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Smart Traffic System

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Abstract: ***There is constant evolution on each and every aspects surrounding us, but the road transportation even being the closest to us has not be so lucky. The system administering manoeuvres on the road is very primitive. It is time to make technological advancement in this part of our circumambient, which touches our life every day. The automation is the key to make the system more advanced and sophisticated. The system must be automated and equipped with devices and intelligence using which it can take the pliable measures to provide the better and efficient solution.***

Keywords: Traffic Management and Regulation, Smart Traffic System

Note to Practitioners—This idea struck in USA while waiting for the green light at a traffic signal in middle of the night. The proffered approach in this paper by the presented system will manoeuvre the conveyance in a distinctly smarter way as compared to reigning system.

1. Introduction

There is lot of emphasis put forth for running the traffic smoothly on the peak hours, especially due to rise in the number of vehicles on the road. Congestion looms like a monster always grabbing the attention when it comes to improvement in the area of traffic management. However, the traffic management in off hours requires attention as well.

The current traffic system perpetuates on the time interval mechanism. It perseveres in this behaviour without being affected by external components. Every country has their own customized way to regulate the traffic signals. In India most of the traffic system after 12 AM opts to '*yellow*' or '*red*' signal in flickering manner till *6 or 7 AM*. This could lead to collision between vehicles if they tend to cross the signal at high-speed with negligence. In most of the countries, the traffic signal is running in same manner all the time. The traffic system operates in obsolete way which must be replaced with an advanced version.

Let's consider the example of traffic signal in India, maximum number of traffic signals in metropolitan area tends to flickering manner implying that, please cross the road carefully, with an additional care related to speed limit and proper observation while crossing the traffic signal at the intersection of roads. These guidelines are in place for specific reasons like: chance of collision between 2 or more vehicle, pedestrians crossing the road over the zebra cross near the traffic signal.

2. Simulation Scenario

2.1 Overview

Let's assume a simulation environment, a four ways signal at Turnpike Road near Fountain-Head Apartments (Westborough-MA). The 4-way roadway copulation framework is constituted by road **A**, road **B**, road **C** and road **D**.

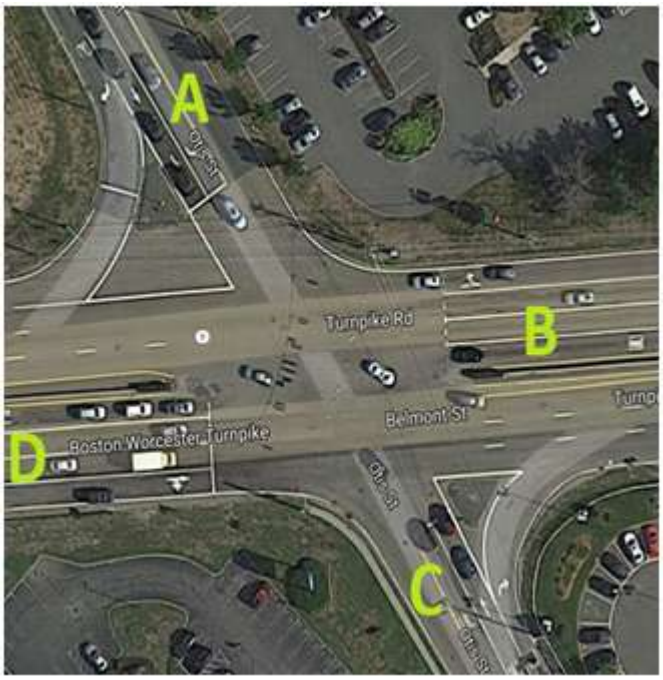

Figure 1: Screen shot from Google Maps

2.2 Simulation

To prove that the current system is incompetent, we will assume the data mentioned in the Table-1. The data displays the average number of vehicles arriving on the roads, *A, B, C and D* at off hours in every 5 minutes. The number of vehicles mentioned in the table is as per the 'Weekends' and 'Weekdays' in the week.

Let's assume that the traffic system regulates in the following manner: Time Allotted for Green Signal for roads A, B, C and D is 10, 20, 10 and 20 seconds respectively. The predicament, such as accident and breakdown is disbarred from the assumed scenario.

