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Introduction to the selection of corridor and requirements, implementation of IVHS (Intelligent Vehicle Highway System) In Hyderabad

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Abstract: *Intelligent highway vehicle system is an advanced system which enhances the transportation systems, reduces the congestion and minimizes the environmental impact. To meet needs of future transportation, the present system must follow some strategies like build new capacity, manage travel demand, increase operational efficiency and advanced new technology. The most important part of system is wireless communication like GPS, fiber optic technology, satellite communication. Considering fiber optic technology, the cost of installation is more and the area of coverage is less. Hence researchers are finding alternate ways and selected WIMAX technology for wireless communication. This paper describes an overview of basic requirements for the implementation of IVHS in Hyderabad (India).*

Keyword: *GPS, IVHS, AVIS, ATMS, CVO, ATIS, PCU.*

I. Introduction

Intelligent vehicle highway system (IVHS) is an integrative program which includes information technology, advanced technologies with transportation system. Basically the congestions, traffic jams and road accidents occur due to lack of knowledge or information. So, to avoid the incidents and maintain the life span of highways IVHS is implemented. The principle behind the system is to exchange the information to and fro [1].This can be achieved by the wireless communication system and specialized sensors which may be non-intrusive sensors or intrusive sensors. Intrusive sensors include weigh in motion sensors and non-intrusive sensors include infrared detectors, microwave radar detectors, laser detectors etc. The data obtained by the sensor will be sent to center and it will be passed to travelers.

II. Implementation

India is the home to ancient Indus valley civilization and a region of historic trade routes and vast empires. The Indian subcontinent was its commercial and cultural wealth for much of its long history. India is a federal constitutional republic governed under parliamentary system consisting of 29 states and 7 Union Territories [2]. Among the 29 States, there are different metropolitan cities in the country.

They are Delhi, Mumbai, Kolkata, Hyderabad, Chennai, Bangalore, Ahmedabad, Pune, Surat, Jaipur and Kochi. Amongst the above cities, the transportation and traffic situations in Hyderabad are comparatively chaotic. The traffic levels are accelerating faster than the road capacity. Traffic congestion is more than an irritant and it is one of the leading problems being faced today. It could get worse unless we find better ways of using highways system and transit infrastructure.

III. Selection Of Corridor And Strategies

The answer for the traffic congestion lies in using the technology to steer traffic in the right direction. When coming to India, IVHS is completely a new concept to implement. It is successfully implemented in North America and South America and Europe.

