A Survey of Smart Technology on Road Traffic and Transport Management System

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***Abstract*- Smart transportation and clever metropolis site visitors control are revolutionizing how towns technique mobility and emergency response, whilst lowering congestion on metropolis streets. The main goal of smart technology is to improve the transportation system in case of cities where there is traffic Implementation of new flyovers, outer ring road mapping, metro mapping, also required junctions and emergency shortcuts road congestion. Traffic congestion on city road networks is increased rapidly, since the 1950s.**

When the traffic demand is great than the interaction between the vehicles reduce the speed of the traffic and finally results in traffic in congestion. To triumph over occasions in gift scenario, clever site visitors control machine may be initiated and we are study to find suitable alternate solutions to make traffic free city. This system also helps in monitoring the traffic signals and flow of vehicles by means of image Processing with sensors. Sensors are used for detecting the quantity of cars and speed. Main focused area of the project is optimizing traffic flow by studying and analyzing traffic volume at peak conditions, study of signal timing, basic and practical capacities at intersections, required routes where flyovers and outer ring road, metro and emergency shortcuts in Vijayawada.

Keywords: **Traffic congestion, Image pre-processing, Sensors, Smart technology.**

1. INTRODUCTION

Smart Technology Transportation System in case of cities is controlling trafficcongestion, regulating the traffic flow and parking studies.

Traffic congestion has been a persistent issue in urban areas around the world, leading to a host of problems such as increased travel times, air pollution, and reduced economic productivity. To address this problem, there has been a growing interest in the use of smart technology for road traffic and transport management systems. Smart technology can offer a range of solutions for traffic management, including intelligent traffic signal systems, real-time traffic monitoring and analysis, and smart parking systems.

This paper presents a survey of the latest developments in smart technology for road traffic and transport management systems. It provides an overview of the different types of smart technology that are being used, the benefits and challenges associated with these technologies, and case studies from around the world that illustrate their successful implementation.

The survey examines how smart technology can improve traffic flow, reduce travel times, and beautify protection for drivers, cyclists, and pedestrians. Additionally, it considers the potential for smart technology to support the transition to sustainable and low-carbon transportation systems by promoting the use of public transportation and alternative modes of transportation, such as cycling and walking.

The goal of Smart Technology is to improve the transportation system to make it more it more effective, efficient and safe. Smart Technology tools are based on three core features- Information, Communication and Integration that help operators and travellersmake better and coordinated decisions. Smart Technology interfaces with other functions (like police, toll collectors, public transport operators, traffic signal system operator's i.e.,local authorities). Smart Technology represents a wide collection of applications, from Advanced traffic control system, to electronic transit fare payments systems, to ramp

meters,to collision warning systems.
It operates 24 hours a day, ensuring the smooth flow of trafficas well as respond in a timely fashion to emergencies.

Why ITS In Vijayawada
Vijayawada is the commercial city of Andhra Pradesh and the third largest after Hyderabad and Visakhapatnam, with an area of 261.88 km2. The city municipal limits have a population of 1,048,240 (2011 Census), while the population of the metropolitan area is 1,491,202. The city is also popularly known by its historic name "Bezwada".
Due to this increase in the vehicles growth rate in the city day by day, the road users are also increasing hence the traffic problem in increased simultaneously. The growth rate of vehicles in Vijayawada is shown in table 1.2. By introducing Smart Technology in the city, it makes a lot of changes in the transportation in Vijayawada.

OBJECTIVES OF SMART TECHNOLOGY
Understand the Intelligent Transportation technologies (wireless communications, computational technologies, sensing technologies, video detection etc.) Study the various ITS applications like vehicle notification systems, warning systems, GPS etc.

- To improve traffic safety.
- To relieve traffic congestion.
- To improve transportation efficiency.
- To reduce air pollution.
- To increase the power efficiency.
- To promote the development of related industries Content.

