Traffic Density Management using Round Robin scheduling with Varied Time Quantum and Traffic Analysis

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Abstract**—**This paper suggests a solution to the problem of traffic management in metropolitan cities. The current technique of managing traffic uses traffic signals with fixed time cycles for each direction of traffic, without taking the amount of vehicles into consideration. This paper illustrates an adaptive system where signal cycles change based on traffic densities of each direction of vehicles. This system will calculate density using infrared sensors that will perform vehicle counting, along with road dimensions. This density is added to a relational database. Further analysis is done to calculate other important parameters that will contribute to deciding the time cycle that the signal will assign to that direction. The main aim of this study is to reduce the amount of time a vehicle has to spend at an intersection, or any such point on a road where traffic is controlled by signals and to analyze the traffic flow at a cross junction.

Keywords*-IR sensors, Round Robin Scheduling with varying time quantum, relational database, IOT.*

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I. INTRODUCTION

1.1 DESCRIPTION

The proposed system will examine the possibility of deploying an intelligent real-time traffic signal controller, which will receive information transmitted from IR sensors, and then utilize this information to optimize the traffic signal scheduling at the intersection. To monitor the density of the traffic, we will keep the Road Side Unit (IR sensors) along the road and based on the data received from them, the time cycle of the traffic signal will be changed. The Density Based Signal Management in Traffic System will solve the traffic congestion problem, which is a big issue in modern cities. We have designed a framework for a dynamic and automatic traffic light control system and developed a simulation based model to help build the system. Generally, each traffic light on an intersection is assigned fixed signal time. It is possible to propose dynamic time-based coordination schemes where the green signal time of the traffic lights is assigned based on the present conditions of traffic.

The Density Based Signal Management in Traffic System is used in heavy traffic roads and junctions, and it will be based on density, and programs that will receive the density information will control time delay. If the traffic density is high on particular side more priority is given to that side by allowing the signal to be green for more time. The Road Side Unit (IR sensors) continuously keeps watching density on all sides and the Green signal for a particular lane is adjusted according to the density of the lane. By using this pattern traffic can be cleared without irregularities and time delay.

1.2 ROUND ROBIN SCHEDULING WITH VARIED TIME QUANTUM:

Round Robin (RR) is one of the algorithms employed by process and network schedulers in computing. As the term is generally used, time slices are assigned to each process in equal portions and in circular order, handling all processes without priority (also known as cyclic executive). Round Robin scheduling is simple, easy to implement, and starvation-free. It is an operating system concept. The name of the algorithm comes from the Round Robin principle known from other fields, where each person takes an equal share of something in turn.

To schedule processes fairly, a Round Robin scheduler generally employs time-sharing, giving each job a time slot or quantum (its allowance of CPU time), and interrupting the job if it is not completed by then. The job is resumed next time a time slot is assigned to that process. If the process terminates or changes its state to waiting during its attributed time quantum, the scheduler selects the first process in the ready queue to execute. In the absence of time-sharing, or if the quanta were large relative to the sizes of the jobs, a process that produced large jobs would be favored over other processes. Round Robin algorithm is a pre-emptive algorithm.

II. PROPOSED SYSTEM

Traffic light controlling or optimization is a complex problem. Even for junctions there might be no obvious solution or critical to solved. With multiple junctions, the problem becomes even more complex, as the state of one light agree the flow of traffic towards many other traffic lights. The complication is the fact that flow of traffic frequently changes, depending on the time.

The Density Based Signal Management in Traffic System tracks traffic density in each lane and controls the traffic signals Red &Green indication. The delay given for Red or Green Signal for a lane depends on the density of the lane. The uniqueness of our work is that besides dynamically adjusting the signal lights based on the density, we store the densities of each lane and use it to analyze the future traffic.

As we consider a scenario (figure1**)** of a 4-Direction 8-lane road junction, it is observed that traffic lights holds on only on 4 lanes while remaining 4 lanes are open. When the signal goes green for one of the lanes that particular lanes density gets distributed in remaining 4 directions for which the signal doesn't hold. By capturing the density distribution for each of the lanes in each of the remaining directions we get to know about the traffic movement. So our system not only dynamically switches the traffic signal lights but also captures the data and analyzes it over time to make predictions.

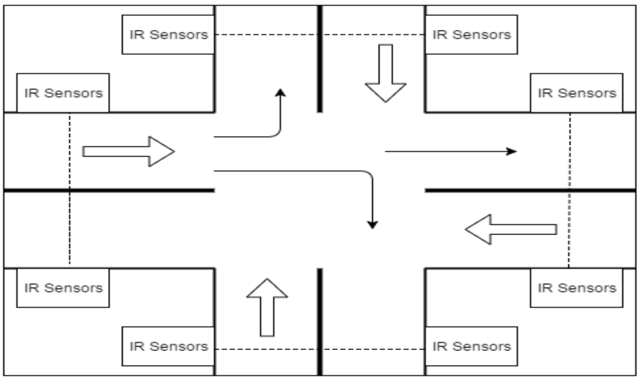

Figure1. A scenario explaining traffic flow and traffic density distribution for one of the lanes

Data will be collected by means of IR sensors installed on each of the lanes giving the exact density. Based on which the instantaneous decision will be taken of switching the traffic signal lights this will be done by a unit called the instantaneous decision maker (IDM).

