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# Assessment of Urban Traffic Conditions and Feasible Solutions in Metropolitan Areas

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***ABSTRACT***

*Vehicular traffic has become an escalating concern in urban areas due to rapid population growth, increased urbanization, and rising living standards. These factors have contributed to a surge in the use of private vehicles and a decline in public transportation usage, thereby intensifying road congestion. This increase in traffic volume directly correlates with higher levels of pollution, more frequent accidents, and general deterioration of urban mobility.*

*To address these challenges, Intelligent Transportation Systems (ITS) have emerged, aiming to deliver timely, safe, and efficient traffic services. There is an urgent need for a smart traffic management system that aligns with the complex and dynamic conditions of Indian roadways. One such approach involves maintaining a specific speed range across road segments and synchronizing traffic signals accordingly. This coordination allows vehicles to traverse multiple intersections without unnecessary stops, provided they adhere to the designated speed range.*

*In the era of artificial intelligence, the development of intelligent traffic signals capable of predicting traffic flow is essential. Traffic patterns are influenced by a multitude of variables, including the day of the week, time of day, seasonal trends, weather conditions, road types, special events, and unexpected incidents such as accidents.*

*This study proposes the use of both historical and real-time traffic data to forecast vehicular flow at intersections. The data is processed using fuzzy logic to generate traffic flow predictions, which are then used to calculate optimal green light durations for all directions at a given junction. By maintaining a consistent speed range and applying data-driven green signal timing, the system aims to significantly reduce delays at intersections. The proposed model demonstrates superior performance compared to conventional pre-timed and actuated signal control methods.*

***KEYWORDS: Intelligent Transportation Systems (ITS)1, Traffic flow2, optimum green signaling3, intersection4, Actuated method5.***

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## I. INTRODUCTION

Traffic congestion is a pressing global issue that continues to escalate, resulting in substantial economic losses and environmental degradation. Across many nations—including Australia, Bangladesh, Brazil, and China—urban areas experience severe traffic congestion, particularly during peak hours. In Australia, commuters traditionally rely on radio and television for real-time traffic updates, though the use of GPS, live webcams, and online platforms is increasingly prevalent for traffic monitoring and dissemination of information.

In Dhaka, Bangladesh, traffic congestion has reached critical levels, causing extensive loss of productive hours and fuel consumption daily. São Paulo, Brazil, is frequently cited as having the worst traffic congestion in the world. According to the city's traffic management agency, Companhia de Engenharia de Tráfego, São Paulo set a record on June 1, 2012, with cumulative traffic queues stretching 295 kilometers during the evening rush hour.

The situation is especially dire in developing countries, where a surge in low-cost vehicle availability—combined with banking reforms that have made vehicle financing easier—has significantly increased car ownership. Unfortunately, this rapid growth has not been matched by proportional infrastructure development, thereby intensifying urban congestion. In India, cities such as Delhi, Mumbai, Hyderabad, Bengaluru, and Pune are facing worsening traffic conditions. The country's growing appeal to international automakers like Nissan, Renault, Toyota, and Ford, who continue to launch new models, has added further strain to already overburdened road networks.

India's lack of long-term traffic planning and limited adoption of automation in road infrastructure has contributed to its ranking among nations with the most severe traffic issues. As a result, traffic engineering has garnered interest from interdisciplinary fields including civil, electronics, and computer science engineering. Researchers are now focusing on innovative solutions ranging from road design improvements to the integration of electronic sensors, detectors, and intelligent algorithms.

One such technological intervention is the Intelligent Transportation System (ITS), a suite of applications designed to enhance transport efficiency, safety, and user decision-making through real-time data and automated systems. ITS helps manage multimodal transportation networks and supports safer, more coordinated, and efficient use of infrastructure. Countries like Japan, Singapore, and South Korea are pioneers in the implementation of ITS, achieving notable improvements in traffic management, congestion reduction, and traveler convenience.

A key subset of ITS is the Advanced Traffic Management System (ATMS), which focuses on real-time monitoring, incident detection, signal control, and arterial management to optimize traffic flow. Despite its proven benefits, ITS deployment remains limited in many developing countries due to low awareness and implementation challenges.

