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DESIGN OF TRAFFIC FLOW PREDICTION SYSTEM AND OPTIMIZATION OF SIGNAL TIMING BASED ON TRAFFIC SOFTWARE

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Abstract: The main objectives of signal timing at an intersection are to reduce the average delay of all vehicles and the probability of crashes. These problems can now only be solved by providing an efficient traffic control at intersections and that can be achieved by provision of volume based traffic signal system at intersections for continuous and efficient movement of vehicles through the intersections. In Amravati City the present traffic signals are based on the static feed of time without considering the actual available traffic. This leads to a situation where vehicles wait unnecessarily in one of the lanes while the traffic flow is not up to the considerable amount in the other lane. This paper provides the feasibility of retiming of existing traffic signals for current traffic flow data with optimization models.

Keywords: Retiming, PCU, Traffic field studies, Optimization

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INTRODUCTION

Traffic Congestion is a crucial problem in urban areas characterized by high population densities and continuous increase in number of vehicles for the same road facilities. The utilization of the cities road network exceeds its planned capacity, leading to a crushing inflation in the numbers of vehicles waiting to be served in line. Massive queues build up, waiting times increase drastically, and the overall productivity is affected. Increase in delay results in the degradation of the environment.

There exist three major types of traffic control modes; Chaotic, Pre-timed and adaptive traffic systems. In the chaotic system, the signal timings are fixed through all periods of the day. Chaotic system, currently applied in Amravati road network, is the most primitive type of control systems, because it does not consider the balance in the demand-supply allocation problem. Pre-timed systems are more advanced, where adequate time-plan is developed, in order to assign different signal light timings to different periods of the day based on the demand pattern. Each period of the day characterized by an average demand, is given different signalization settings. The adaptive traffic control system is state-dependent. It can instantly adjust the timing intervals rendered to a specified control point according to the fluctuating demand crossing that point. Selection of the appropriate control system that best optimizes the vehicular flow in the network is major problem in traffic engineering.

In Amravati city Rajkamal square is situated in the heart of city and has approaches for Railway Station, Bus Stop, Main Market and shops. Due to construction of fly over geometry of the road and traffic flow pattern changed considerably. This causes congestion at one lane while the traffic flow is not up to the considerable amount in the other lane and results in unnecessary delay. In this paper the stepwise procedure to retiming the signal is discussed. This process involves four distinct steps: 1. Organizing existing information, 2. Collecting new traffic flow data in the field, 3. Coding and running signal timing optimization program(s), 4. Validating and selecting optimum signal timings settings..

II. LITERATURE REVIEW

Sr. No.	References	Evaluation Approach
1.	Ahmed A. Ezzat, Hala A. Farouk	This presents the study to minimize the traffic congestion through the optimization using simulation of traffic light signal timings in a road network exhibiting severe traffic density.

2.	Ishant Sharma, Dr. Pardeep K. Gupta	The paper deals with the feasibility of provision of inductive loop detection based traffic signals in place of existing pretimed traffic signals by comparing their performance, suitability and economics.
3.	Kishor Bambode, Vishal Gajghate	This presents an intelligent transportation system for traffic flow prediction and control it through traffic signal optimization and coordination.
4.	Vidhya & Banu [9]	Designed a project to develop a density based dynamic traffic signal system.

III. METHODOLOGY

Step1: Recording Geometric Characteristics [4] The physical configuration of the intersection is obtained in terms of number of lanes, lane width, grade, movement by lane, parking locations, lengths of storage bays and so forth and is recorded on the appropriate form.

Step 2: Recording Traffic Conditions: This involves the recording of bicycles, pedestrian and vehicular traffic.

Step 3: To determine optimum cycle length for present traffic volume by Webster Method.

Step 4: Stochastic way of optimizing the signals considers delay as an objective function. Optimization of signals involves decreasing the unwanted delays at an intersection. So it is necessary to calculate the field delays manually using the methods suggested by highway capacity manual (HCM). The road network is formulated and simulated by specifying the input as field values. Field delay values were compared with the simulated delay values. Software results are considered as valid for the delays obtained in the field and simulation do not differ more than 15 %. Sensitive analysis is to be done after validating the software i.e. by verifying which input parameter has the most influence on the output delay values. Optimal cycle time for a signalized intersection will be selected by considering less amount of delay after running 'n' number of simulations. A brief methodology is proposed for the optimization of signal timings is presented in flow chart figure 1. The results obtained by SYNCHRO optimized timing plans by means of microscopic simulation program CORSIM are to be compared with optimal cycle length obtained by Webster Method.

The traffic volume data of the Rajkamal Square, Rajapeth Square, Irwin Square and Camp Square Intersection are collected and peak hour flow by converting the vehicles in Passenger Car Unit (PCU)by making use of PCU factors [5] given in table 1. The average peak hour traffic from 11.00 am to 12.00 pm and 12.00pm to 1.00 pm is 2068 PCU/hr for lane 4 (fig.2) whereas average peack hour traffic from 5.00pm to 6:00pm, 6.00pm to 7:00pm and 7.00pm to 8pm is 1450 PCU/hr for the same lane. Similarly for lane 2 such difference exists in morning and afternoon peak hours.

