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Advanced Traffic Management System and Possible Solutions for Traffic Congestion

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Abstract - *Traffic congestion is perhaps the worst of the scenarios seen in the cities. With rapid development, increasing population and demand for innovative services managing a city's transportation network is a complex challenge. Traffic congestion on main roads leads to various problems such as transportation delays, accidents and air pollution. The cities need to implement new strategies and technologies with the aim to reduce traffic congestion. Various techniques have been applied to control traffic. However, Advanced Traffic Management System (ATMS) is an efficient solution for traffic management that showed significant potential for reducing traffic congestion on road networks. The Advanced Traffic Management System (ATMS) is a specialized area of research and study within the field of Intelligent Transportation System (ITS). Smart cities that adopt ATMS solution are capable of solving traffic congestion problem by exploiting its technologies.*

Key Words: **ATMS (Advanced Traffic Management System), ITS (Intelligent Transportation System), Traffic congestion, LOS (Level of Service).**

1. INTRODUCTION

Rising Traffic congestions on urban road networks has become an inescapable and increasingly problematic condition as it is characterized by decreased speeds, loss of travel time and increased vehicular queueing. Rapid growth of urbanization and economic development has resulted into growth in urban population due to which there is a remarkable increase in urban travel demand. Over last few decades with advancement of technology new luxurious vehicles have captured the market which has increased the demand of the private vehicles. Thus, due to increase in urban population and growth in private vehicle ownership even the cities with sufficient infrastructures and well-planned road networks are facing the problem of traffic congestion. Traffic congestion has resulted in the saturation of the transportation infrastructures, increase in number of road accidents and air pollution due to harmful vehicular emissions.

Various solutions were implemented for the mitigation of traffic congestion and its outcomes. Construction of better and efficient road networks, building new transportation infrastructures, encouraging the use of public transport facilities, implementing taxes for controlling growth of private vehicle ownership, introducing new traffic controlling solutions and safety systems are some of the solutions utilized for the purpose of reducing traffic congestion on the roads. However, these conventional solutions are not sufficient enough to control the increasing traffic congestion problems.

The difficulties arising in controlling the traffic congestion has attracted the attention of many researchers to work in the areas of Advanced Traffic Management System (ATMS). Intersections integrated with intelligent technologies have the potential to control the traffic congestion and its outcomes. Advanced Traffic Management System (ATMS) is an efficient and cost-effective solution to manage highway traffic by collecting real time information, processing, analyzing and finally providing the proper solution according to the situation to the users. Advanced Traffic Management System (ATMS) apply modern information technologies to provide effective monitoring, control and operation of traffic. It involves a set of intelligently integrated roadside equipment that are connected to ensure smooth traffic movement and safe journey.

A study of traffic congestion on the selected study route of Amravati district of Maharashtra state is presented in the project. Various applications of Advanced Traffic Management System (ATMS) are suggested which will help to manage the traffic efficiently, reduce the traffic congestion on the study route and improve the road safety of the road users. The study provides possible solutions for reducing the traffic congestion by the application of Advanced Traffic Management System (ATMS).

2. METHODOLOGY

The study of existing condition of the study route is essential to determine the exact reasons of traffic congestion and the problems associated with it. Field data of the study route such as traffic volume count during peak hours, vehicle speed study, accident study and parking study is needed so that appropriate application of Advanced Traffic Management System (ATMS) can be utilized for the mitigation of traffic congestion problem.

The survey of the selected study route was carried out to gather the data of physical attributes of the road network. Traffic volume count was conducted at various road intersections which are included in the study route. Traffic

volume count is required for determining the capacity of the road and level of service (LOS). Spot speed study was carried out at different sections of the study route. Roadside interview is very essential to know about the actual traffic related problems faced by the road users and to estimate the extent of traffic congestion. The capacity of the roadway can be determined by using the empirical formula for investigating the problems of traffic congestion.

2.1 Study Route

The study route chosen for this project is from IRB Toll to Rajapeth square Amravati.