2.LITERATURE SURVEY

2.1 Traffic Data and Analysis-Botswana

Botswana has been making efforts to improve its traffic data and analysis capabilities in recent years. The country's Department of Road Transport and Safety (DRTS) is responsible for collecting and analyzing traffic data and implementing policies and measures to improve road safety and traffic flow.
One of the key initiatives implemented by the DRTS is the establishment of a Traffic Management Center (TMC) in Gaborone, the capital city. The TMC uses advanced technologies and data analytics to monitor and manage traffic flow in real-time. The center collects data from various sources, including traffic cameras, sensors, and weather stations, and uses this data to optimize traffic signal timings and improve traffic flow.
Another initiative implemented by the DRTS is the deployment of a mobile traffic data collection system. The system consists of a fleet of vehicles equipped with cameras, sensors, and GPS trackers that collect real-time traffic data on key roads and intersections in major cities. The data is analyzed to identify traffic patterns, bottlenecks, and areas of congestion, and used to inform traffic management policies and measures.
Despite these efforts, there are still challenges in collecting and analyzing traffic data in Botswana. These include a lack of resources and skilled personnel, inadequate infrastructure, and limited access to advanced technologies. The DRTS is working to address these challenges through partnerships with other government agencies, private sector organizations, and international development partners.
Overall, Botswana has made significant strides in improving its traffic data and analysis capabilities in recent years, and the country is poised to continue to make progress in this area. By leveraging advanced technologies and data analytics, the country can improve road safety, reduce congestion, and enhance the efficiency of its transportation systems.

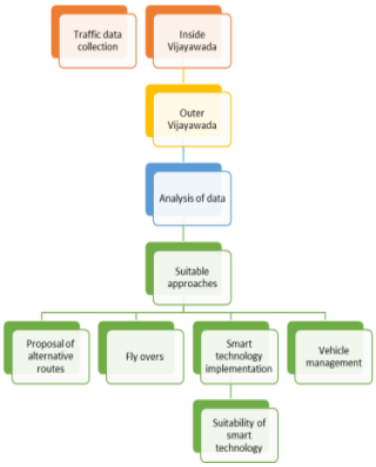
2.2 An Overview on Bus Rapid Transit System

Agarwal P K, Sharma Anupama, Singh A. P
In a study published in the Journal of Transport Geography, researchers analyzed the implementation and performance of BRT systems in Indian cities. The study found that BRT systems have the potential to provide efficient and sustainable transportation options in Indian cities, but the success of BRT projects depends on factors such as proper planning, design, and implementation.
In their book "Bus Rapid Transit Systems: Policy, Planning, and Implementation," the authors provide an overview of BRT systems, including their history, benefits, planning and design, and case studies from around the world. The book highlights the potential of BRT systems to provide efficient and cost-effective transportation solutions, particularly in developing countries where the need for sustainable and accessible public transportation is high.

Another study published in the Journal of Public Transportation by Agarwal P K and Sharma Anupama analyzed the implementation and performance of BRT systems in Indian cities. The study found that BRT systems have the potential to provide efficient and sustainable transportation options in Indian cities, but the success of BRT projects depends on factors such as proper planning, design, and implementation.

A review of BRT systems published in the Journal of Transport Geography by Singh A. P and Tiwari G. analyzed the development and implementation of BRT systems in different cities around the world. The review found that BRT systems can improve public transportation services by providing faster, more reliable, and more comfortable service than traditional bus systems. The evaluation additionally recognized the importance of planning, design, and stakeholder engagement in the success of BRT projects.