Understanding and predicting traffic flow remains complex due to its inherently stochastic nature. Factors such as traffic density, vehicle speed, time of day, day of the week, weather conditions, and geographical location all contribute to variability. While mathematical models often struggle with this unpredictability, experienced traffic police officers can intuitively anticipate flow patterns based on their familiarity with specific intersections and conditions.

Historical traffic data offers valuable insights into these patterns, revealing consistent trends based on temporal and environmental variables. When effectively collected and analyzed, this data can be used to anticipate congestion and inform smarter traffic signal management strategies. Despite its random appearance, traffic flow often exhibits discernible patterns that can be leveraged to design more adaptive and responsive urban traffic systems.

### 1.1 STUDY AREA

We have selected site for our project, which is from Pune station to Wadia College of engineering which is 1.1 km, consist of 5 signal. Pune is second largest city in Maharashtra and ninth most populous city in the country. As per census 2011, population was 3124458 and in 2016 it is estimated to be 5,926,606[5.9 million]
Vehicular/Road Statistics of Pune City is as follows [Reference: Express News Service 30 July 2015]

– 2-Wheelers : 2,152,911
– 3-Wheelers : 47,554
– 4-Wheelers :4,57,698
– The frequency 110-130 vehicles per minute have been observed on internal roads.

There is a need felt to improve the traffic control at junctions. PMC also plans to install sensors in city roads for Intelligent Traffic Control.
This project is an effort to provide better traffic control.

