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INVESTIGATIONS, ANALYSIS AND SCOPE FOR MONITORING VEHICLE TRAFFIC AT HIGHWAY INTERSECTION

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Abstract:

Traffic signals need an honest coordination and control to make sure the graceful and safe flow of the vehicle traffic. During the push hours, the traffic on the roads is at its peak. Also, there's an opportunity for the emergency vehicles to be within the holdup.The purpose of our work is to set traffic signal time in dynamic manner so that traffic count & waiting time will be uniformly distributed for particular intersection. The vehicle count is observed and analysis of its consecutive effect of arrival of these vehicles on preceding intersections is going on. This will probably help us in future to determine the congestion distribution strategy among various intersections we are going to consider in our work. In this paper we had tried to study the parameters for some other default values. We had tried to observe and analyze traffic related parameters requirements by considering vehicle count on highway intersections, vehicle speed & time required for various vehicles to depart and to arrive between the consecutive intersections.

Keywords: *Traffic control, Congestion distribution, consecutive intersection, Parameter Simulation, SUMO, TRACI*

I.INTRODUCTION

In this paper, we are trying to write a pseudo code containing vehicle priority algorithm. The traffic single glow sequence of reference intersection will be decided accordingly. Thus the traffic load will be shared at various intersections on highway. By observing the importance of probability statistics we are trying here to point out various traffic parameters that will be helpful in determining the traffic light glow sequence accordingly as per traffic count and probability.

OMNET++ acts as a application connecting to SUMO via a TCP socke [7]. OMNET++ also uses the TRACI (TRAffic Control Interface) interface to send the vehicle control information in the form of TRACI commands [8]. Referring to figure 1.1, every vehicle in SUMO is mapped to a mobile node in OMNET++. Our extended OMNET++ module allows generating new nodes as the vehicles are penetrated into SUMO, removing nodes when it's corresponding vehicles reach to their destination. This reflects the movement of the corresponding vehicles in SUMO. The traffic trace generated by SUMO is analyzed in detail in various angles by a supervisor module. SUMO executes in discrete time steps. The supervisor module, after such parsing then communicates the traffic trace to the OMNET wireless or mobile nodes.

The commands like e.g. GREEN_SIGNAL, RED_SIGNAL,YELLOW_SIGNAL can be used to identify traffic signal controller and accordingly passes through its phases or lanes one by one. During the simulation, at regular intervals, the supervisor module triggers the execution of one time step of the road traffic simulation, receives the resulting mobility trace, and triggers position updates for all wireless nodes it has decided to point out (instantiated) after detail analysis.

II. LITERATURE REVIEW

[1] Authors had mentioned a VANET (Vehicular Ad hoc Network) is a special kind of ad hoc network in which each vehicle is regarded as a communication unit. Weiwei Liu et.al.came to know that in VANET vehicle's movement is restricted by road and environment and the traditional random mobility model and way-point mobility model unable to put the realistic vehicle traces. Authors have studied the communication methods between road traffic simulator for urban mobility (SUMO)

and network simulator NS3 on establishing a feedback loop between them. They have designed a new protocol to combine NS3 and SUMO together and conduct coordinated simulation of VANET routing protocols as well as traffic control policies by implementing a client named TraciClient that manages the communication process between SUMO and NS3. SUMO may be a portable, microscopic agent-based traffic simulator designed to handle large road networks. It is an application suite, can be redesigned or configured to simulate traffic of different scenarios. SUMO is out there as an open source to assist many researchers to further contribute and improve the framework. SUMO can be used both for a simple and complex traffic simulations which are bundled with a remote control interface (TraCI), a transmission control protocol based interface external application like NetEdit& SUMO)) to adapt the simulations online [2]. In [3] Nurulet. al. has mentioned that traffic simulation is a widely used method in the research on traffic modeling, planning and development of traffic networks and systems. From the literature study, they found, the traffic simulation models can be categorized into: microscopic modelling, macroscopic modelling and mesoscopic modelling. Here they have reported the overview of these traffic simulation models, in term of its function, limitation and application. Selecting the proper model consistent with study aims is a crucial step towards traffic problem resolution. Khumaraet. al. [5] stated that the increasing the vehicle amount which is not balanced with the capacity of road impact on the transportation system especially the density of vehicles on the road so needed to minimize congestion and traffic accidents and also develop ITS (Intelligent Transport System). This paper discussed realistic vehicle mobility simulation supported traffic surveys of a city employing a microscopic model simulation by using Simulation of Urban mobility. SUMO is an open source road traffic simulator allows users to build simulations of vehicle movement on network topology. In particular, the SUMO network has some information like each edge as a set of paths including the position, shape and regulation of every path, the logic of traffic lights sourced from the crossroads. The traffic distribution pattern can be modeled on SUMO applications. The data traffic will be managed and computed with Kalman Filter to enhance location accuracy. Then, it will be displayed on Website. Based on analyst of auto traffic