3. METHODOLOGY



4. DATA COLLECTION AND ANALYSIS

Table 4.0

TYPE OF VEHICLE	PCU VALUE
CAR	1.0
AUTO	0.5
BUS	2.2
LORRY/TRUCK	2.2
BIKES	0.4
BICYCLE(NMV)	0.3

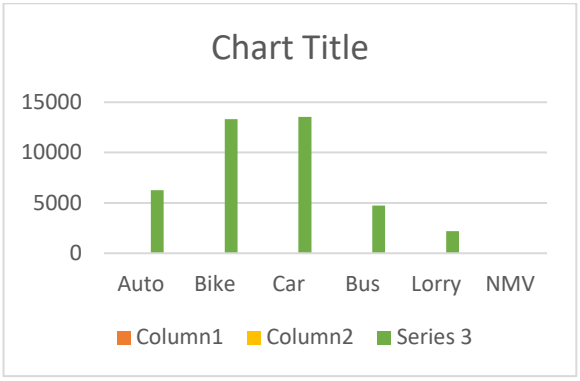
The traffic flow is tabulated into two paths. They are traffic flow away from Vijayawada and traffic flow towards Vijayawada.

Traffic flow is studied for period of 8 hours in three sessions.

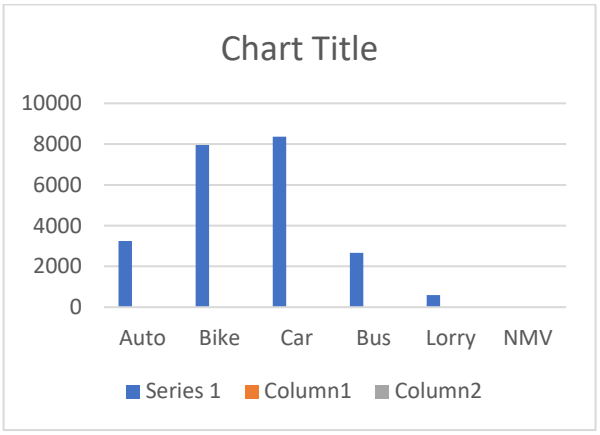
SESSION-1: 8.00AM TO 11 AM.

SESSION-2: 2.00PM TO 4.30PM.

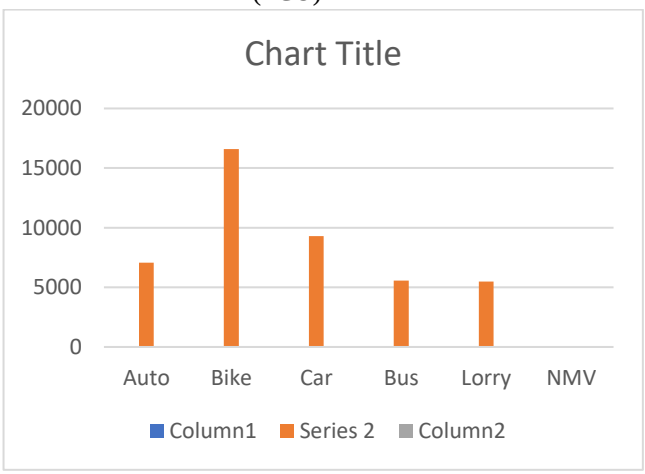
SESSION-3: 5.30PM TO 8.30PM.



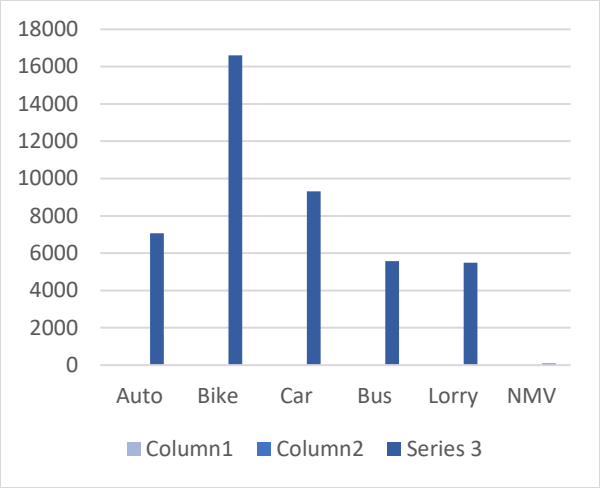
Graph-1 Over All Traffic Flow At Benz Circle (PCU)



