Case Study on Traffic Control in Signals from Periyar Bus Stand to Thepakulam – Madurai

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Abstract - *In a developing country like India, the traffic congestion poses a great issue and stands as great obstacle to the economical development. This issue is due to the increase in individual vehicles; reduction in the use of public transport etc .Many experts suggested and implemented great ideas to reduce the traffic congestion by increasing the facilities of transportation. This paper suggests a simple way to reduce traffic congestion, travel time, pollution, fuel consumption etc by reducing the time spent in traffic signals*

Keywords: Congestion, Traffic signal, Road speed, Environment, Pollution control, Signal timings, Travel time reduction.

1. INTRODUCTION

The first development of a man's journey started with a playful invention of single wheeled vehicle. It lacked in balancing and the drawback was overcome by two wheeled one. Since then, each drawback was overcome with an alternative solution. The development is still in process and would be so till a man's brain functioning stops. Man used animals for his transportation purpose. Then, in a drastic innovative leap, vehicles that function with help of mechanical engines were invented. Today the usage of vehicles has gone too high giving impacts in two extremes. In one hand it gave rise to great technological development in the modern world and in other hand gives the worst possible effects on the environment.

In our daily routine vehicles has given an incredible effects in our lives .Each household owns at least one vehicle .In most cases it is more than one and in the few cases it is more than the number of members in the family in our developing nation this development ultimately increases the traffic congestion to a great extent reducing traffic is the most discussed topic by the officials related to traffic more steps such as installations of traffic signals , construction of flyovers , new road facilities , one way diversions and division of lane are taken by the government to solve the issue

The thoughts might be the same in every single minds standing in traffic congestion including traffic management officers most of them say extension of roads the invaluable time spent in the traffic congestion is the worst tragedy we face in life each day. Increase in traffic increases the fuel consumption of the vehicles, increases the heat produced; more time is wasted and environmental issues increases with traffic issues.

In this study the route chosen is just a sample from a lot. All over the chosen route; lane separations, one-way diversions, route changing, installation of traffic signals, construction of flyovers, bridges have good impact on the traffic control, reduces accidents, facilitates good monitoring of traffic but has no effect on the time spent in traffic signals and its consequences on environment. A good number of schools, colleges, factories, markets, etc contribute to the traffic in the route considered.

Reduction of traffic congestion and the environmental effects caused by the vehicles are very essential to preserve today's degrading environment and rapidly increasing count of vehicles. This should be done in all possible ways so that the environmental effects though not eliminated is at least reduced to some extent as the country is moving towards the sustainable development which means development without disturbing the rights of the future generation, aiming the development of traffic facilities in the same way is also an essential one. Thus we also consider the aspect of environmental effects of the issue focused.

Fuel consumption of vehicles contributes to the major part of the fuel used in the country. Such a non renewable resource must be used, handled and preserved with at most care and should also be handed over to the next generation since it is their right to use, handle and preserve. In such a critical situation, the vehicles waiting for the green signal of each traffic obviously is in running mode and hence the fuel consumption increases. The heat produced by the vehicles is already high, when it is in traffic congestion; the heat produced by all the vehicles accumulate and by all the vehicles accumulate and again leads to more global warming effects.

With more social concerns, the automobiles then manufactured was done with less fuel consumption, less production of heat and smoke, safety precautions, etc. the automobile industries has gone a far way in development regarding this issue has very less impact. The increasing population increases the vehicles and also lead to increase in traffic. Each development of industries, institutions, increase in employment, all contribute to the traffic. Parking of vehicles in a congested road or area also contributes to the traffic. Gradual or sudden narrowing of a road in a route of travel has a great impact on traffic congestions.

Movement of vehicles like trucks, municipal solid waste collection vehicles, containers during peak hours or in the narrow paths or single lane roads in one of the major reason for traffic congestion. To overcome all the above mentioned effects of vehicles struck in traffic congestion, more than increasing the lanes, increasing road facilities , reducing time spent in travelling and traffic congestion is the most easier way to without any trouble.

This idea would work when vehicles comes across only green light of a traffic signal and is made to reach the next traffic signal when there is a green signal during its travel. In this way, when a vehicle reaches each traffic signal, the cycle of signal should be on its green stage.