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volume in Central Surabaya, it's Gaussian distribution traffic which is that the hour in 4 pm. - 5 pm. [6] Microscopic traffic simulation is the most important tool for traffic research. In this paper the authors explained the newest developments concerning intermodal traffic solutions, simulator coupling and model development and validation on the instance of the open source traffic simulator SUMO. The author Pablo Alvarez Lopez et. al. also mentioned that even though SUMO already provides a large framework with helpful tools for the generation, validation and evaluation of large traffic scenarios; but there are still more features and extensions. Axel Wegener et. al. [7] has mentioned that a Traffic ControlInterface (TraCI) a technique is effective to interlink road traffic and network simulator. TraCI allows us to control the behavioral status of vehicles while simulation is running. In [8], Kartik Pandit et. al. has prposed the Oldest Job First (OJF) algorithm, that helps in minimizing the delay across the intersection.

III. RELATED WORK

We are considering, in this paper, the intersections taken from OpenStreetMap (Fig. 1.1 below) or Google map (Fig. 1.2 below) to understand and to get the location of the vehicles exactly on the highway. We are using tools like SUMO simulator app, OMNET++ language, VEINS and NetEdit software and co-ordination among them. The results obtained clearly shown that the vehicle location is very close to highway; almost on highway instead those were far away from the highway previously.

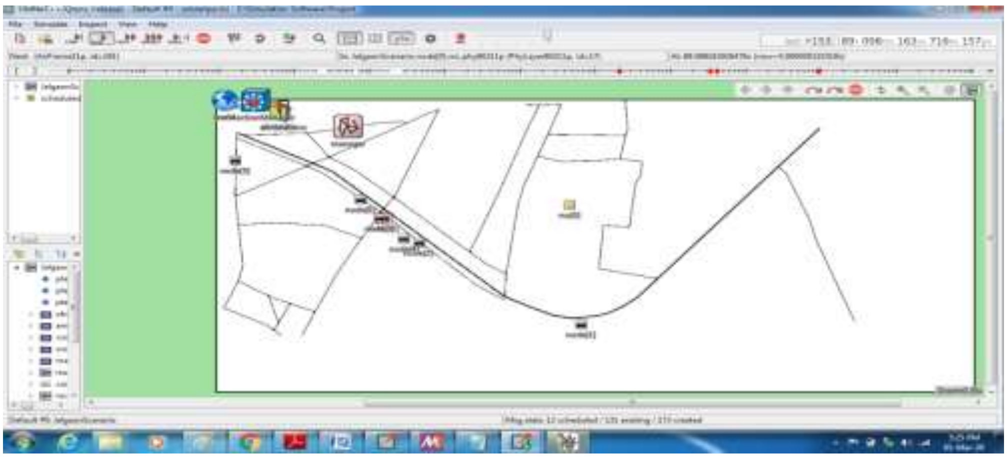

Fig. 1.1 Vehicles line node [3] arrived at the Akashvanichowk, taken from OpenStreetMap