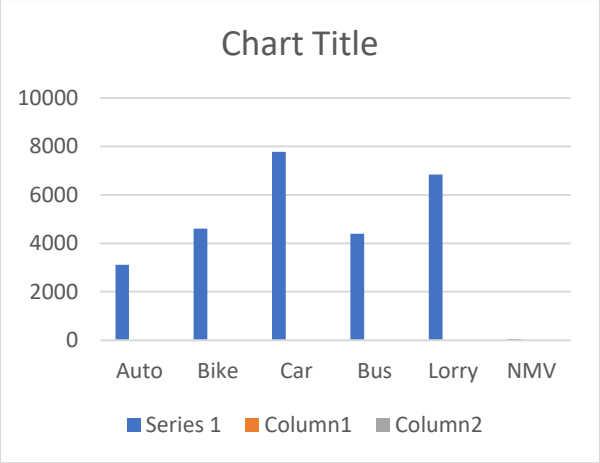
Graph-2 Over All Traffic Flow at Ramesh Hospital (PCU)



Graph-3 Over All Traffic Flow at Ramavarappadu Ring (PCU



Graph-4 Over All Traffic Flow at Police Control Room (PCU)



Graph-5 Over All Traffic Flow at IBM (PCU)

Peak Hour Problems: -

- Due to VIP'S Canvey's traffic jam occurs.
- No of Vehicles have been increases in peak hours mostly.
- More Traffic jams take place.

5. SMART TECHNOLOGIES

Technology	Working Principle	Sensors Used	Advantages	Disadvantages
Micro Wave Radar	Traffic Sensors work on the principal at when a signal is transimitted on to a moving vehicles.	Wavetronix Smart Sensors.	Low Power Consumption as the signals are of higher frequencies.	Radar takes more time to lock on an object.
Video Image Processing	Video Image Processing consists in signal processing employing statistical analysis and video filters to extract information are perform video manipulation.	Active -pixel sensor.	It helps to improve images for human interpretation.	It is very much time consuming.
Magnetometer	Current in the magnetic field can generate a Lorentz force	Magnetic Sensor	Fast access and retrieval times	Can be easily damaged
Ultra sonic	It works by emitting sound waves at high frequency	Character user interface(CUI) devices	It can work in any adverse conditions	It is very sensitive to temperature variations
Inductive Loop	Inductive loops are installed in roads to detect the presence of passing vehicles	Inductive Sensor	Mature and well developed & low cost	Poor performance under bad pavement conditions

6. ELEMENTS OF AN INTELLIGENT TRAFFIC MANAGEMENT SYSTEM

- Traffic sensors and cameras: These devices monitor traffic flow, speed, and other parameters and provide data to the ITMS for analysis and decision-making.
- Data analytics and processing: The ITMS uses sophisticated algorithms and machine learning models to analyze the data collected by sensors and cameras and generate insights that can help manage traffic more efficiently.
- Intelligent transportation systems (ITS) infrastructure: This includes communication networks, servers, and software that enable the ITMS to communicate with various transportation entities and systems, such as traffic lights, message boards, and emergency services.
- Traffic control and optimization: The ITMS uses data analytics and machine learning to optimize traffic flow by adjusting traffic signals, rerouting vehicles, and managing congestion.
- Incident detection and response: The ITMS can detect incidents such as accidents, breakdowns, and other disruptions and alert authorities and emergency services as needed.
- Real-time information and communication: The ITMS can provide real-time information to drivers, such as traffic updates, road closures, and detours, using various methods such as mobile apps, message boards, and radio broadcasts.

