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Development of Traffic Flow Prediction System to Reduce Travel Delay

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Abstract - *Vehicular Traffic is a matter of growing concern in cities. Growing population, urbanization and higher standards of living has le d to more private vehicles on road and lesser use of public transport. This in turn has led to an increase in road traffic. Pollution, accidents etc. care a direct effect of increase in road traffic. Intelligent Transportation Systems (ITS) aims at providing prompt, safe and comfortable traffic service for drivers. In this era of artificial intelligence, an intelligent traffic signal is a must. This can be achieved if signals can predict the traffic flows in city. Traffic flow can be dependent on a number of fact or such as seasons, day of week, time of day, occasions, accidents, direction of flow, type of road, region, weather conditions etc. In this thesis an attempt has been made to use historical data as one of the important parameters to predict the traffic flow at an intersection. The historical data and live traffic data at an intersection to predict the traffic flow at a particular junction which then, is fed to the particle swarm optimizer to provide optimum green signaling in all directions of the intersection*

Key Words: Optimized signal cycle time, Signal Timing Optimization, Traffic signal coordination, Traffic Flow Prediction, Traffic Simulation

1. INTRODUCTION

Traffic congestion is a major issue. It is a growing matter of concern as it leads to a number of economic and environmental problems. In many countries like Australia, Bangladesh, Brazil, China traffic during peak hours is usually very congested. Australians rely mainly on radio and television to obtain current traffic information. GPS, webcams, and online resources are increasingly being used to monitor and relay traffic conditions to motorists. Traffic jams have become intolerable in Dhaka. People lose valuable working hours as well as the automobiles' costly fuel every day. São Paulo in Brazil has the world's worst daily traffic jams. The worst affected are the developing countries wherein the sudden rise in launching of low budget vehicles in addition to newer banking reforms for providing easy installments for purchase of vehicles has increased the number of car buyers multifold which has outpaced the highway construction. India too has seen a rise in vehicles on road. The traffic in cities like Delhi, Hyderabad, Mumbai, Bangalore & Pune are getting worst day by day.

Urban traffic problem, an important factor that affects the development and restricts the economic construction of cities. It's a complex system in a random way so it was necessary to optimize traffic control signals to cope with so much urban traffic problems. Inappropriate signal timing. Plans can cause not only discomfort (extra delay) to drivers but also increased emissions and fuel consumption. Thus, it is important to investigate the practice of signal optimization methodology to ensure that newly developed timing plans will improve the system performance. Cross intersection is an important part of the urban road system [1]. Signal timing optimization is most important method that improves the intersection level. Intersection is an important part of the urban road system. It is very easy to cause the low efficiency in vehicle operating that vehicle have diverging, merging or intersecting repeatedly on the grade crossing. This case will cause the decline of the ability in traffic capacity, the increasing of vehicle delay, and thus the noise pollution and exhaust emission will increase. On the other hand, once the intersection is blocked, it is not only the roads near the intersection but also the roads which are far away will be affected [2].

The Advanced Traffic Management System (ATMS) is a primary subfield within the ITS that integrates technology for improving the flow of traffic and safety. Some of ATMS functional area includes Real Time Traffic monitoring, Incident monitoring, Traffic signal monitoring and control, Arterial Management etc. Lack of awareness & implementation of ITS in developing countries have worsened the traffic scenario. Some of the main causes of Traffic congestions are

1) Lesser use of public transport
2) Higher standards of living
3) Increase in private vehicles on road.
4) Road conditions
5) Weather conditions etc.

1.1 Basic Terminologies used in Traffic Modeling

1) Traffic Flow Modeling

Traffic Flow can be classified into three categories: Macroscopic, Microscopic and Mesoscopic Models Macroscopic models are aggregates of the behavior seen in microscopic models.

A) Macroscopic Model

Macroscopic modeling looks at traffic flow from a global perspective. It simulates traffic flow taking into consideration cumulative traffic stream characteristics and their relationships to each other. The simulation in a macroscopic model takes place on a section by section basis rather than by tracking individual vehicles.

B) Microscopic Model

A microscopic model of traffic flow attempts to analyze the flow of traffic by modeling driver-driver and driver-road interactions within a traffic stream which respectively analyzes the interactions between a driver and another driver on road and of a single driver on the different features of a road.

C) Mesoscopic Models

Mesoscopic models combine the properties of both microscopic and macroscopic models. Mesoscopic models are somewhat less consistent than microscopic tools, but are superior to some traffic analysis techniques. These models simulate the individual vehicles, but describe their activities and interactions based on aggregate (macroscopic) relationships.