IV. How IVHS Is Applicable To Hyderabad?

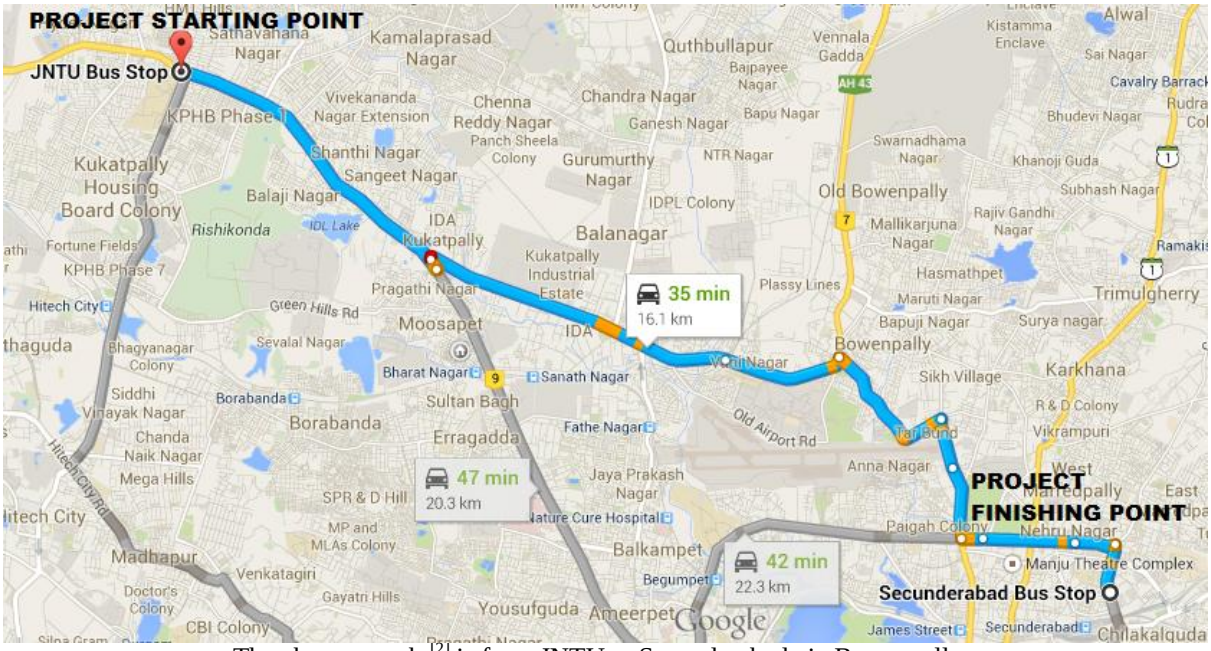
The road network in Hyderabad is radially configured with 3 National Highways (NH) passing through centre of the city. They are (i) NH-7 (National Highway 7 : North to south), (ii) NH-9 (National Highway 9 : Northwest to southwest), (iii) NH-202 (National Highway 202 : towards Northeast). While looking into condition of roads a gradual deterioration is noticed due to heavy flow of traffic. This causes uneven loadings, lack of material properties and composition lead to a low quality road that degrades faster and leads to accidents. To resolve the traffic related issues, the present system would prove to be a plausible solution. An upgradation to the current system is required to solve the traffic congestion, traffic jams, accidents and response time to

accident sites. The only option is IVHS, which will track the traffic information with help of computers using Closed Circuit TV Visuals (CCTV), Global Positioning System (GPS), satellite information and the other technologies.

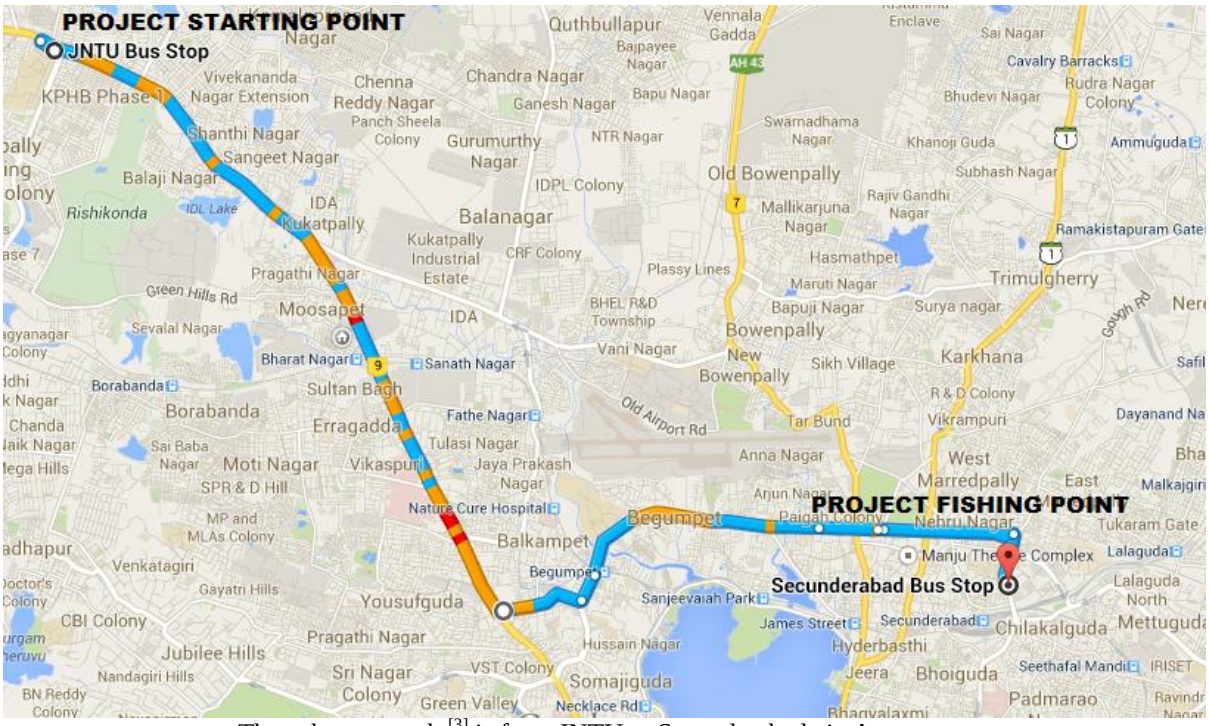
Surveys and studies are done in the corridor to get a clear idea for the implementation of IVHS. The corridor is from JNTU to Secunderabad via Bowenpally and via begumpet. This specific corridor is selected because of the traffic conditions and traffic flow in the corridor. The distance from JNTU to Secunderabad is 17.04KM via Begumpet and the distance between JNTU to Secunderabad is 15.8KM via Bowenpally.