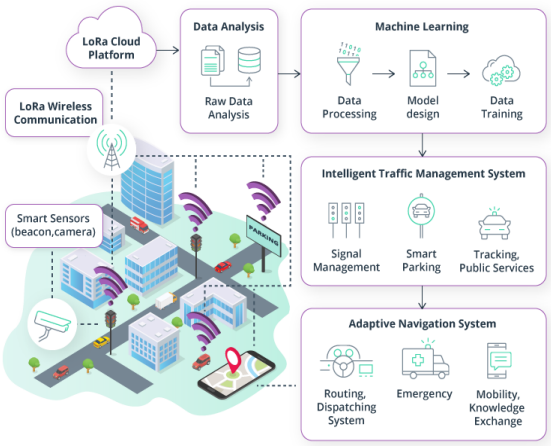


Fig: 1: Intelligent traffic management system

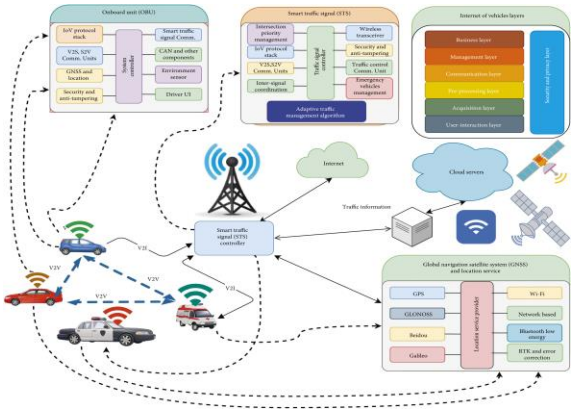


Fig: 2: Proposed Intelligent Traffic Management System (ITMS)

7.MODERN TRAFFIC INCIDENT MANAGEMENT SYSTEMS (TIMS)

Modern Traffic Incident Management Systems (TIMS) are designed to improve the safety and efficiency of traffic incident response, reduce incident duration, and minimize the impact of incidents on traffic flow. These systems typically leverage advanced technologies and real-time data to provide a coordinated and powerful reaction to site visitors incidents.

- Real-time data collection: Modern TIMS rely on real-time data collection from various sources, such as traffic cameras, sensors, and GPS devices, to provide accurate and up-to-date information about incidents.
- Automated incident detection: TIMS use advanced algorithms and machine learning techniques to automatically detect incidents, such as accidents, congestion, and road closures, and alert the appropriate response teams.
- Coordinated response: TIMS enable a coordinated response by providing a unified view of incidents to all stakeholders, including emergency responders, transportation agencies, and law enforcement.
- Advanced communication: TIMS provide advanced communication capabilities, such as two-way radios, mobile devices, and internet-based communication tools, to enable quick and efficient communication among response teams.
- Incident management tools: TIMS provide a range of incident management tools, such as incident tracking, resource management, and decision support systems, to help response teams manage incidents more effectively.
- Performance monitoring: TIMS use performance metrics, such as incident duration and response time, to monitor the effectiveness of incident response and identify areas for improvement.

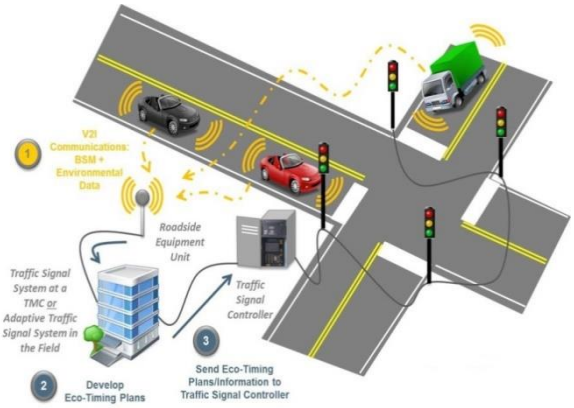


Fig: 3 Traffic Incident Management Systems (TIMS)

8. SMART JUNCTION MANAGEMENT

Smart Junction Management is a traffic management approach that uses advanced technologies and data analytics to improve traffic flow and safety at intersections. Smart Junction Management systems aim to optimize traffic signal timings, reduce delays, and minimize congestion by dynamically adapting to real-time traffic conditions.