2) Intersection Control

Intersection is an area shared by two or more roads. This area is designated for the vehicles to turn to different directions to reach their desired destinations. Its main function is to guide vehicles to their respective directions. Conflicts at an intersection are different for different types of intersection.

The essence of the intersection control is to resolve these conflicts at the intersection for the safe and efficient movement of both vehicular traffic and pedestrians. Traffic signals are an efficient way of managing traffic flow at an intersection. Control using traffic signal is based on time sharing approach. At a given time, with the help of appropriate signals, certain traffic movements are restricted where as certain other movements are permitted to pass through the intersection. Two or more phases may be provided depending upon the traffic conditions of the intersection. When the vehicles traversing the intersection are very large, then the control is done with the help of signals. The signals can operate in several modes. Most common are fixed time signals and vehicle actuated signals.

A) Fixed Time Signals (Pre timed Signals)

In fixed time signals, the cycle time, phases and interval of each signal is fixed. Each cycle of the signal will be exactly like another. But they cannot cater to the needs of the fluctuating traffic.

Advantages:

1) Fixed time signals can be used to provide efficient coordination with adjacent fixed time signals, since both the start and end of green are predictable.
2) It does not require detectors, thus making its operation immune to problems associated with detector failure.
3) It requires a minimum amount of training to set up and maintain.

Disadvantages:

1) Fixed time control cannot compensate for unplanned fluctuations in traffic flows.
2) It tends to be inefficient at isolated intersections were traffic arrivals are random.

B) Actuated Signals

Vehicle actuated signals can respond to dynamic traffic situations. Vehicle detectors will be placed on the streets approaching the intersection and the detector will sense the presence of the vehicle and pass the information to a controller. The controller then sets the cycle time and adjusts the phase lengths according to the prevailing traffic conditions.

Advantages:

1) Allows for coordination
2) It reduces delay relative to pre-timed control by being highly responsive to traffic demand and to changes in traffic pattern.
3) Detection information allows the cycle time to be efficiently allocated on a cycle-bicycle basis.
4) It allows phases to be skipped if there is no call for service, thereby allowing the controller to reallocate the unused time to a subsequent phase.

Disadvantages:

1) Cost (initial and maintenance) is higher than that of other control types due to the amount of detection required.
2) Efficiency depends on the quality of data provided by the sensors/detectors.

C) Adaptive Signals

Adaptive traffic signal control is a concept where vehicular traffic in a network is detected at an upstream and/or downstream point and an algorithm is used to predict when and where the traffic will be and to make signal adjustments at the downstream intersections based on those predictions. The signal controller utilizes these algorithms to compute optimal signal timings based on detected traffic volume and simultaneously implement the timings in real-time. This real-time optimization allows a signal network to react to volume variations, which results in reduced vehicle delay, shorter queues, and decreased travel times.

Advantages:

1) Better response to live and changing traffic due to proactive control.
2) Direct ability to minimize average travel times.
3) Reduce intersection stopped delay and hence improve efficiency of traffic flow.

Disadvantages:
1) Cost and maintenance is higher than fixed time control.
2) Efficient control of intersection can be achieved only by understanding the nature and flow of traffic.

2. METHODOLOGY

The nature of traffic flow is dependent on a number of characteristics which includes density, speed and traffic volume and natural factors such as time of day, week day, week end, weather conditions and the area/location under consideration. The inherent stochastic nature of traffic flow makes it difficult to predict the traffic flow mathematically. However a traffic policeman at an intersection can predict the flow easily. This is because of his knowledge about the intersection and a variety of other natural factors that affect the flow of traffic. Historical data plays a significant role in determining the traffic flow. Traffic flow though random in nature does follow a pattern. The historical data helps to understand the traffic flow within the city which is a variable based on the time of day, weekday/weekend, holiday/working day/festivals, area, weather condition etc. This data if captured can be used to effectively determine the traffic flow.

2.1 The System Design

A knowledge base containing historical data of an intersection is built for prediction of traffic flow. The knowledge base contains the hourly volumes of flow at a particular intersection, along with additional parameters like weekday/weekend, special events etc. Due to its random nature historical data alone cannot be used for predicting the flow. Live traffic data from detectors at upstream nodes are used in addition to the historical data. Data from detectors may not always be accurate, especially when the traffic flow is of mixed type. A combination of historical data and live data from detectors would help in better prediction of the traffic flow.

