AL.*. [61] proposed statistical background subtraction methods that made the background extraction more robust to non-stationary backgrounds, illumination changes, and other artifacts, while Li *ET.AL.,* [62] proposed a Bayesian framework that incorporated spectral, spatial, and temporal features to characterize the background appearance. These methods adapt to both gradual and sudden background changes, but the long computation time, the sensitivity to the environment, and inefficient background updating are still issues that must be resolved.

Moving object detection in image sequences is fundamental in application areas such as automated visual surveillance, human-computer interaction, content-based video compression, and automatic traffic monitoring. Especially, vehicle detection with stationary camera is an important problem in traffic management, which is essential for the measurement of traffic parameters such as vehicle count, speed, and flow. In recent years, background modeling is a commonly used technique to identify moving objects with fixed camera. However, accurate detection could be difficult due to the potential variability such as shadows cast by moving objects, non stationary background processes (e.g. illumination variations), and camouflage (i.e. similarity between appearances of moving objects and the background).

Cucchiara *ET.AL.,*[64] proposed to extract moving vehicles during daytime by means of motion extraction using frame-differencing algorithms and morphological operators, while at night time vehicles are identified by their headlights. For counting vehicles, moving objects must be extracted from images. The most common method is known as background subtraction, which is normally a computationally efficient algorithm. Background must be updated in a dynamic way since background in road traffic images is variable. Subtracting this background image from the original image, moving objects can be extracted. However, this method generates erroneous ghosts during the background evolution period, which affects clustering and tracking processes

1. Optical flow algorithms can be used too, but the computational burden is sometimes overwhelming for real time applications. One challenging problem in these applications is shadows detection, since shadows move along with the moving objects in the image. Shadows are detected as foreground pixels, since the difference with background is significantly. Shadows can cause object merging and object losses which imply that shadows identification plays a key role in road traffic applications.

Prati *ET.AL.,* [66] studied different algorithms for shadows detection. Normally shadows detection algorithms use colour information or some probabilistic shadows model. After moving objects segmentation and shadows removal, vehicles are tracked using a Kalman filter in a tracking process [67][3].

Yeh *ET.AL.,* [70] have applied fuzzy multi-criteria analysis to performance evaluation for urban public transport system. The fuzzy multi-criteria analysis provides crisp ranking outcomes for the evaluation problem. An empirical study of 10 bus companies in Taipei’s public transport system has been carried out to exemplify the approach.

Wen *ET.AL.,* [71] have developed probabilistic neural network to solve incident detection problem. Efficient incident management is an important issue in freeway traffic management system. A wide range of incidents that include different patterns under a variety of flow conditions and traffic periods were generated to train and evaluate the performance and the transferability of the proposed probabilistic neural network-based algorithm. Test results with simulation data showed that the probabilistic neural network has the potential to achieve good incident detection performance.

For real time traffic incident detection, Xu *ET.AL.,* [72] have developed a real time on-line adaptive algorithm. The developed method consists of two stages. First a real time adaptive on-line procedure is used to extract the significant components of traffic states,namely, average velocity and density of moving vehicles. Second, a neural network called fuzzy CMAC (Cerebellar Arithmetic Computer) has been applied to identify traffic incidents. CMAC consists of both fuzzy logic unit and neural network unit. The system will help drivers to select an optimum route, it will be able to provide information for efficient dispatching of emergency services and moreover, it will provide accurate knowledge of existing traffic conditions.

Also Lee *ET.AL.,* [73] have developed the fuzzy-logic-based incident detection algorithm that feeds an incident report (i.e., the time, location and severity of the incident) to the system’s optimization manager, which uses that information to determine the appropriate signal control strategy. The developed algorithm was tested under laboratory setting and its overall performance was encouraging in terms of detection rate, false alarm rate and mean time to detect. Fuzzy logic has been successfully used to detect traffic anomalies.

Weil *ET.AL.,* [74] have developed a novel time-indexed traffic anomaly detection algorithm. Depending on type of the day and time of the day the fuzzy sets “normal “ and “abnormal” are determined for each traffic descriptor by using unsupervised learning algorithm. Fusion of the multiple traffic descriptors, on per lane basis, in order to determine membership “normal” or “abnormal” lane status, is implemented with fuzzy composition techniques. Finally, each lane status is fused to determine an over all road segment status.