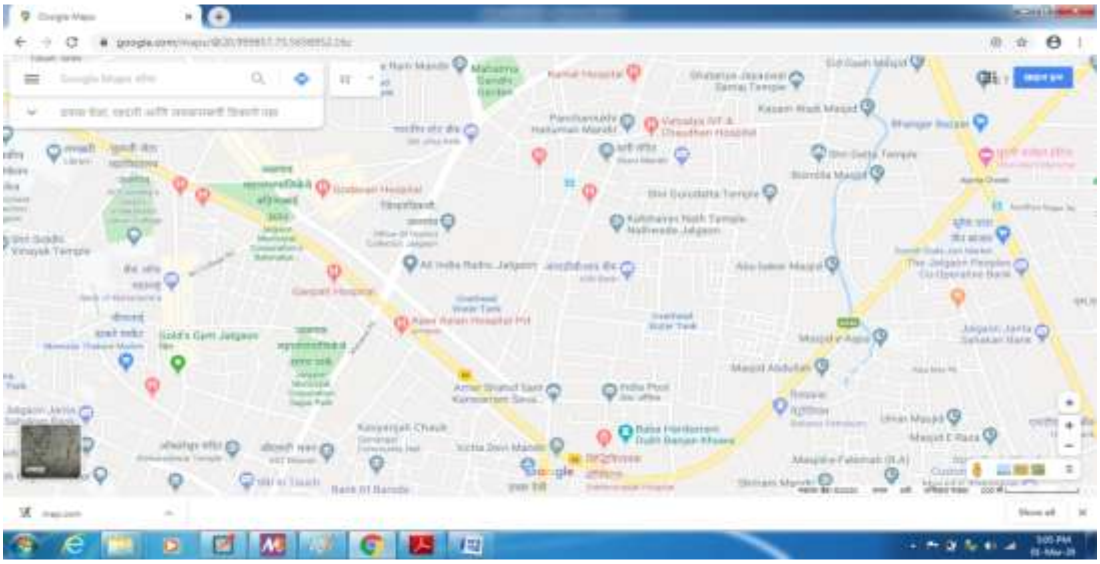

Fig. 1.2 Scenario of 03 intersections in Jalgaon city taken from Google map

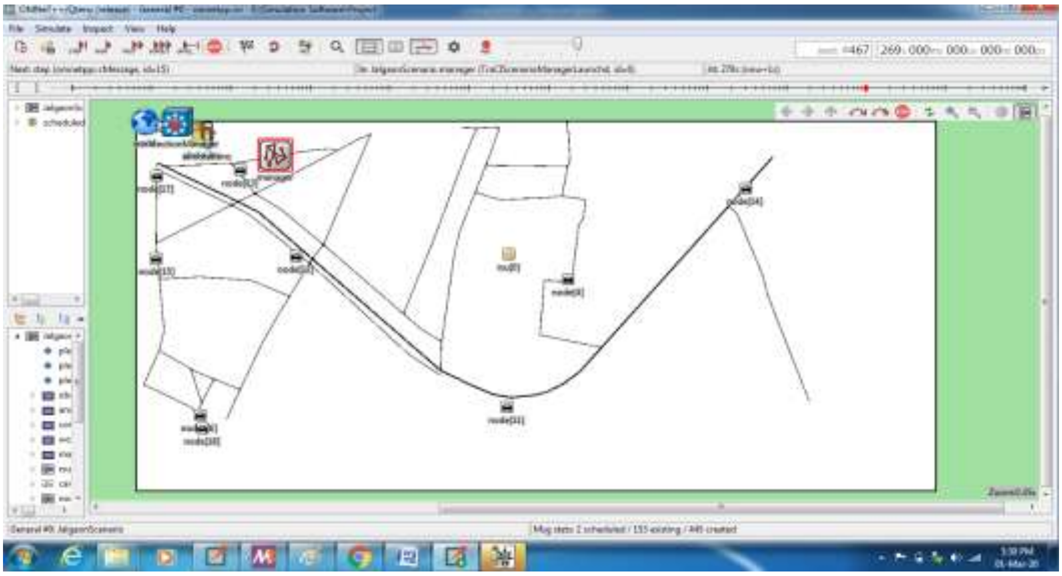

Fig. 1.3 Vehicles like node[14] arrived from Ajintha road and moved towards Bhusawal on NH-6