Table and Graphical representation of the data about the number of vehicle arriving on Road A, B, C and D:

Table 1

Days	Road A	Road B	Road C	Road D
Weekends	6	7	6	8
Weekdays	2	15	3	13

Graph 1

3. Dynamic Traffic Operations

3.1 System Overview

The following diagram outlines schematic representation of the system.

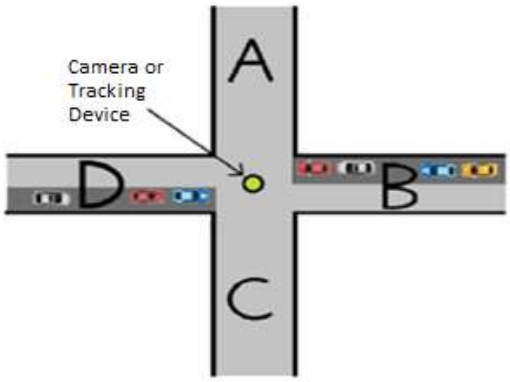

Figure 2

Now a days the traffic signal have *CCTV* camera installed beside them for surveillance purpose. The primary role of the camera is to implicate the offenders who are violating the traffic rules and regulations. However, it can be used for other purpose like security. It would be bonus if the CCTV camera can provide the helping hand in traffic management.

The above diagram depicts the system with a camera monitoring the vehicles on all the roads. In this structure the camera will be the one working behind the scene with traffic signal for better control over the vehicles. How? Well the camera will be connected to the system, employed for synchronize exchange of data and communication in the background for better regulation purpose. The camera is designated for being the eyes observing the road continuously, capturing the site constantly, which acts as input to the system. The inputs from the camera help to understand the whereabouts of the roads. Based on the visual inputs received from the camera the system can take the decision of manipulating the actions of the traffic signal to provide the better solution at that given point.

3.2 Working

After receiving the inputs from the camera, the system will be running an algorithm. The purpose of the algorithm is to identify the presence of object, and the object should be specifically an automobile. The algorithm will use the procedures written in form of program to perform the identification process, which belongs to concepts of digital image processing, to identify the vehicles precisely. Based on the calculations a set of command is released and sent to the traffic signal, which executes the set of instructions. Open-CV provides computer vision libraries available in various programming languages.

3.3 Off Hours

Using the structure portrayed in Figure-2, let's consider the *Case-1*, with a vehicle arriving on any of the road and stopping before the traffic signal, since the traffic signal facing the road is flashing red colour. It has to wait until the traffic signal for the road turns green. The ludicrous part is that there are no vehicles standing on any of the road accept the one with the vehicle. Still the rider arrived on the road must wait for the green signal.

If we consider a footpath with reminiscent structure portrayed in Figure-2, but this 4-way passage is strictly pedestrian. As human beings we don't require the traffic signal at all to efficiently superintend our movement; we can autonomously master our movement. Due to our intelligence and cognitive skills we unequivocally walk and run without bumping each other, provided we are paying attention on the path. So why shouldn't be the same alternative applicable to the Case-1. We are not contemplating to adopt the idea of crossing of the road by jumping the red signal; that is not an option, doing this would be felony. As a due diligence what we are suggesting instead is that the traffic signal should alter its state on basis of best possible resolution.

The system that we are proposing will work in the following manner: The CCTV camera, installed for surveillance, will be persistently sending the images of all the roads to the system, the system will run algorithm on the received images to identify the road with the vehicle on it. For instance, a vehicle arrived on the road B and the signal assigned to the road B is red; on contemporary the signal for road D was green. The system identifies that the road B has vehicle on it and road D doesn't. There are no vehicles standing on any other roads as well. The system instantly dispatches the command to traffic signal for providing clearance on road B. Traffic signal for road D, currently green, turns yellow and then red; after this act, the traffic signal for the road B turns green, indicating the rider on road B to cross the road.

4. Merits

4.1 Peak Hours

The day time happens to be the peak hour for the road, because the automobiles gravitate more on the road due to the business hours resulting in soaring number of vehicles. But there could be a time when a road might experience sparse and plummeted number of vehicle as compared to other days, at peak hours. Let's assume road A, on a particular day during the peak-hours, there are no vehicles available to cross the road even when the signal is green. On

contrary, the other roads experience the number of vehicles arriving with the same tempo as every day.