Intelligent techniques as a part of decision-making can be very effective. Fay [82] has developed a dispatching support system for use in railway operation control systems. System contains expert knowledge in fuzzy rules of the “IF-THEN” type. Actually system is a fuzzy Petri net notion that combines the graphical power of Petri nets and the capability of fuzzy sets to model rule-based expert knowledge in a decision support system. The proposed assistant system for dispatching support can be integrated into an operating center. Improvements can be seen in traffic performance, reliability and customer satisfaction.

Correspondingly, Hegyi *ET.AL.,* [83] have presented a fuzzy decision support system (FDSS) for assist the operators of the traffic control system. Fuzzy decision support system is part of a larger traffic support system and it can be used to provide a limited list of appropriate combinations of traffic control measures for a given traffic situation. The main role of the fuzzy decision support system is to suggest whether a particular local traffic controller or control measure should be activated or not. The kernel of the system is a fuzzy case-base that is constructed using simulated scenarios. The FDSS uses a case-base and a fuzzy interpolation to generate a ranked listing of combinations of control measures and their estimated performance. In the future system will be complemented with an adaptive learning feature and with a set of fuzzy rules that incorporate heuristic knowledge of experienced traffic operators.

Aid Decision-making fuzzy system is very useful because a lot of knowledge in the real situation concerning decision-making is uncertain. That was kept in mind when Aziz *ET.AL.,* [84] developed a new strategy for the aid decision-making based on the fuzzy inferences in the traffic regulation of an urban bus network. The system helps operators of the urban bus network to solve the problem of connections between buses.

Sadek *ET.AL.,* [85] have examined the potential for using case-based reasoning (CBR), an emerging artificial intelligence paradigm, to overcome this task. In their study a prototype CBR routing system for interstate network in Hampton Roads, Virginia, was developed. Cases for building the system’s case-base was generated using heuristic dynamic traffic assignment (DTA) model designed for region. The results showed that the prototype system is capable of running in real-time, and of producing high quality solutions using case-bases of reasonable size.

Montero *ET.AL.,* [86] have developed a combined methodology for transportation planning assessment. The methodology is a combination of a well-known traffic assignment tool, the EMME/2 model, with a microscopic traffic simulator, Advanced Interactive Microscopic Simulator For Urban and Non-Urban Networks (AIMSUN2) with emphasis on the description of the specific interfaces that make consistent the combination of both tools in Generic Environment for Traffic Analysis and Modeling (GETRAM) environment. GETRAM environment has open and flexible computer architecture suitable for modeling complex transportation systems. Evolutionary algorithms seemed to achieve some success as a planning tool of different kind of networks.

Bielli *ET.AL.,* [87] have developed a GA-based heuristic method for bus network optimization. The different networks of buses create the initial population for genetic operators. The final result after genetic manipulation is set of bus network each equipped with fitness function that describes the performance of that network. This heuristic was implemented for bus network planning in northern Italy, Parma. Results were found promising. Future developments are related the usage of neural networks for fitness function evaluation or usage of n-best solutions container.

Correspondingly Lin *ET.AL.,* [95] have introduced a versatile traffic flow model capable of making optimal traffic predictions. Furthermore this model can be used to evaluate various traffic-light timing plans. It also provides a framework for implementing adaptive traffic signal controllers based on fuzzy logic technology. The paper presented the procedure for the design of an adaptive fuzzy controller.

The study of Niittymäki *ET.AL.,* [96] discusses the fuzzy traffic signal control in general and presents some results of fuzzy signal control. Traffic signal control is a control problem with number of complex and sometimes conflicting variables and objects. The final hypothesis is that fuzzy signal control can achieve better performance compared to traditional vehicle actuated signal control.

Beauchamp-Baez *ET.AL.,* [97] have developed a new fuzzy logic approach for traffic control. The developed system is a fuzzy logic based phase sequencer (PS) for signalized intersection control. The phase sequencer operates in conjunction to the fuzzy logic controller for traffic systems (FLC-TS). PS decides when to finish a phase and also determines what should be the next phase based on the traffic demand and the time elapsed since the last time maneuver was attended. Results did not show a significant difference between the FLC-TS and the PS + FLC-TS. The adaptive tuning of the membership functions and rule base of the PS might result better performance.