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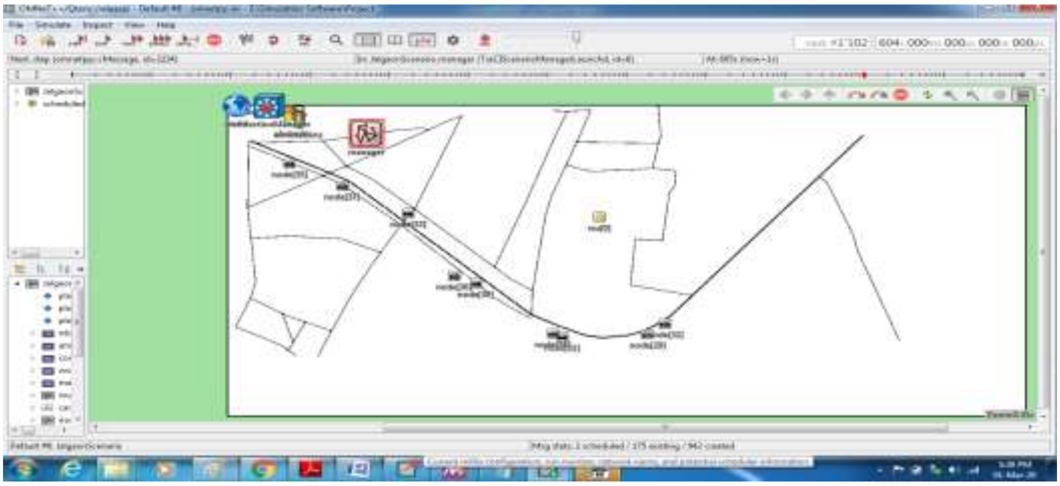

Fig. 1.4 Vehicle node 29 to 37 passing on NH-6

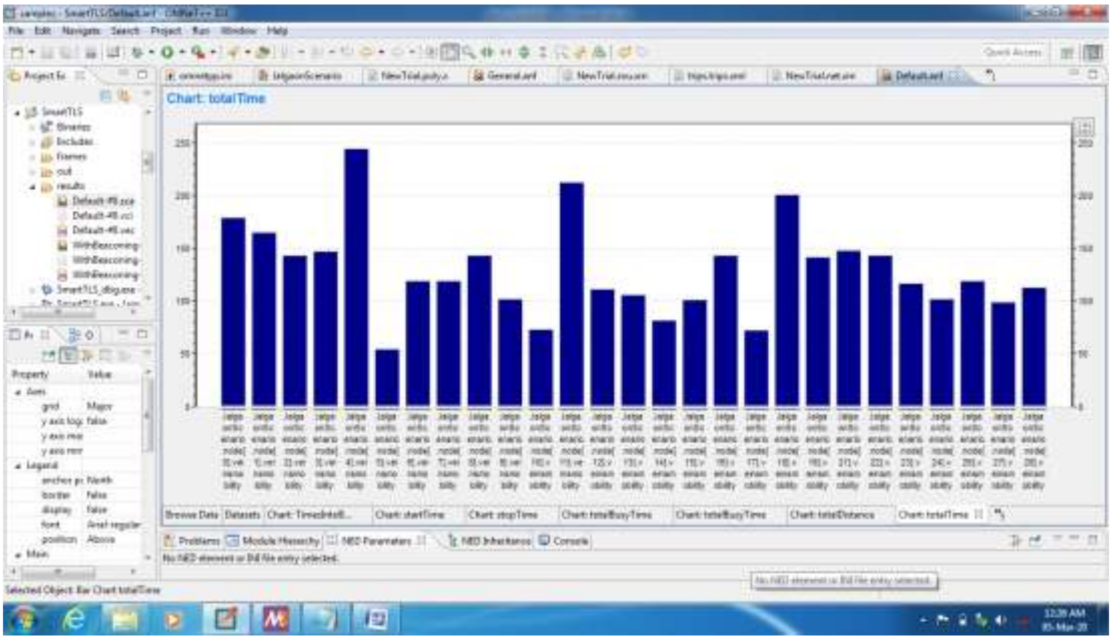

Fig. 1.5 Total time taken by vehicle to pass through Akashwani to Ajinthachowk

The analysis parameters observed after simulation is mentioned in Table 1.1 below. The vehicles are passing from Akashwanichowk to Ajinthachowk via Icchadevichowk.