The proposed system can provisionally permute the signal for road A to the red colour. This action can be countermanded to operate in the previously assigned modus operandi, altering the adopted state during the interim period, upon arrival of an automobile on road A. In this way significant amount of time is allotted to the traffic signal for the other roads deserving more time.

4.2 Pedestrian Convenience

Pedestrian are a facet of the roadways, but everyone tends to turn a blind eye when it comes to their convenience and comfort while crossing or walking on the road.

On most of the roads in USA, the pedestrians have to push a button attached to the bar of traffic signal, which sends a message to the traffic signal in order to activate the pedestrian signal for road crossing. However, the walking signal is activated as per the sequence assigned to the traffic signal (explained in the following paragraph).

Consider the structure of road depicted in the *Figure-2*, with the time allotted to green signal, for all the roads, mentioned in section 2.2. The sequence of green signal given to all the roads is as follows: First for the road A then B, C, D and at last the walking signal (*Sequence-1*). Let's say that the pedestrians are waiting for their signal after pushing the button. Suppose, if the green signal is active for road A, then the turn of the pedestrian's signal will come after B, C and D. The people travelling by foot have to wait for atleast 50 seconds (combing the number 20, 10 and 20 mentioned in section 2.2). In case, if there are no vehicles present on any of the road, then also people waiting to cross by foot have to wait for their turn.

What the ideal proposed system will do is: it will sense the presence of vehicle on all the roads; if no vehicles are present on any of the roads then the walking signal must be activated. In this way the pedestrian won't have to wait much longer, which makes sense.

In many parts of the world, the walking signal appears even without pushing the button, meant to send the message to activate the walking signal. In several parts of the world, like in India, traffic signal is unequipped with the button to activate the pedestrian's signal. The activation of the walking signal at the cross-road would be useless without the presence of pedestrians on the road.

Consider the structure depicted in Figure-2, with zebra crossing and walking signal, and without the implementation of button, pushed by pedestrian's to activate the walking signal. The time allotted to the pedestrian's signal is 20 seconds and it gets activated automatically as per the sequence mentioned in Sequence-1 (section 4.2). Suppose the structure hardly encounters any people travelling by foot on the road, and the average time difference between pedestrian entrants structure is 20 to 30 minutes. Assuming the hypothesis, we conclude that, the walking signal will kill lot of time in aggregate, of the travellers embarking automobiles. Well is circumvented using the camera to sense the presence of pedestrians and upon not concluding anyone the walking signal should be turned off till the sighting of walker(s).

4.3 Better Substitute

During the off hours in India, the light of the traffic signal opts to switch to flickering behaviour. There are certain practices to be adopted while crossing the traffic signal in this condition, like the vehicle must not exceed certain speed limit due to road intersection and presence of zebra crossing. Upon noticing the flickering phenomenon of the traffic signal, drivers only tend to understand non-halting concept and abruptly discharge the precautions to be taken care of on the crossroads.

The flickering phenomenon of the traffic signal must be replaced with strict arrangement to avoid the accidents and casualties, caused due to negligence of riders. The proposed system will act as benevolent substitute for the senile incumbent flickering format.

4.4 Better Sense

Anything is possible on the road, no possibility can be ruled out no matter how good or bad. Suppose a vehicle is trying to cross the road and suddenly gets stuck in the middle of the cross road due to some reason. Even though people can see what's blocking the road and would eventually stop their car or take the alternative lane adjacent to the lane, which has halted vehicle on it; but upon having the blocked it is really inappropriate for the traffic signal to flash green signal. In this case the smart system will flash yellow signal with flickering behaviour for the road, which encountered predicament.

4.5 Time Management

Time is very well managed by the traffic signal at the intersection point of the road. The needy one gets the additional time due to removal of turn or time, from the signal, allocated to entities (such as roads and zebra crossing) from conglomerate structure devised at the crossroad. Such an act can put a huge impact at some situations under crisis. Even by skimming off some time on the alternate basis can end up saving a lot of time in entire day.

5. Conclusion

Implementation of the proposed system is the apogee of controlling roadways transportation. It will handle the imperceptible situations coherently. The administration of the traffic system will be governed with agility and flexibility. Macabre of meeting an accident will be reduced due to functioning of smart and efficient system in place.

Travellers will be at ecstasy on realising that the roadway is controlled by the smart system rather than the rudimentary one. The concerns related to pedestrians are discerned very well.

6. Acknowledgment

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References

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[2] Google Maps

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