Krause *ET.AL.,* [101] have used fuzzy logic for two different kind of traffic management problem. First fuzzy logic is used to take into account the uncertainties of traffic data, and to detect traffic congestion in isolated road sections. Second, a fuzzy model based traffic control approach has been introduced. The approach was also implemented in an existing traffic control system in Germany. The results were compared with the previous approach based on conventional control technology.

Gasser Auda *ET.AL.,* [102] developed a mobile, bus-mounted machine vision system for transit and traffic monitoring in urban corridors, as required by Intelligent Transportation Systems. In contrast to earlier machine vision technologies used for traffic management, which mainly rely on simple algorithms to detect certain traffic characteristics, the new proposed approach makes use of a recent trend in computer vision research; namely the active vision paradigm. Active vision systems have mechanisms that can actively control camera parameters such as orientation, focus, zoom, and vengeance in response to the requirements of the task and external stimuli. Mounting active vision systems on buses will have the advantage of providing real-time feedback of the current traffic conditions while possessing the intelligence and visual skills which allow them to interact with a rapidly changing dynamic environment such as moving traffic.

Shadow detection is critical for robust and reliable vision-based systems for traffic vision analysis. Shadow points are often misclassified as object points causing errors in localization, segmentation, tracking and classification of moving vehicles.

Hong Liu *ET.AL.,* [103] proposed a novel shadow elimination method SEBG for resolving shadow occlusion problems of vehicle analysis. Different from some traditional method which only consider intensity properties, this method introduces gradient feature to eliminate shadows. In this approach, moving foregrounds are first segmented from background by using a background subtraction technique. For all moving pixels, the approach SEBG using gradient feature to detect shadow pixels is presented in detail. This method is based on the observation that shadow regions present same textural characteristics in each frame of the video as in the corresponding adaptive background model. Gradient feature is robust to illumination changes. The method also needs no predefined parameters, which can well adapt to other video scene. Results validate the algorithm’s good performance on traffic video.

Khalid A. S. Al-Khateeb *ET.AL.,* [104] have circumvented or avoided the problems that usually arise with systems such as those, which use image processing and beam interruption techniques. RFID technology with appropriate algorithm and data base were applied to a multi vehicle, multi lane and multi road junction area to provide an efficient time management scheme. A dynamic time schedule was worked out for the passage of each column. The simulation has shown that, the dynamic sequence algorithm has the ability to intelligently adjust itself even with the presence of some extreme cases. The real time operation of the system emulated the judgment of a traffic policeman on duty, by considering the number of vehicles in each column and the routing proprieties. RFID together with Internet and GSM technologies are anticipated to create a revolution in traffic management and control systems. The data base contains online statistical information, which can be used by operators and planners to develop better models in the future.

Saab *ET.AL.,* [109] have developed a forecasting system for predicting the number of passengers boarding for the next N scheduled flights on a particular route. The kernel of the system is Kalman filter. Inputs for the system are the booking levels made for N departure days ahead of the data date for that flight leg. The strong correlation is assumed between the numbers of passengers that boarded the plane on that flight and the number of bookings made for that flight just before departure. The system can be used as decision support system to find the optimal limits on the number of bookings that may be accepted in a particular fare class on the future flight leg.

Sen *ET.AL.,* [110] have explored the consequences of using link travel time estimates with high variance to compute the minimum travel time route between an origin and destination pair. They have noticed that variances of the travel times remain high even when sample sizes become large. So the increase in sample size of travel times does not guarantee better quality of information given by Intelligent Transportation Systems (ITS). The average route travel times incurred by the guided drivers under numerous ‘guidance strategies’ were tested out. Simulation results showed that static travel time estimates offered better quality of guidance than dynamic travel time estimates. That was, because the variance of dynamic travel time estimates remain high.

The prediction and modeling of traffic flows involves great challenges for sciences. Related to before mentioned problem Wahle *ET.AL.,* [111] have studied the quality of the reproduced traffic states with regard to vehicular densities and link travel times. They have developed a simulation tool for urban traffic, which can also be easily extended to model traffic flow on highways. Both spatial and temporal scales of traffic states can be extrapolate by simulation. The simulation tool can also be used for designing and evaluating dynamic traffic management system taking into account different criteria. Conventional statistical models usually suffer their strict mathematical assumptions when describing complex traffic conditions.