Apart from switching the lights according to the densities it is also going to store the density values of each lane into a database, which gives the information of densities before switching the lights. Once the signal goes green for one of the lanes its density distribution is also understood by means of sensors and even those values are stored into another table of the same database.

By using various kinds of SQL queries on the database we can get to know about the densities in each of the lanes at a given point of time not only that we can also come to know about how the density is during rush hours or how it has been for the entire day.

If such kind of data is made available to common people it will be of very good use to them. They can decide upon which particular route to select in order to reach their destination and also the traffic flow will be smooth as everyone would select the best path from this information.

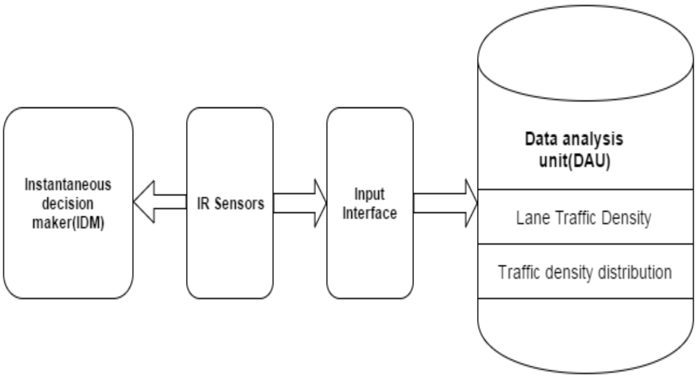

Figure2. Proposed System for Traffic density management and analysis

As in the proposed system (figure 2**.)** it can be seen that there are four modules. Input is received from the sensor network and fed into Instantaneous decision maker (IDM) and to the data analysis unit (DAU) through input interface. The instantaneous decision maker performs the switching of traffic lights whereas the data analysis unit stores the data into a relational database consisting of tables of two types one is Lane traffic density and the other one is Traffic density distribution. Lane Density stores the value of the densities before switching the lights it does this for all the lanes on which the signal holds and the other table Traffic density distribution stores the distribution of traffic in all directions for the lane which goes green. In this way the densities are collected. By firing various required queries at various instances of time we can come to know about traffic density in each direction and the data which is collected over time can be useful in making future predictions.

The switching pattern that we consider is

Lane_E->lane_S->lane_W-> lane_N

E, S, W, N denotes the directions East, South, West and North respectively.

The IR sensors installed on the roads are used for counting the lane densities. These lane densities are then processed by means of a microcontroller that takes the density counts and allows the signal to be green for given amount of time. The average time for the car to cross the signal is assumed and according to it the signal timings are adjusted.

TABLE I. Table for schedule of lanes

Lane_E	Lane_S	Lane_W	Lane_N	Scheduled timings(in secs)
12	15	18	14	
0	20	24	20	36
10	0	30	24	40
15	9	0	28	90
20	16	10	0	84

Assuming the average time for a car to cross the signal in all 4 lanes is 3 seconds then the time for which the signals will be scheduled will be as follows:

Scheduled Timings= Average time for a car to cross the junction * Density of the lane

Thus it can be seen that chance is given equally to all lanes and also that the time quantum is not fixed thereby curbing the problem of starvation and waiting time.

Collection of Data**:** The Data that is obtained from the IR sensors is sent to a relational database this relational database stores the density of the lanes before allowing any of the lane to be scheduled.

The selection of relational database is done because the data is highly structured and relational databases prove to be best for such processing.

The Entity in the relational table will be named as Traffic_Signal_ID where ID is the identification number for the traffic signal. The Relation will be as follows refer table

Traffic Signal_ID(Timestamp, time interval, Lane_E, Lane_W, Lane_N, lane_S)

Where timestamp is the time at which the data is collected and time interval is the interval at which the traffic is scheduled. Lane_E, lane_W, lane_N, lane_S denotes the densities in each of the lanes in each of the directions.

(**Please see how the naming of the subtopics is done**)Collection of density distribution

Once the traffic is scheduled for any of the lanes then we are going to store the distribution of traffic as well. This traffic distribution is stored in the relation named Density distribution.

Even here the relation will be of same format as Traffic_Signal_ID except for that both of the tables will be used for different purposes. One will be used to store the densities and the other one will be used to store density distribution.