2. OBJECTIVE

The main objectives of the study are to reduce the travel time of a person on travel; to increase energy efficiency by decreasing fuel consumption and to reduce traffic congestion during peak hours.

3. STUDY AREA

Madurai being the third biggest city in Tamil Nadu is located in the geographic position 9.9252°N latitude and 78.1198° E latitudes in the banks of Vaigai River. It serves as the administrative home office of the entire district. Population in Madurai according to 2011 data report is 1.56 million and 2017 is 2.94 million. The population density of Madurai is 823 persons / sq km. 91, 00,000 is the count of people who visited Madurai from in and around the country in which 5, 24,000 are foreigners. In the rank of most populated cities in India Madurai is in 25th place.

 Madurai has a railway junction which is a primary rail road station of few districts around. Indian Railways has 100 principle booking stations and Madurai junction is one among them. Madurai junction is the headquarters of railway division of southern railways. According to 2018 report, 60,000 passengers are dealt by the Madurai railway junction each day. The 2011 report says that 84.93 lakhs which is almost 85 lakhs is the count of tourist visitors in Madurai.

Madurai Airport has now become an international cum domestic airport under Airport Authority of India (AAI). It serves Madurai and other surrounding districts like Virudhunagar , Dindigul, Ramanathapuram, Sivagangai and Theni as a central one. In the year 2017-2018, Madurai airport has dealt with 14,42,807 passengers and 13,578 aircraft movements. The 35 non metro airports chosen for modernization includes Madurai airport and new integrated terminal was inaugurated on 12 September, 2010. It also started to serve as a customs airport from 1st January 2012 onwards.

The AIIMS (All India Institutes of Medical Sciences) hospital which is in Delhi is now to be started in Madurai as the 2nd branch in India and 1st branch in south India. Any special medication, therapy consultation or treatment required to cure a problem regarding health would now be available at Madurai. People from all over south India would visit Madurai for this reason.

The project has been approved for Rs1264 crores budget. The facilities would be as follows: there would be 15 to 20 super speciality departments, 1500 outpatients per day and 1000 inpatients per month. It has been announced that 262.62 acres were granted for the massive construction. All these aspects give a good idea about the number of people and vehicles going to visit Madurai and the traffic to be increased.

Most people from the districts of southern Tamil Nadu have the habit of visiting Madurai for shopping purpose, official dealings, medical treatments, educational purpose, marketing facilities, tourism, cargo, etc. Tamil Nadu's important traffic circles includes Madurai one among them. 12754 auto rickshaws are on run in Madurai and are all registered. All Of them are registered for renting purpose running inside the city limit. Apart from government buses running in Madurai there are many private buses which are registered and all serves as means of local transportation. SH-32, SH-33, SH-72 are the state highways that has connected many parts of Madurai with them. There are seven circles in highway network of Tamil Nadu that is inclusive of Madurai. Tamil Nadu state transport corporation (TNSTC) is working with Madurai as its headquarters. Madurai, Dindigul, Viruthunagar, Theni are the districts connected by the city buses running in the city and also connects local areas.

The central Madurai consists of Periyar bus stand. Its eastern zone owns Anna bus stand and Anupanadi bus stand. Northern part is covered by Pudur bus stand and southern part is covered by Thiruparankundram and Thirumangalam. Next to Chennai, Madurai is the city that is served best by city buses. All these aspects contribute to major traffic in Madurai since all these factors are somehow linked with road travel as at least a part of it.

4. CAUSES

The chosen route is Periyar bus stand to Thepakulam. It covers five traffic signals namely Periyar bus stand, Keelavasal, Munichalai, Ganesh theatre and Thepakulam signal. Many of the factors influence traffic in each of this location.

Periyar signal: Madurai railway junction; Periyar bus stand; textile shops like Pothys, Chennai silks, etc; Pandi bazaar and Meenakshi bazaar; Meenakshi Amman temple and surrounding commercial streets in its western zone, etc causes traffic in Periyar signal. Fig 1 to fig 7 shows traffic in Periyar.