The corridor consists of Educational hubs like JNTU, Kukatpally, S.R. Nagar, Business centres like Patny, Balanagar, Paradise, Ameerpet and the Residential areas like KPHB, Bharathnagar, Moosapet, Erragada, Begumpet, Prashantnagar. The corridor has around 10 junctions in each stretch.

Firstly, the reconnaissance survey was done to get a coarse assessment of corridor.



The above stretch [2] is from JNTU to Secunderabad via Bowenpally.



They above stretch [3] is from JNTU to Secunderabad via Ameerpet.

For the sake of convenience let the stretch of the corridor via Bowenpaly is termed as S1with the same aspect the stretch of the corridor via Ameerpet is termed as S2. We know that the Intelligent Vehicle Highway System will heavily rely on technology. Let us take a corridor in to consideration, for the basic installation of IVHS technological application like weigh in motion, GPS, detector technology, satellite communication, CCTV, Infrared, Radar technology etc. The reason behind the use of advance technology is to gather the information and pass it on in fraction of seconds.

To setup IVHS in this particular corridor, adoption of data receiving and transmitting system is required. Approximately the corridor covers the distance about 28.5kms. So, setting up the communication room may or may not be in the corridor but it must have an entire visual cover on the corridor.

Intelligent Vehicle Highway System is supported by different interactive elements. By linking them to the installation in this corridor we come to a conclusion that following equipment and implementation procedure are necessary [4]. They are:

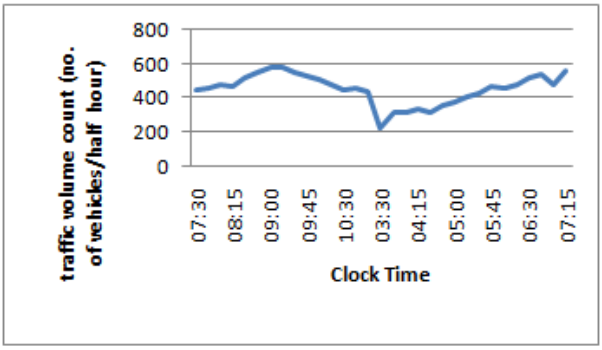
i. Advanced Traffic Management System (ATMS) ,
ii. Advanced Traffic Information System (ATIS) ,
iii. Advanced Public Transportation System (APTS) ,
iv. Commercial Vehicles Operations (CVO) and ,
v. Advanced Vehicle Information System (AVIS).

V. Advanced Traffic Management System (ATMS):

This element will monitor, control and manage area with wide operations and serve as the communication link between road way, vehicles and travellers. ATMS gets the information in operation from the traffic management centre, signals, detector technology, parking areas, police emergency and vehicles. The information acquired from here will be used to identify the traffic congestion and optimise the traffic signal timings. There is a limitation in this corridor i.e, the connection of vehicles with source for information is done by updating the vehicles with GPS technology and provides a user interface for the vehicle to operate smoothly. But so far now these sort of vehicles are hardly few. And the visual surveillance could be limited to traffic signals. For better efficiency the application of cameras must be provided in public places, parking areas etc. The detector technology is in the developing stages in the country, once developed it will differentiate between type of vehicles and the average vehicle velocity. At the signals fixed cameras arranged throughout the corridor. If the swinging cameras are arranged that will cover good amount of information than the fixed cameras. When coming to police emergency, the delay on response timing is reduced as the IVHS main concept is to integrate every agency and acquire information and transmit to the travellers, vehicles and commuters. Linking the police emergency to IVHS, the corridor consists of police stations in Kukatpally, SR Nagar, Begumpet, Bowenpally and Secunderabad. By maintaining the good coordination the delay in incident response time would be reduced.