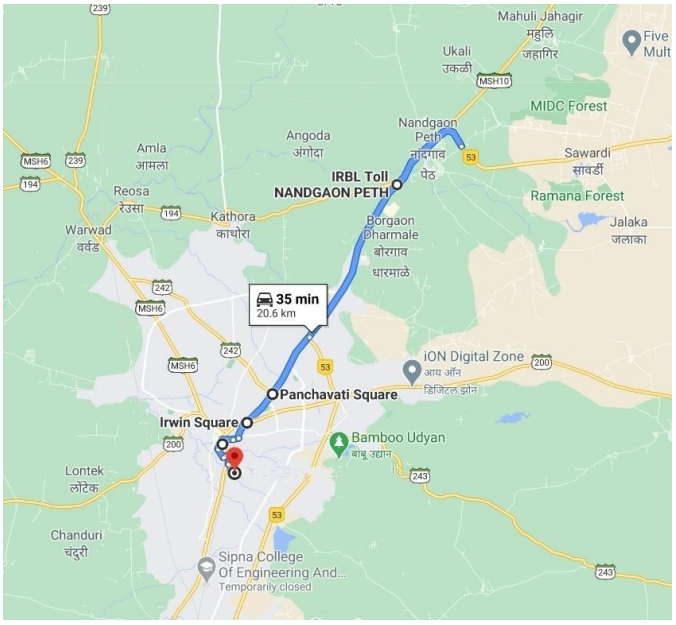

Fig -1: Study Route (Source: Google Map)

2.2 Traffic Volume Study

A traffic volume count is a count of number of vehicles crossing a section of a road within a specified period of time. Traffic volume study is essential for understanding the general quality of service offered by the road to the road users and efficiency of that road network. Traffic flow characteristics can be used to find out whether the particular road section is handling the traffic more or less than its capacity. Traffic volume is expressed in vehicles per hour or vehicles per day. Traffic volume counts can be conducted manually or by using mechanical counters.

The traffic on the roads is composed of vehicles of various different categories having different static and dynamic characteristics. Certain equivalency factors are used to convert these different types of vehicle to one common standard vehicle unit. Therefore, the traffic flow is converted into equivalent Passenger Car Unit (PCU). The traffic volume and capacity are then expressed as PCU per hour or PCU per day. The Indian Road Congress (IRC) has recommended equivalency factors for conversion of different types of vehicles into equivalent passenger car units (PCU).

Table -1: PCU values adopted for study

Sr. no.	Type of Vehicle	PCU
1	Bus	3.0
2	Passenger Car, Auto-rickshaw, tempo or Van	1.0
3	Cycle, Scooter or Motor Cycle	0.5
4	Light Commercial Vehicles	1.5
5	Agricultural Tractor without Trailer	1.5
6	Agricultural Tractor with Trailer	4.5
7	Truck	3.0
8	Truck with Trailer	4.5
9	Cycle-rickshaw	2.00
10	Horse-drawn vehicle	4.0
11	Bullock Cart	8.0

2.3 Spot Speed Study

Spot speed is the instantaneous speed of a vehicle at a specified location. Spot speed study is required for determining the problems related to traffic congestion on roads and the data gathered in spot speed study is used for the study of the traffic capacity of the road.

2.4 Road Side Interview

A roadside interview is a quick and simple method of collection of data within a short duration of time. Interview stations are selected on the study route where the vehicles are stopped and the information such as origin and destination, time of arrival, purpose of trip, type of vehicle, number of passengers in the vehicle, location of stoppages etc. are collected on the spot by the group of persons. Road side interview can be conducted by directly interviewing the drivers of the vehicles on the spot or by collecting the answers to the prescribed questionnaire.

2.5 Capacity

Capacity analysis helps to acquire a clear understanding about the capability of a transportation facility to accommodate traffic volume. According to the Highway Capacity Manual (HCM) the capacity is described as the maximum hourly rate at which vehicles can pass a uniform segment of a roadway or lane within a specified period of time under prevailing traffic, roadway and control condition.