Fig-1

Fig-2

Fig-3

Fig-4

Fig-5

Fig-6

Fig-7

Keelavasal signal: Tourist spots like Thirumalai Nayakar mahal and Meenakshi Amman temple; surrounding commercial streets in eastern zone of Meenakshi Amman temple; the Vethalapettai market; schools; etc. . Fig 8 to fig 12 shows traffic in Keelavasal
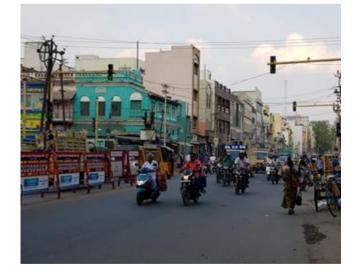

Fig- 8

Fig -9

Fig -10

Fig -11

Fig -12

Munichalai signal: VHN Girls school, wedding halls nearby; Sandhapettei market; Nirmala school; etc. . Fig 13 to fig 14 shows traffic in Munichalai

Fig-13

Fig- 14

Ganesh theatre signal: Nirmala school; Thiagarajar College of arts and science; commercial streets around; etc. Fig 15 shows traffic in Ganesh Theatre.

Fig- 15

Thepakulam signal: Amman temple; Thiagarajar college of arts and science; Velammal College of Engineering and Technology; KLN Polytechnic college; etc. . Fig 16 and fig 17 shows traffic in Thepakulam.

Fig-16

Fig-17

5. TRAFFIC FORECASTING METHODS

The previous studies regarding this issue has used various methods of forecasting vehicles such as using historical big data, deep learning method, internet of vehicles, floating car data, hybrid model analysis, technological forecasting attributes of adjacent roads, using multivariate non parametric regression, heterogeneous historical data, etc.

While using the historical big data, the spatio temporal behavior of vehicles is measured and its accuracy is made higher by Mean Squared Error (MSE) and Mean Absolute Percentage Error (MAPE). Internet of vehicles (IoV) when in use gives the congestion level when all of them are seen with integrated view at each location. Floating Car Data is again the same but it uses the data of moving vehicles that are using servers like GPS, etc.

Technological forecasting is a great tool that can be used for future generation vehicles. Attributes of adjacent roads such as traffic flow, traffic speed, road occupancy and traffic density are used to predict speed flow. Heterogeneous historical data is used to forecast by simple methods like arithmetic increment, etc. All these are methods used in previous studies about traffic.

Traffic forecasting method used

In this paper, manual counting method is carried out to forecast the number of vehicle of each category such as two wheelers, cycles, auto rickshaws, car, jeep, van, trucks, buses etc.

6. METHODOLOGY

The preliminary data collection is done. The first step is to collect data regarding the geographical information such latitude, longitude, altitude, road width, etc. The next step is to collect data of the traffic volume at each signal. Table 1 to table 5 shows the geographical position of each traffic signal along with the road width.

Table-1: Preliminary data– Periyar bus stand

Details	Data
Latitude	9.91658° N
Longitude	78.1128° E
Altitude	214.48 m
Road width	60 ft (17.94m)

Table-2: Preliminary data – Keelavasal

Details	Data
Latitude	9.91764° N
Longitude	78.12554° E
Altitude	213.95 m
Road width	20 ft (5.64m)

Table-3: Preliminary data – Munichalai

Details	Data
Latitude	9.91716° N
Longitude	78.1328° E
Altitude	215.84 m
Road width	6m

Table-4: Preliminary data – Ganesh theatre

Details	Data
Latitude	9.91489° N
Longitude	78.14088° E
Altitude	208.49 m
Road width	13.29m

Table-5: Preliminary data – Thepakulam

Details	Data
Latitude	9.97171° N
Longitude	78.14871° E
Altitude	201.08 m
Road width	40 ft (10.97m)

An average value of the vehicle count in each category at each signal that is calculated by taking manual counting for 3 days. Table 6 to table 10 shows the average values at peak hours in morning and evening.