- Real-time traffic monitoring: Smart Junction Management systems use sensors and cameras to monitor traffic flow in real-time. This enables

traffic managers to detect congestion, delays, and incidents quickly and respond with appropriate measures.

- Intelligent traffic signal control: Smart Junction Management systems use advanced algorithms to optimize traffic signal timings based on real-time traffic conditions. This helps to reduce delays, improve traffic flow, and minimize the number of stops and starts for vehicles.
- Pedestrian safety: Smart Junction Management systems prioritize pedestrian safety by providing features such as dedicated pedestrian phases, countdown timers, and push-button controls.
- Multi-modal transport integration: Smart Junction Management systems integrate with other modes of transport, such as buses, trams, and bicycles, to ensure smooth traffic flow and reduce conflicts among unique modes of transport.
- Data analytics and predictive modelling: Smart Junction Management systems use data analytics and predictive modelling techniques to anticipate traffic patterns and proactively adjust signal timings to reduce congestion and delays.
- Emergency response: Smart Junction Management systems can be integrated with emergency response systems to facilitate quick and efficient responses to incidents such as accidents, road closures, and emergencies.

9.PROPOSED OF SMART TECHNOLOGIES SYSTEM

As per the traffic survey different problems related to traffic at different junctions are identified in Vijayawada city. To minimise these problems during flow of traffic following smart technologies are proposed based on their suitability.

At Benz Circle Junction: - At this junction most of problems arise due to traffic signals timing system is incompatible with amount of traffic flow which leads congestion. To reduce traffic problem either inductive loop (or) AD-Hoc sensor system can be used in this location.

- Inductive loop system is most applicable in heavy traffic areas which most suitable for current scenario.
- AD-Hoc has an advantage of detecting emergency vehicles, and incident even in congested regions which can be implement in this junction.

At Ramavarapadu Junction: -

At this junction most of problem arise due to traffic flow which leading to congestion. To reduce traffic problem either magnetometer sensor (or) AD-Hoc sensor system can be used in this location.

- Magnetometer is most applicable in heavy traffic areas which most suitable for current scenario.
- AD-Hoc has an advantage of detecting emergency vehicles, and incident even in congested regions which can be implement in this junction.

At Ibrahimpatnam Junction: - To reduce the problem that has been identified at this junction. To reduce traffic problem either Video Image Processor and implementation of signals can be used in this location.

- Video Image Processor is most applicable in heavy traffic areas which most suitable for current scenario.

At Ramesh Hospital Junction: -To reduce the problem that has been identified at this junction. To reduce traffic problem either Video Image Processor.

- Video Image Processor is most applicable in heavy traffic areas which most suitable for current scenario.

10.CONCLUSION

- Smart technology can provide real-time traffic information, reduce traffic congestion, improve safety, and provide sustainable transportation.
- ITS system Can be applied to all types of economical regions including low-income and marginalized communities, to ensure equitable and inclusive transportation systems.
- Ad-hoc sensors have the potential to improve traffic management systems by providing real-time traffic data that can be used to monitor traffic flow and optimize traffic control which is best suitable for current traffic condition in Vijayawada.
- Inductive loop sensors are an important technology used in transportation systems for

detecting the presence of vehicles at intersections and on highways.

- To reduce the traffic flow implementation of island ring along with proposed smart management system at Benz circle junction and alternative emergency routes.
- Implementation of alternative route in ramavarapadu ring to reduce the traffic flow from mahanadu to Nidamanuru outer road.
- Implementation of traffic signals with Video image processor at Ibrahimpatnam circle can reduce the traffic related problems.
- To enhance safety, but further research and development are necessary to optimize their performance and address challenges related to processing speed and accuracy.

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