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AUTOMATED HIGHWAY SYSTEM ON INTELLIGENT TRANSPORT SYSTEM

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***Abstract*— Automated highway system (AHS) is an intelligent transportation system that removes human drivers from the operation of vehicles while driving. This talk is focused on activities on AHS at the California Partners of Advanced Transit and Highways (PATH). AHS includes control problems from the vehicle level to the highway network level and offers a number of challenging opportunities for intelligent electronics. The Automated Highway System (AHS) concept defines a new relationship between vehicles and the highway infrastructure. AHS refers to a set of designated lanes on a limited-access roadway where specially equipped vehicles are operated under completely automatic control. AHS uses vehicle and highway control technologies that shift driving functions from the driver/operator to the vehicle. Throttle, steering, and braking are automatically controlled to provide safer and more convenient travel. AHS also uses communication, sensor, and obstacle-detection technologies to recognize and react to external infrastructure conditions.**

***Keywords*—**Automated Highway System(AHS) Mechatronics, Obstacles.

I. INTRODUCTION

The automated highway system is a long-term transportation system that may provide a number of benefits down the road. Roads and transportation networks are connected in a new way by AHS technology. This method uses an automated control system to operate cars without a driver. An automated highway system is designed using a range of methods related to advanced civil engineering techniques, microelectronics, computational principles, and many sensors. The main components of any mechanically powered vehicle, such as the steering, brakes, and throttle, are all automatically operated in an automated highway system. Coordinated vehicle flow, barrier clearance, an improvised traffic system, and safety are all essential needs of any traffic facility that can be easily met by an automated highway system. In order to connect highways, the newly created intelligence algorithms are widely utilized.

An automated highway system enables more vehicles to utilize a given section of road by reducing the clear distance between them. The goal of an automated highway system is to move people and commodities in a safe, orderly, and efficient manner while preventing collisions where possible. This improves the general quality of the surrounding roads and the local environment. A well-managed transportation system is required due to the rise in traffic issues in large cities, including congested roads, collisions, delays, fuel usage, etc. Because urbanization, which is growing at a rate of 15–17% per year and putting thousands of new cars on the road every day, is increasing demand for vehicles, the old transportation system is unable to keep up.

1.1 NEED& NECESSITY

- Greatly lowering the number of fatalities, serious injuries, suffering, and stress related to driving in order to increase safety.

- Increased mobility and accessibility can help reduce delays, ensure smooth traffic flow, and

make driving more accessible to those who are less able to do so.

- Implementing the necessary safety-related automated highway systems in automobiles and traffic infrastructure, as well as making sure that safety-related interactions are elaborated in terms of people and machines.

- Creation of traffic demand control systems in both urban and rural areas, as well as alarm systems for drivers and passengers.

- Smoothing traffic flow and putting cars near enough to one another to take advantage of aerodynamic drafting may help cut down on fuel use and emissions.

1.2 OBJECTIVES

- To study the effect of Traffic volume, Capacity, Road feature, Surface properties on accident rate on highway road.

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- To study the defects on highway and annual, monthly accidents rates on the selected highway road. To survey and document automated highway system with driver And passenger safety systems on roads.

- The reliable intelligent driver assistance systems and safety warning systems is still a long way to go. To study eliminate the more than ninety percent of traffic crashes that are caused by human errors such as misjudgments and in-attention.

II. AHS BENEFITS

According to research, AHS will eventually have a significant and wide-ranging positive impact on the operation of the current American transportation system. In the long run, there will be less traffic, a nearly collision-free environment due to improved safety, and predictable and dependable driving. More precisely, the following are some benefits of implementing AHS:

- The highway can accept more automobiles. As headway distances are reduced and traffic speeds are standardized and raised, it is possible to greatly increase the number of cars per hour per lane.

- Emissions and fuel consumption can be decreased. These reductions will be achieved in the near future due to a reduction in start-and-stop driving and the monitoring of on-board sensors to guarantee optimal vehicle performance. In the long run, the AHS can help with future fuel and propulsion concepts for vehicles.

- Roads won't need to occupy as much space since AHS amenities should enable more efficient use of the right of way, and land can be used more effectively.

- Automating transport operations can boost service and patronage by increasing the transit option's flexibility and convenience.

III. LITERATURE REVIEW

Kriti Sahu Tripure(2023)[1],The proposed intelligent transportation system (ITS) technology known as an automated highway system (AHS) or "Smart Road" would enable automobiles to operate autonomously on specific highways. Because it allows more cars to drive on a given stretch of road and drastically reduces following distances, it is typically discussed as a means to reduce traffic. The automated highway system will contribute to the development of new concepts that will

facilitate the safe and controlled movement of more people. These new concepts will make use of technology that are safer, more effective, and less detrimental to the environment than those we currently employ. Future metropolitan environments will include these new modes of transportation.