Table-6: Average vehicle count – Periyar bus stand

Timing/ Category	Morning 8 am to 10 am	Evening 4.30 pm to 6.30 pm
Two wheeler	2390	2436
Auto rickshaw	728	738
Car/jeep/van	541	498
Tempo	38	50
Mini bus	120	119
Standard bus	374	328
Truck	48	22
Tractor	3	2
Cycle	300	215

Table-7: Average vehicle count – Keelavasal

Timing/ Category	Morning 8 am to 10 am	Evening 4.30 pm to 6.30 pm
Two wheeler	2052	1897
Auto rickshaw	607	551
Car/jeep/van	419	423
Tempo	28	25
Mini bus	91	83
Standard bus	189	192
Truck	21	15
Tractor	2	1
Cycle	230	240

Table -8: Average vehicle count – Munichalai

Timing/ Category	Morning 8 am to 10 am	Evening 4.30 pm to 6.30 pm
Two wheeler	1633	1557
Auto rickshaw	355	389
Car/jeep/van	395	425
Tempo	9	14
Mini bus	53	62
Standard bus	181	187
Truck	21	21
Tractor	1	1
Cycle	11	12

Table-9: Average vehicle count– Ganesh Theatre

Timing / Category	Morning 8 am to 10 am	Evening 4.30 pm to 6.30 pm
Two wheeler	1550	1305
Auto rickshaw	444	404

Car/jeep/van	460	445
Tempo	14	12
Mini bus	43	45
Standard bus	172	153
Truck	16	11
Tractor	1	1
Cycle	11	10

Table-10: Average vehicle count – Thepakulam

Timing / Category	Morning 8 am to 10 am	Evening 4.30 pm to 6.30 pm
Two wheeler	2390	2436
Auto rickshaw	728	738
Car/jeep/van	541	498
Tempo	38	50
Mini bus	120	119
Standard bus	374	328
Truck	48	22
Tractor	3	2
Cycle	300	215

The traffic signal cycle is made to complete in **2 mins** (120 secs) which gives 30 secs of green signal in each direction of traffic clearance.

In our country, all the traffic signals are operated manually though it can be used as automated one. In this paper, we use it as automated one. The preliminary data collection also involves the distance between consecutive traffic signals it is listed in table 11.

Table-11 : Distance between consecutive signals

Starting point	Distance	Destination
Periyar bus stand	2.5 km	Keelavasal
Keelavasal	0.8 km	Munichalai
Munichalai	1 km	Ganesh theatre
Ganesh theatre	1.1 km	Thepakulam

All these data are thoroughly analyzed to determine the speed to be incorporated by vehicles so that it is made to encounter the green light when it reaches the next traffic signal.

The timing of the traffic signal cycle to be adopted at each traffic signal is decided based on the number of vehicles that passes the traffic signal within the required period of time as 2 mins i.e 30 secs for traffic clearance of each direction.

As the timing to be adopted is determined, then the speed to be incorporated is calculated. When the distance and time is known, it facilitates the determination of speed

$$\text{Speed} = \frac{\text{distance(km)}}{\text{time(hr)}}$$

Since we have incorporated our signal cycle timing as 2 mins, we need to ensure that we reach the next signal in time which is a multiple of range 1.5 to 2 mins. Thus we encounter a green signal in the next traffic signal.

7. RESULT

Table 12 shows the starting point, destination, distance and speed to be adopted and time that would be consumed.

Table -12: Speed to be adopted between each signal

ROUTE	DISTANCE (km)	SPEED (km/hr)	TIME (mins)
PERIYAR TO KEELAVASAL	2.5	40	3.75
KEELAVASAL TO MUNICHALAI	0.8	30	1.6
MUNICHALAI TO GANESH THEATRE	1	40	1.5
GANESH THEATRE TO THEPAKULAM	1.1	40	1.65

8. DISCUSSION

Thus by incorporating this speed as the design speed of specified roads in the chosen route passengers are made to encounter green light in each traffic signal in the route. The traffic congestion can be reduced to considerable level and the fuel consumption can also be reduced. Our objectives of reducing traffic congestion, fuel consumption and travel time can be achieved.

9. TRIAL JOURNEY

A trial journey was made from Periyar bus stand to Thepakulam to ensure the speed and time determined. Apart from the time spent in traffic signals 8.5 mins to 10 mins was required to reach the destination.

A friend was made to travel in the speed of 50 km/hr and asked for time spent in travel. It was found that it took 25 mins to reach the destination during peak hours. Thus by adopting the determined signal timings and speed, the travel time is reduced along with the reduction of fuel consumption and traffic congestion and would ultimately lead to an economic transportation and good impact on environmental effects.

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