A controller is used for traffic flow prediction. To set the signal timing for a particular node, first the traffic flow at the intersection has to be estimated. This estimation is done based on the historical data collected over a period of time and live traffic data from upstream detectors. These values are input to the fuzzy controller. The output of the controller will be the predicted traffic flow for the intersection.

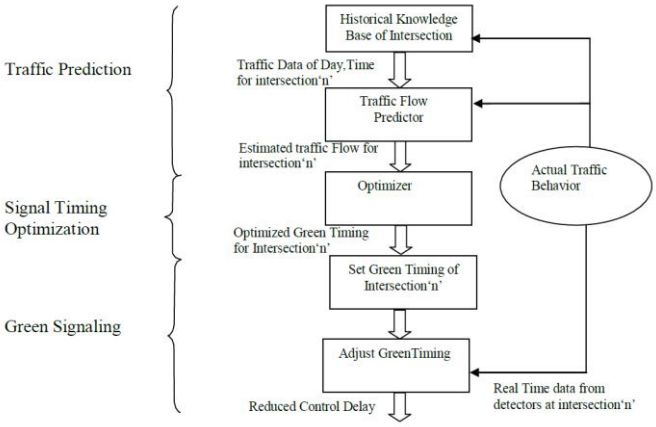

Figure1- The Proposed System

Figure 2 shows the Traffic Prediction module. The live and historical traffic flow values are using the membership functions Less, Medium, High. For example if the historical value for Monday peak hour is High(H) (40-60 vehicles) and the live data collected from detectors placed at upstream nodes also record High then the predicted traffic data is also High. The green timing will then be optimized as per this predicted flow.

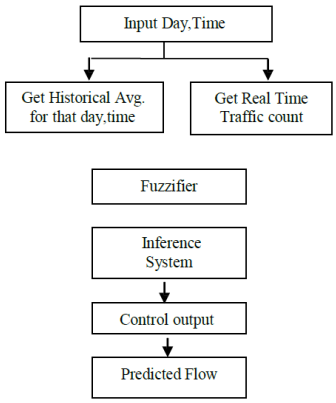

Figure2- The Traffic Flow Prediction Module

Figure 3 shows the signal optimization module. The output of Traffic prediction module is the predicted traffic flow at an intersection. The predicted traffic flow is then provided as input to the particle swarm optimizer which outputs the optimized green timing for the intersection.

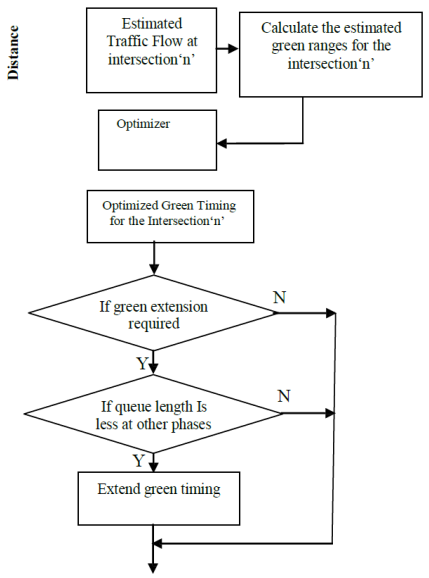

Figure 3- Flow chart of Traffic Signal Timing Optimization module

3. CONCLUSIONS

Road congestions are seen as a global problem leading to many economic and environmental issues. Research on transportation has been undertaken by western countries. There are a number of Adaptive systems being adopted in these countries; however the scenario is not the same in Asian countries. In countries where the signal timings are pre-timed and there are issues of pollution, accidents, breaking of traffic rules, loss of time etc. the proposed method on Signal Timing Optimization of an intersection will address the issues. This can be achieved by correctly predicting the traffic flow arriving at an intersection. A fuzzy traffic controller was developed to predict the traffic flow based on the historical data in the knowledge base and live data obtained from upstream node detectors. The predicted traffic flow is then input to the particle swarm optimizer which predicts the green timing for the intersection. The predicted green timings are set at the intersection. Green signaling is then used to adjust the signal timing based on the traffic flow at other links. This is required because of the stochastic nature of traffic flow. The particle swarm optimizer uses the control delay as its objective function. It provides the green timing for which the intersection delay is the minimum. Results show that the proposed method performs better than the actuated and pre-timed signal controls.

REFERENCES

[1] Zhao Xin-hua., 2010. Optimal design of urban road intersection,. Railway Construction.

[2] Lu Baichuan et.al, "Traffic Flow Prediction based on wavelet analysis, genetic algorithm and artificial neural networks", International Conference on Information Engineering and Computer Science, ICIECS, 2009