2.6 Level of Service

Level of Service denotes the quality of traffic service. Level of service (L.O.S.) is a qualitative measure which describes the operational conditions within a traffic stream, based on service provided by the road such as convenience, comfort, traffic obstructions, travel time, speed and freedom of movement.

3. Application of Advanced Traffic Management System (ATMS)

Advanced Traffic Management System (ATMS) is an integrated solution which can efficiently manage the traffic by the collection of real time information, data processing and data analysis. Various applications of Advanced Traffic Management System (ATMS) includes Variable message sign (VMS), Road Weather Information System (RWIS), Ramp metering system, Traffic signal monitoring and control, Automated warning system, Automatic Traffic Counting and Classification System, Emergency call boxes, Video Incident Detection System.

3.1 Variable Message Sign (VMS)

Variable Message Sign (VMS) are electronic display panels which are installed along the roads for effective and safe traffic management on the roads by displaying information and messages in the form of text, images and graphics. It provides information to the travelers about special incidents, road accidents, traffic congestion, speed limit, traffic conditions, weather conditions and provide guidance to the drivers about parking and alternative routes. Variable message sign (VMS) uses solar sensors and LED technology for providing clear visibility at night, during day time and in all types of weather condition.

3.2 Road Weather Information System (RWIS)

Road weather information provides data about real-time atmospheric conditions, Pavement surface conditions, water level of channels or rivers near the roads and other data. The components of Road Weather Information System (RWIS) includes automatic measurement and monitoring stations and various sensors. Meteorological sensors are used to determine weather data such as precipitation, atmospheric temperature, wind speed and direction, relative humidity, barometric pressure and snow accumulation. Pavement sensors can determine the condition of the pavement, temperature of the pavement and the subgrade and freezing point of the pavement surface.

3.3 Ramp metering systems

Ramp metering system are efficiently used to manage and control the traffic entering freeways. Ramp meter is the device consisting of traffic signal controller that regulates the flow of traffic at entrances to freeways. Ramp metering system helps to reduce traffic congestion caused by uncontrolled access of vehicles at the entrance of the freeways. It reduces the delays by breaking the large group of vehicles entering the freeways. Ramp metering system controls merging and diverging operations of the vehicles and allows safe and smooth traffic movement. It reduces the risk of accidents and improves safety of the drivers.

3.4 Video Incident Detection System

Traffic incidents that occur on roads are the major cause of traffic congestion and delays. Incidents are the random events that occur on roads such as traffic crashes, accidents, spilled cargo, stopped vehicles, highway maintenance or construction operations, sporting events or concerts. These incidents affect normal traffic flow. Video Incident Detection Systems automatically detects these incidents. It provides incident detection by processing image data captured by CCTV cameras installed on the roads. As soon as the incident is detected by the Video Incident Detection System, it implements pre-programmed responses and alerts the concerned authorities for immediate action.

4. RESULT

After performing the traffic volume study, spot speed study and roadside interview it was found that traffic congestion is the major problem on the study route. After calculations the result was found that the volume/capacity ratio exceed 1 and the level of service (LOS) of Intersections within the study route is F.

5. CONCLUSION

The problem of traffic congestion on the study route can be reduced by the application of Advanced Traffic Management System (ATMS) as the suggestions are made according to the problems observed on the study route after collecting the data and performing traffic volume study, spot speed study and roadside interview. Traffic volume study carried out at the intersections helped to determine the volume/capacity ratio and roadside interview carried out on the study route gave an idea about the actual traffic related problems. The capacity and level of service (LOS) of intersection can be improved by proper application of Advanced Traffic Management System (ATMS). Advanced Traffic Management System (ATMS) can be an effective system for reducing congestions on study route. It can improve the traffic situation on the highways by improving travelling safety, improving the travelling mobility, improving the system efficiency and conserving the energy and protecting the environment.

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