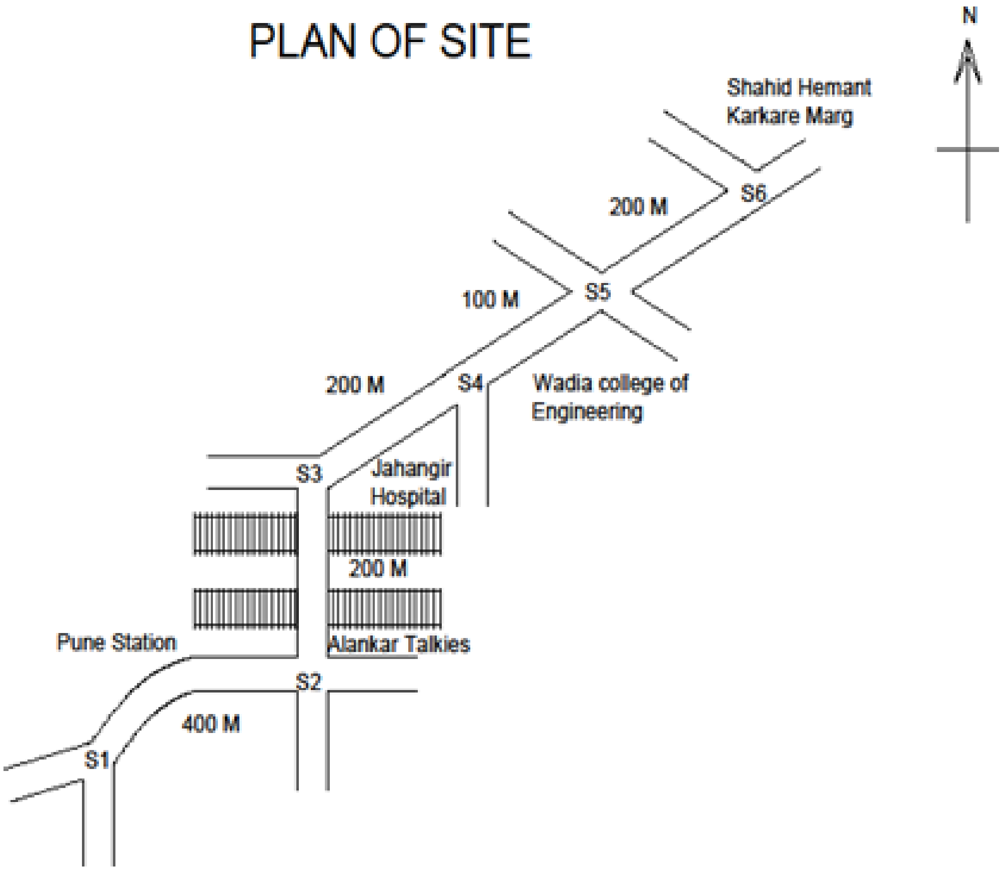


Fig -1 Plan of Site

## II. RESEARCH PAPER

Study of Techniques for Intelligent Traffic Control System. Review paper by Nishant Bastian, Ayush Kanodia, Praveen Kumar Sharma, 2015. From the complete literature survey, it can be concluded that no matter whatever methodology is being employed by the author, the focus is to use a precise and correct segmentation technique many technique has been developed to make traffic light intelligent. Image processing has done a major contribution in this field by making the traffic light take decision on a real time basis. Even after so many techniques, problem is still faced when it comes to congestion and problem in image acquisition. Many times, there are certain noises, which can distort the images the images, leading to wrong decision by the traffic light.

Design of Intelligent Traffic Control System Based on ARM, Review paper by: Ashwini Dakhole, Mrunalini Moonet, 2013. In this paper, we have studied the optimization of traffic light controller in a city using ARM7 and micro controller. The ARM7 based traffic control system works on traffic related problems such as jams, unreasonable latency time of stoppage of vehicle emergency vehicle forcibly passing, etc. can be solved the system has several benefit such as simple structure, high reliability, low cost, good real –time, easy installation and maintenance so on. By using this system configuration, we try to reduce the possibilities of traffic jams caused by traffic light. The number of passing vehicle in the fix time slot on the road decide the density road range of traffic and on the basis of vehicle density calculation micro controller decide the traffic light delays.

## III. METHODOLOGY

Our methodology of this project is to preliminary survey for obtaining various traffic data such as volume. The fieldwork and survey identify and notify the landslide. First, we are going to study basic parameters of traffic system. After we have selected site for our project, which is from Pune station to Wadia College of engineering which is 1.1 km, consist of 5 signal. Then calculating traffic flow of selected route by using video photography for five days, 12 hr. per day. After calculating traffic flow, calculate traffic parameters like density, speed, headway etc. For our pre decided route the average speed calculation by observation. We are going to design signal by Webster method by providing a speed range in between 35 km/hr. to 45km/hr. to reach the next signal. From this design, optimum green signal and fix, the next signal timing.

## IV. EXPERIMENTAL WORK

Route such as to allow traffic flow without getting red signal.
For this, we have to maintain speed range in between 35 km/hr. to 45 km/hr. In our videography we come to know that morning, 9 am-10 am is peak hour and more traffic as compare to the evening 7 pm-8 pm peak hour, so in all signal design we concerned with morning peak hour.

- First, we are going to study basic parameters of traffic system.
- After we have selected site for our project, which is from Pune station to Wadia College of engineering which is 1.1 km, consist of five signals.
- Then calculated traffic flow of selected route by using video photography for five days, 12 hr. per day

- We are going to design signal by arithmetic means by providing a speed range in between 35 km/hr to 45km/hr to reach the next signal.
  - From this design optimum green signal and fix the next signal timing.

| Time interval(min) | Flow(q) (veh/hr) | Speed (v) (km/hr) | Density(k) (veh/km) | Space mean speed(VS) (m/s) | Space headway(HS) (m) | Time headway(HT) (sec) |
|---|---|---|---|---|---|---|
| 0-5 | 1400 | 16.37 | 86 | 4.52 | 11.62 | 2.57 |
| 5-10 | 1110 | 16.37 | 68 | 4.53 | 14.70 | 3.24 |
| 10-15 | 1130 | 16.37 | 69 | 4.55 | 14.50 | 2.19 |
| 15-20 | 1246 | 16.37 | 76 | 4.55 | 13.15 | 2.89 |
| 20-25 | 1310 | 16.37 | 80 | 4.55 | 12.5 | 2.75 |
| 25-30 | 1120 | 16.37 | 68 | 4.57 | 14.70 | 3.22 |
| 30-35 | 920 | 16.37 | 56 | 4.56 | 17.85 | 3.85 |
| 35-40 | 810 | 16.37 | 49 | 4.49 | 20.40 | 4.54 |
| 40-45 | 1112 | 16.37 | 68 | 4.54 | 14.70 | 3.24 |
| 45-50 | 825 | 16.37 | 50 | 4.58 | 20 | 3.37 |
| 50-55 | 925 | 16.37 | 57 | 4.51 | 17.54 | 3.89 |
| 55-60 | 724 | 16.37 | 44 | 4.57 | 22.72 | 4.97 |

Table -1. Calculation Of Traffic Parameter

•After calculating traffic flow, calculate traffic parameters like density, speed, headway etc.
•For our pre decided route the average speed calculation by observation.