Most of the traffic control systems rely on historical and current traffic data as a basis for traffic management actions. These systems have no information of future events and therefore their performance is constrained. The potential to alleviate traffic congestion and enhance the performance of the road network can be added by providing predictive information for the traffic control centers.

Dia [114] have developed the object-oriented neural network model for predicting short-term traffic conditions on a section of the Pacific Highway between Brisbane and the Gold coast in Queensland, Australia. The object-oriented neural network was developed to predict speed at a detector station up to 15 minutes at the future and shows how similar models were developed for freeway travel time estimation. The results showed high degree of accuracy (90 – 94 %) when predicting speed data up to 5 minutes into the future. The models developed for travel time estimation were also successful in predicting travel times up to 15 minutes into the future with a similar degree of accuracy (93-95 %). The longer prediction horizon with the same accuracy could be achieved by using additional traffic data inputs (e.g., flow and occupancy) and measurements from previous time intervals.

Chang [115] have studied an approach of combining both advanced neural networks and conventional error correction techniques to improve freeway traffic operational behavior analysis based directly on real world traffic measures. The error correction algorithm as a part of the system can be used to smooth out the errors that may be caused by sharp neural net prediction. The developed system was found to be promising in traffic prediction and proactive control.

**CHAPTER 3**

**PRESENT WORK**

**CHAPTER 4**

**EXPERIMENTAL RESULTS**

This chapter provides the information of simulation platform and experimental results of study. The results of different techniques are compared on the basis of output parameters.

**4.1 Simulation Platform**

Linux

**4.2 Introduction to Linux Operating system**

As biological data sets have grown larger and biological problems have become more complex, the requirements for computing power have also grown. Computers that can provide this power generally use the Linux operating system

* Linux is a command line interface, used by most large, powerful computers.
* It is very popular, and very easy to find information and get help.
* Linux is very stable - computers running Linux almost never crash.
* Linux is very efficient which can smoothly manage extremely huge amounts of data.
* Most new bioinformatics software is created for Linux - it’s easy for the programmers

**4.3 Architecture of the Linux Operating System**

**Kernel**

The Linux kernel includes device driver support for a large number of PC hardware devices (graphics cards, network cards, hard disks etc.), advanced processor and memory management features, and support for many different types of filesystems (including DOS floppies and the ISO9660 standard for CDROMs). The kernel (in raw binary form that is loaded directly into memory at system startup time) is typically found in the file /boot/vmlinuz, while the source files can usually be found in /usr/src/linux.The latest version of the Linux kernel sources can be downloaded from [http://www.kernel.org](http://www.kernel.org/).

**Shells and GUIs**

Linux supports two forms of command input: through textual command line shells similar to those found on most Linux systems (e.g. sh - the Bourne shell, bash - the Bourne again shell and csh - the C shell) and through graphical interfaces (GUIs) such as the KDE and GNOME window managers. If you are connecting remotely to a server your access will typically be through a command line shell.

**System Utilities**

Virtually every system utility that you would expect to find on standard implementations of UNIX has been ported to Linux. This includes commands such as ls, cp, grep, awk, sed, bc, wc, more, and so on. These system utilities are designed to be powerful tools that do a single task extremely well (e.g. grep finds text inside files while wc counts the number of words, lines and bytes inside a file). Users can often solve problems by interconnecting these tools instead of writing a large monolithic application program. Like other UNIX flavours, Linux's system utilities also include server programs called daemons which provide remote network and administration services (e.g.telnetd and sshd provide remote login facilities, lpd provides printing services, httpd serves web pages, crond runs regular system administration tasks automatically). A daemon (probably derived from the Latin word which refers to a beneficient spirit who watches over someone, or perhaps short for "Disk And Execution MONitor") is usually spawned automatically at system startup and spends most of its time lying dormant waiting for some event to occur.

**Application programs**

Linux distributions typically come with several useful application programs as standard. Examples include the emacs editor, xv (an image viewer), gcc (a C compiler),g++ (a C++ compiler), xfig (a drawing package), latex (a powerful typesetting language) and soffice (StarOffice, which is an MS-Office style clone that can read and write Word, Excel and PowerPoint files).

**CHAPTER 5**

**CONCLUSION AND FUTURE SCOPE**