VI. Advanced Traffic Information System (ATIS):

This element provides travellers with trip and traffic information with safety and warning messages related to environmental conditions. The travellers can get the pre-travelling information through different sources. Actually, the information given by the ATIS can be used as real time traffic information. If the IVHS is implemented the traveller can use the pathfinder in the event of doubt in the route. This operation is done by using the Global Positioning System for the identification of routes and to know where the vehicle is exactly located. The another mode of information from the ATIS is related to traffic congestion information. Through this the traveller can select the safest route which saves time and other resources. The real time traffic information can be received by the people by radios and internet etc. If a route is selected a person heading to Secunderabad from JNTU, using traffic information he can chose the route without traffic congestion or else can divert the route. Generally the route S1 will be with heavy traffic flow near Balanagar junction at peak hour time.



The above graph (taking the interval of 30 minutes in the peak hour time) show the traffic volume in the Balanagar junction in the peak hour timing in April 2014.

Due to heavy rush of traffic flow in the corridor and lack of information as well as lack of efficient management, the major traffic jams are becoming common. This traffic jams and congestions are degrading the quality of roads and eventually the life span of the pavement has gone down drastically. The strength of the pavement can be determined using level of service.

Level of service is defined as the qualitative measure describing the operational conditions within a traffic stream, and their perception by drivers/ passengers. Level of service generally describes the factors such as speed and travel time, freedom to manoeuvre, traffic interruptions, comfort, convenience and safety.

A level of service chart taken from IRC: 106-1990 is given in Fig.1.

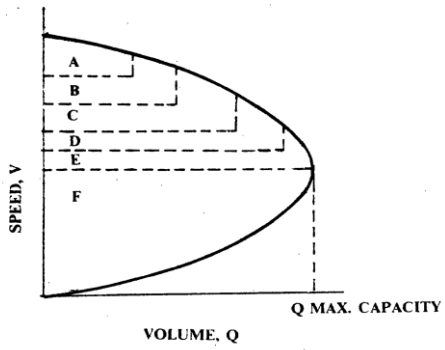


Figure1: Level of Service

Commonly six levels of service are recognized, designated from A to F , with level of service "A" representing the best operating condition(i.e.., free flow) and Level of Service "F" the worst (i.e.., forced or break down flow). The calculation of LOS is done by taking the junction points at different distances in the corridor in two stretches S1 and S2. These calculations are done by taking the passenger car unit PCU values at the section points which are considered as mid blocks for the corridor.

Level of service at section 1 (Kukatpally) Over all PCU values at mid block 1 = 2889 PCU/hour
Total design service volume = 2900
2889/2900= 0.996 => 99.6% (which is greater than 95%)
So, level of service for mid block 1 falls under category 'F'.

Level of service at section 2 (Erragadda)
Over all PCU values at mid block 2 = 2788 PCU/hour
Total design service volume = 2900
2698/2900= 0.903 => 90.03% (which is greater than 85%)
So, level of service for mid block 2 falls under category 'E'.

Level of service at section 3 (Ameerpet)
Over all PCU values at mid block 3 = 2877 PCU/hour
Total design service volume = 2900
2877/2900= 0.992 => 99.2% (which is greater than 95%)
So, level of service for mid block 13 falls under category 'F'.

Level of service at section 4 (patny)
Over all PCU values at mid block 4 = 2700 PCU/hour
Total design service volume = 2900
2700/2900= 0.931 => 93.1% (which is greater than 80%)
So, level of service for mid block 4 falls under category 'E'.