From Table 1.1 above it can be seen that vehicle nodes e[1], e[11], e[21] and e[23] are continuously passing through all intersections without waiting; this means we can say they are getting the green signal every time that they pass in. Another thing is we don't need to consider minimum speed of vehicle node e[4] as it turned away in different path. Even though e[4] travels 2800 meter distance in 240 s (4 minutes), its none of our business due to earlier mentioned reason.

Table 1.1: Parameters observed after simulation of vehicle traffic passing from Akashwanichowk to Ajinthachowk via Icchadevichowk.

Sr. No.	Vehicle ID or Node (*travelling from Akashwani to Ajinthachowk*)	Total busy time (seconds)	Total time required (seconds) (*Akashwani to Ajinthachowk*)	Max Speed (m/s)	Min Speed (m/s)	Total distance travelled (meters)
1	e[1]	-	165	14	4.1	2250
2	e[2]	0.0011	140	14	4	1900
3	e[4]	0.0011	240	14	-	2800
4	e[8]	0.0011	140	14	3.6	1900
5	e[11]	-	210	14	3.7	2800
6	e[13]	-	105	14	3.8	1300
7	e[18]	0.007	200	14	3.2	2600
8	e[21]	-	145	14	3.8	2000
9	e[23]	-	120	14	3.3	1550

In around 3.5 minutes, e[11] seems 2800 m distance at given maximum and minimum speed. Vehicle node e[23] seems passed 1550 m distance in 120 seconds (2 minutes). If we decide priority and apply probability to these vehicles nodes, the arrival and departure of vehicles at the intersections can be controlled. Due to this monitoring action the unexpected traffic congestion occurs at any particular intersection (chowk) can be avoided.

IV. Proposed Algorithm showing the psudocode

Proposed Algorithm showing the psudocode using vehicle priority is as below:

Precondition: All vehicles, lane information, vehicle density, neighbour traffic signal information

Postcondition: Compute the traffic signal timing

```
Begin:
 Neighbor signal () {
        Measure the lane information
        Begin forloop
         Calculate each lane vehicle density
End forloop
        Measure the Long vehicle with lane id
        Sends the message to Current signal.
}
Current signal () {
        Measure the current lane information
        Begin forloop
        Calculate each lane vehicle density
End forloop
 Measure the long vehicle with lane id
 Get the neighbor signal information and compute the total priority level.
}
 Signal Priority () {
        Priority level 1: Long
        vehicle → Green signal
Priority level 2: Compute the final vehicle density with current traffic signal with neighbour traffic signal
Based on the vehicle density, assign the traffic signal timing.
 }
```

Pseudocode for the traffic signals are working based on the vehicle priority algorithm.

V.Conclusion and Future Scope

If we can able to provide the suitable probability to specific vehicles as per our motive and if we could able to apply the probability of occurrence of heavy loaded or lengthy vehicles at the intersection, we may predict the switching time interval and specific sequence of switching the traffic light signals. This decision of switching time variation may takes place due to variation in probability. It will be interesting to study if we could able to vary this probability as per category of vehicles occurred.

Our algorithm needs to improve this average delay to make our vehicle priority algorithm so effective that it'll give continuous green signal after facing lowest delay.Soon after improving this problem we can able to provide the suitable probability to specific vehicles. After pointing probability of occurrence of heavy loaded or lengthy vehicles at the intersection, we can predict the switching time interval and specific sequence of switching the traffic light signals. This decision of switching time variation may takes place due to variation in probability. It will be interesting to study if we could able to vary this probability as per category of vehicles occurred.

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