IV. PRETIMED TRAFIC SIGNALS

A four phase signal system is to be designed for the intersection by making use of Webster's method for signal design and IRC method

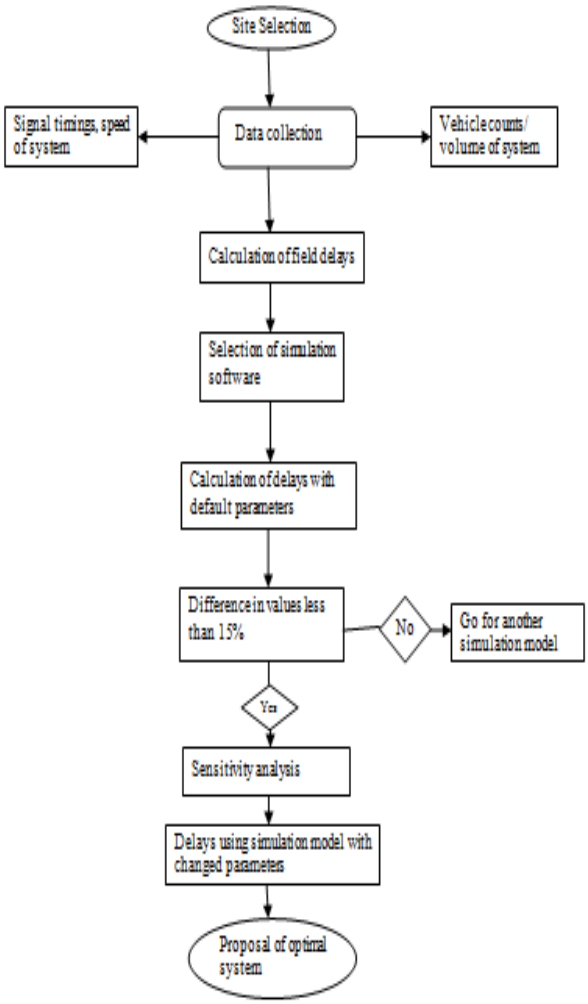

Figure 1. Methodology

for the minimum time for pedestrian crossing. [6] In the signal design only right turning movements and straight traffic is included. Pretimed signals are designed by making use of the webster's method of signal design and IRC method. Webster's method gives the optimum cycle length

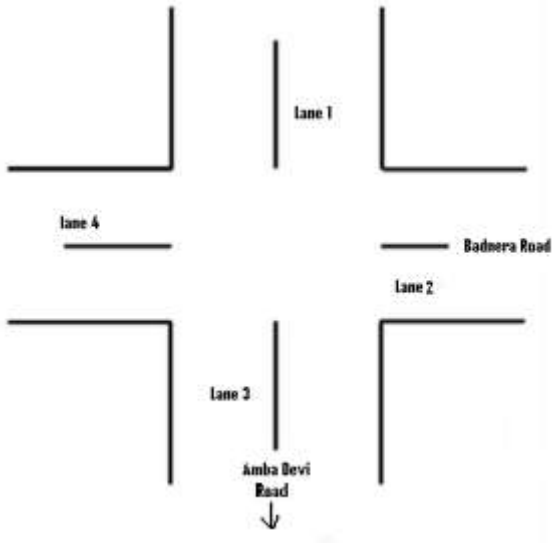

Fig. 2 layout of Rajkamal Square

Whereas the IRC method gives the minimum green time on the basis of time taken by pedestrians to cross the approach lanes.[2]

$$Co = \frac{1.5L+5}{1-y}$$

Where, Co is optimum cycle time,

L is lost time and

y = sum of maximum present flow to saturation flow ratios of all the phases.

Table 1 PCU Factors for volume counts

Vehicle	PCU Factor
Car	1
2 Wheeler	0.5
3 Wheeler	1
Bus/Truck	3
Cycle	0.5

Rikshaw	1.5
Horse Drawn	4.5

V. FUTURE TRAFFIC PREDICTION

The peak hour so found is then further used to predict the growth of traffic in next 10 years. The formula applied for calculations of the projected traffic volume for the next ten years is as [7]

$$\mathbf{A = P\ (1 + r)^n}$$

Where, A is the projected traffic volume, P is the volume count of the available year or current year, r is the rate of growth of traffic per year usually taken as 0.075 [7] and n is number of years. The peak hour traffic is generally 8- 10% of the Average Daily

VI. CONCLUSION

Traffic volume study data shows that there is fluctuation in traffic volume for the same lane at different time of day. This results in the need for more accurate implementation of optimized signal timing for desired output. The traffic signal design by Webster method for present traffic volume counts are compared with the traffic signal timings after optimization by using CORSIM. Assignment of different optimized signal light timings to different periods of the day based on the demand pattern is good solution where adaptive signals are not possible.

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