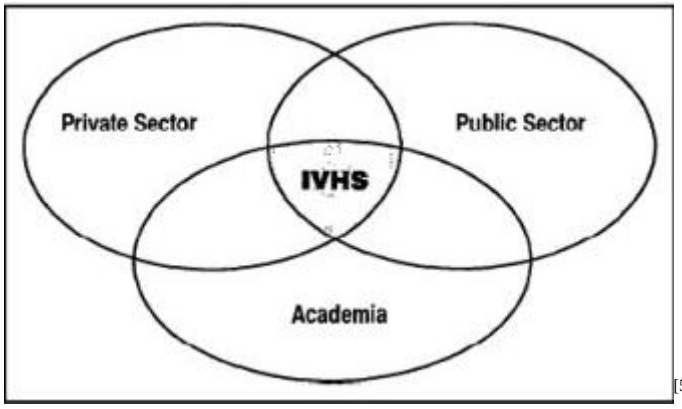
Level of service at section 5 (Balanagar)
Over all PCU values at mid block 5 = 2687 PCU/hour
Total design service volume = 2900
2687/2900= 0.926 => 92.6% (which is greater than 80%)
So, level of service for mid block 5 falls under category 'E'.

Level of service at section 6 (Bowenpally)
Over all PCU values at mid block 6 = 2557 PCU/hour
Total design service volume = 2900
2557/2900= 0.88 1 => 88.1% (which is greater than 80%)
So, level of service for mid block 6 falls under category 'E'.

The values of level of service explain the condition of pavement. Therefore, boosting the current transportation system is necessary at least now.

VII. Advanced Public Transportation System (APTS):

Another element behind the strategy of efficient IVHS is APTS. This particular system uses the advanced technology to make public transportation more attractive. This enhances number of customer utilizing the service in turn improves the profit. Therefore, intelligent vehicle highway system is a smart way to invest.
This system provides a customer interface to obtain information related to fares from one stop to another stop, availability of buses, frequency of buses etc. The best example is Bus Rapid Transit System. When coming to the corridor and taking S1 in to consideration, it consists of 14 bus stops (from project starting point to finishing point). Taking S2 in to consideration, it consists of 10 bus stops (from project starting point to finishing point). The advanced public transportation system can be used smoothly by digitalization of bus stops. By that a commuter can acquire the information related the travel. These bus stops (in the corridor) will get the information from the traffic management centre. Hence it will track the buses by satellite communications and detectors etc. The implementation of intelligent vehicle highway system will be preferred by all levels of government offices, the private sector and the academia.



[5]

VIII. Commercial Vehicles Operations (CVO):

This element will enhance the efficiency of motor carrier industry. Highways and roads are critical for everyday life. Traffic congestion, traffic jams, and truck overloading generates tremendous damages to highway system (pavements especially). Overloading trucks and other vehicles accelerates the deterioration of transportation infrastructure. The important way to reduce the damage is to control traffic loads. This will be analyzed by weigh-in-motion system. It will calculate the measurement of gross and axle weights of commercial vehicles and this calculation can be done by weigh in motion sensors. The sensors located on highways weigh trucks at high speed and the vehicles with no over loading will continue on their way. Potential offenders are diverted for inspection. Weigh in motion protect investment and ensures useful life. It also decreases CO2 emission and increases user satisfaction. Taking the corridor in to consideration the application of commercial vehicle operation consists of WIM sensors at particular areas where the commercial vehicles will have more frequency than other. The placement of sensors at Prashanthnagar, Balanagar, Bowenpally and the areas at Moosapet, Bharathnaagar, Ameerpet and Secunderabad will helps to identify the heavily loaded vehicles and help to divert them for inspection.

IX. Advanced Vehicle Information System (Avis):

This element will help the drivers to perform various vehicle functions. It warns the presence of the obstacles and vehicles in "driver blind" spots at night times and at the poor weather conditions. Basically this system will involve Infrared technology for the proper vision at dark. Whichever corridor is used this type of technology will help the drivers to drive safe at darks times that eventually reduces accidents.

X. Conclusion

Adapting and installing system described in the paper will upgrade the transportation in Hyderabad. The most important thing is updating the vehicles with user interface and installing with global positioning system. As the level of service for the roads is degrading, IVHS is a better way for investing in advanced technologies.

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