Density_Distribution(Timestamp, Time interval , Lane_E, lane_N, lane_W, lane_S, lane_density_distribution)
Here Timestamp denotes the timing at which the data is collected. Time Interval denotes the interval at which the data is collected from all the lanes whereas the lane_Density_distribution denotes the lane for which the traffic is getting distributed.

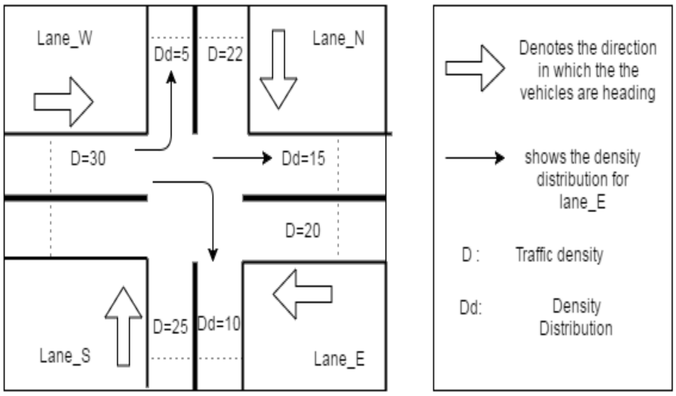

Figure 3. Traffic Distribution and traffic density capture

TABLE II. Relations in the database

Traffic_signal_ID

Timestamp	Time interval	Lane_E	Lane_W	Lane_N	Lane_S
10:00:00	60	0	20	25	22

Density Distribution

Timestamp	Time interval	Lane_E	Lane_W	Lane_N	Lane_S	Lane density distribution
10:00:00	60	15	0	5	10	Lane_E

Queries on the Table

Select Time_stamp From Traffic_Signal_Id where lane_N in

(Select lane_N from Traffic_signal_ID where lane_N in (select AVG(lane_N) from Traffic_Signal_ID) BETWEEN (select MAX(lane_N) from Traffic Signal_ID))

Above query is a composite query consisting of a subquery which finds out the maximum density in lane_N and from the result of this query we obtain the time at which the density was maximum. Thus getting data about the density during rush hours.

Select AVG (lane_S) from Density_distribution

where lane_density_distribution='Lane_N' and

Timing interval in BETWEEN 19:00:00 AND 20:00:00

Query will contain average Traffic moving from lane_N to lane_S in the time interval 7:00pm to 8:00pm.

In this way various aggregate queries can be used to analyze the traffic and obtain useful information from it.

So firing such kind of queries on the relational tables it is possible to get various kinds of information. Information collected from various traffic junctions can then be collected and Large amounts of data can be processed.

III. ANALYSIS

The below mentioned papers were thoroughly studied and a concept of "round robin scheduling system" was found most suitable, both economically and keeping in terms with viability of the entire process. The system proposed by Salama A.S., Saleh B.K. and Eassa M.M suggests the use of photoelectric that will help identify the density of each road. This system helped us understand the importance of IR sensors. Further evaluation made us take this system a step further by attempting to use real-time data for processing. The processing results can then be stored in a relational sensors database which can then be studied. The system can then be made adaptive by learning from the data stored in these databases. This proposal also made us cautious of the fact that the system must react to emergency situations in which vehicles such as ambulances and fire brigades can obtain priority for their lanes to turn green. This however must be treated as an exception and the system must return to normal functioning once the emergency vehicle crosses the signal.

The concept of VANET(vehicular ad-hoc network) introduced by Khekare, G.S., Sakhare A.V. Was found to be cumbersome due to the setting up of an extra tower near every junction and an internal device in every vehicle to initiate communication between vehicles. This system proposes to change the entire system rather than improving the current scenario. Hence, further evaluation of this system was not considered.

IV. CONCLUSION

Density Based Signal Management in Traffic System shows how the Traffic Light Signal controls, including

With the implement of Traffic Scheduling Algorithm which is used to gain information from the density of the

vehicles on each lane. A Round Robin Scheduling Algorithm with varying time quantum is used for managing traffic. The acquired data from Road Side Units reschedule the traffic light timing according to the traffic condition for low or high-density road traffic. If the density of the road traffic is high then Maximum density of traffic will allow maximum default timing for traffic lights. Minimum density of traffic will allow traffic with minimum timing for traffic lights. The proposed approach will not only give chance to all the lanes but also the density of the vehicles on the road and also will control the traffic light sequence efficiently and more accurately. This system aims at saving a large amount of man-hours caused by traffic problems and accidents, where prevention can save lives and property. Also this system stores data from the sensors into database and makes use of various aggregate queries to get important results. Traffic analysis that has been shown is on single traffic signal. In future traffic signals data from various junctions can be collected and big data processing can be applied on it to get more accurate information on larger scale.

V. ACKNOWLEDGMENT

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