Kore Lakkappasubhash(2021)[2], Automated Highway Systems: An Intelligent Transportation System The Automated Highway System (AHS) is an intelligent transportation system that eliminates the need for human drivers to operate vehicles while they are being driven. This talk focuses on activities related to AHS at the California Partners of Advanced Transit and Highways (PATH). The concept of the Automated Highway System (AHS) defines a new relationship between vehicles and the highway infrastructure. AHS refers to a set of designated lanes on a limited access roadway where specially equipped vehicles are operated under fully automated control.

Sangeeta Mishra and Ajinkya Bavane(2018) [3], the ambitious goals of the Automated Highway System can be accomplished by: Developing advanced concepts for advanced road vehicles for passengers and goods Most previous projects addressed specific aspects of the mobility problems of cities, whereas the Automated Highway System focuses on the overall urban transportation problem. Introducing new tools for managing urban transport The Automated Highway System will develop tools that can help cities cross the thresholds that are preventing them from introducing innovative systems, such as the lack of certification procedures and appropriate business models. Removing obstacles that stand in the way of the widespread use of automated systems, some of which are technological, and some of a legal nature.

P.V. Manivannan (2018) [4], Vision Based Intelligent Vehicle Steering Control Using Single Camera for Automated Highway System: Stereoscope vision is typically used to guide autonomous intelligent road vehicles because image depth can be easily calculated, but if one of the cameras fails, it will be advantageous to have a suitable guidance algorithm that can detect the lane marking using a single camera. The main goal of this work is to develop and implement control algorithms for identifying and guiding the intelligent road vehicle in the assigned lane using image-processing techniques, using a single camera. It deals with splitting the video being taken by the camera into multiple frames, which are then processed using image acquisition techniques in Matlab.

Dr. Prakash Yalavatti(2017)[5], By coordinating vehicle movement, avoiding obstructions, and enhancing traffic flow, the highway and its vehicles increase safety and lessen congestion. In terms of meeting the demand for moving people and products, the current vehicle-highway system has peaked. An automated highway system (AHS) architecture is sketched in this paper. The architecture can be implemented using a variety of designs with varying levels of sophistication and performance. In the event of a malfunction, a design that may assure collision-free operation, restrict performance degradation, cut emissions in half, and treble capacity and travel time is outlined. A summary is provided of the evidence that suggests the design can be implemented.

Prof. Feroz H. Khan and Nayan R. Wasekar (2017) [6], A fully automated highway system (AHS) must develop gradually rather than be deployed all at once due to a number of considerations, including financial limitations and market forces. Planning therefore requires an awareness of the interdependencies among the necessary AHS functional skills. Three AHS functional evolution reference models, comprising both essential and supplemental functions, are proposed in this research. Selected infrastructure support functions, obstacle handling, longitudinal motion handling, and lateral motion handling are all included in the reference models.

Sanju Meena and Dr. Om Prakash(2017) [7], A key component of every zone's infrastructure development is

the construction of new highways, which are now completed in a variety of ways. The recently created concept known as the Automated Highway System, or AHS, uses a variety of sensors and microprocessors to automate the planning process. Using intelligent vehicles and roadside controllers to manage and control traffic is a novel approach to highway system architecture. The design idea known as the Automated Highway System was created to improve highway efficiency, safety, and numerous other user and vehicle featuresarchitectural plan for the highway design.

Vishnupriya R. and Dr. N.P. Ananthamoorthy(2017)[8] In most parts of the world, dedicated short range communication technology is used to construct electronic toll collection systems.A mechanism for automatically paying toll taxes is being proposed, and drivers' cell phones will receive transaction details via GSM modem technology. The automatic toll collection method for the expressway network is a cutting-edge technology. Designing a system that can automatically recognize an incoming vehicle and record its number and time is the project's goal.

Dhevi Lakshmi, Bart Baskar (2013) [9], The best course of action for automated roadway systems: We introduce a technique to routing advice that can be applied to Automated Highway Systems (AHS). In automated highway systems, intelligent cars are arranged in platoons and driven to their destination under the supervision of a hierarchical control structure. Within this framework, roadside controllers provide the platoons directions on lane allocation and speed.

Dr. S. S. Jain and Dr. M. Parida (2011) [10], RSA is a formal process used to evaluate the safety performance and accident risk of both new and existing roads. An effective, economical, and proactive strategy to raise road safety is RSA. It has been demonstrated that RSA can save lives. The United Kingdom, the United States, Australia, New Zealand, Denmark, Canada, Malaysia, and Singapore are among the nations that have developed the RSA since its inception. Bangladesh, Thailand, South Africa, and India are among the emerging countries where it is being implemented at different stages. The lack of fundamental and reliable accident data makes RSA seem like the perfect tool for enhancing road safety in India.