### 4.1 Fuel Consumption

Fuel consumption have been calculated by considering only one side traffic volume i.e. S1-A, S2-A, S3-A, S4-A, S5-A. This is only because of we are designing signal for this route only.

| Sr no | Types of vehicle | Fuel consumption ml/sec | Remark | No. of vehicles | Fuel consumption ml/sec | Fuel rate per lit | Consumption cost in Rs/sec | Consumption cost in Rs/min |
|---|---|---|---|---|---|---|---|---|
| 1. | Two wheelers | 0.056 | Petrol | 520 | 29.12 | 76 | 2.21 | 132 |
| 2. | Car | 0.163 | Diesel | 179 | 29.18 | 62 | 1.80 | 108 |
| 3. | Bus/truck | 0.891 | Diesel | 58 | 51.69 | 62 | 3.20 | 192 |
| 4. | Auto/six seater | 0.145 gm/sec | CNG | 295 | 42.77 | 42 | 1.79 | 109 |
| | | | | | | | Total = | 541 |

From table 2 it has been observed that from peak hours, those no of vehicles stop over S1 (A) signal for an hour it will consume Rs 541 per minute and Rs 6492 for a day.

a. Fixing of signal timing for S2 signal

If group of vehicle pass from S1 signal at speed range in between 35 km/hour to 45 km/hour, it will reach the S2 signal in,

$= \frac{35*1000}{60*60} = 9.72$ m/sec

$= \frac{45*1000}{60*60} = 12.5$ m/sec

Distance from S1 to S2 is 400m,
At 35 km/hour, Time taken to cover distance = t = d/s = 400/9.72 = 41.15 sec
At 45 km/hour, Time taken to cover distance = t = d/s = 400/12.5 = 32sec
Therefore, average of time taken to reach the S2 signal at speed of 35 km/hour & 45 km/hour is 40 sec.
Therefore, from above it is concluded that, green timing of S2
(A) should fix after 40 sec of green signal S1 (A) so to pass the group of vehicle without stopping.
Therefore fixing of all signal timing in same manner.

Signal designed by Webster method and timing of signal fixed so as vehicle can pass without stoppage. The developed timing of signal is as shown in table 3:

| | | Green | | | | Red | | | | Yellow | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Intersection name | WE A | NS B | EW C | SN D | WE A | NS B | EW C | SN D | WE A | NS B | EW C | SN D |
| 1 | S1 Gadital | 30 | 40 | 40 | | 45 | | 50 | 50 | 3 | | 3 | 3 |
| 2 | S2 Alankar talkies | 110 | 100 | 125 | 130 | 80 | 95 | 115 | 105 | 4 | 4 | 4 | 4 |
| 3 | S3 Jahangir hospital | 50 | 55 | 60 | | 60 | | 80 | 130 | 4 | | 4 | 4 |
| 4 | S4 Wadia college | 60 | | 60 | 55 | 60 | | 60 | 140 | 4 | | 4 | 4 |
| 5 | S5 Petrol pump | 40 | 40 | 40 | 40 | 60 | 150 | 110 | 140 | 4 | 4 | 4 | 4 |

## V. CONCLUSIONS

Due to revise signal arrangement once get green signal at any crossing it will get green signal for processing signal which will helps to save time and petrol. Traffic Flow Prediction and Signal timing optimization method proposed in this project has proved to reduce delays at an intersection. A traffic sensor was developed for predicting the traffic flow and optimizing the green timing. Coordinated Signal Timings along an arterial can reduce delays further. Future work will be to create a system that can control and coordinate the signal timings along an arterial. To make such arrangement be generally spends a money on infrastructure such as flyovers and under ways its cost near about 225 to 250Cr. This development signal system its development and installment cost is very cheap as compare to infrastructure and under ways project cost. It will be beneficial for environment pollution control. In this, develop system chances of accident are reduce.

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