III RESERCHE GAPS

- Vehicle certification: How to authorise a car to operate automatically and how toauthorise a car and driver to operate manually

- Handling malfunctions: How to handle issues in an AHS. Three AHS-related requirements for transit and commercial vehicles How to satisfy these requirements in an AHS.

- Implementing access and exit points for an AHS: A Guide The effect that an AHS will have on adjacent roads that are not included in the AHS.

- AHS safety concerns: What potential safety concerns could an AHS present.
- Aspects of institutions and society: The effects of an AHS on institutions and society.

- Cost-benefit factors: How to evaluate an AHS's cost-benefit aspects.

IV METHODOLOGY

Infrastructure and automobiles will be the two main subsystems that make up the AHS. The section of the system that travels along an AHS will be part of the vehicle subsystem. Sensors, data processing, actuators, linkages, and communications devices are all part of the vehicle subsystem. The following driving functions will be automated by the AHS to regulate vehicle movement.

The driver would then maneuver toward a merging area,

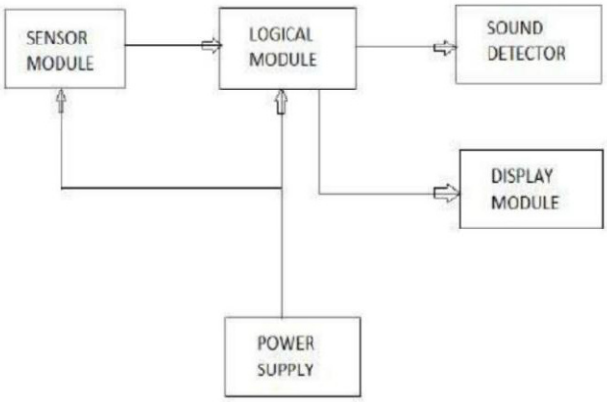
where the car would be guided through a gate and into an automated lane. An automatic control system would be used to coordinate newly arriving traffic with already-existing traffic. Once in autonomous mode, the driver can relax till the turnoff. The car would be taken off the road if the procedure were reversed. If the driver was asleep, sick, or even dead, the system would then have to decide what to do and whether they could regain control.

Car for Passengers	Automobile, SUV, Cab, and Van (Traditional / Modern Technology) Minibus
Bus	Minibus, Regular Bus
Truck	Light Commercial Vehicle (LCV)
	Two-Axle Truck Three-Axle Truck (HCV)
	Multi-Axle Truck (4-6 Axles)
	Oversized Vehicles (7 or more Axles)
	Agricultural Tractor
Other Vehicles	Tractor with Trailer

This kind of dedicated lane system can be replaced with a mixed traffic system, where both automated and non-automated vehicles use the route. This approach would yield the biggest gains, but it would necessitate more significant changes to the transportation system.

Actually, one might envision a variety of approaches for highway automation systems that differ in the degree of autonomy for every car. Finally, by using data-rich regions, an efficient augmented DL-based transfer-learning model is built to solve the issue of poor prediction in data-strapped regions.

Middle-range vehicles would be able to adjust to varying degrees of platooning, or vehicle cooperation. On the other end of the spectrum are systems that rely more or less on the roadway infrastructure for automatic support. But usually, the car would be equipped with the majority of the technology.



V RESEARCH HYPOTHESIS

The following research methodology has been followed to achieve the primary objectives.

1. Initially, research is conducted to comprehend the idea, varieties, difficulties, and uses of AHS in traffic control systems. analysis of the intricacy of road transportation and its network, thereby investigating the major determinants of mode of transportation.

2. investigation of the prediction of traffic information on road transportation by investigating diverse methods for forecasting different macroscopic features and their traffic-related applications.

3. Given the popularity of DL approaches and DL hybrid methods based on the conducted study, a review is conducted to investigate possible research in the field of road transportation for traffic information prediction. also illustrated the difficulties to be investigated.

4. The accuracy gaps in traffic information prediction were examined for related approaches that take into account irregular, insufficient, missing, uncertain, non-linear, and abnormal traffic data conditions brought on by contextual and environmental variables.

5. Using the flow strength indicators as features with the input traffic data while considering spatiotemporal information, a hybrid deep learning approach is created to overcome the accuracy issue caused by the irregularity of the traffic data.

6. Finally, by using data-rich regions, an efficient augmented DL-based transfer-learning model is built to solve the issue of poor prediction in data-strapped regions.

VI BENEFITS OF AHS

According to recent studies, AHS will eventually have a significant and wide-ranging positive impact on the operation of the current American transportation system. Long-term improvements in safety will result in an environment that is almost completely free of collisions; driving will be predictable and consistent; and traffic congestion will be lessened. More precisely, the following are some benefits of implementing AHS.

- As headway distances are reduced and traffic speeds are standardized, more cars may be accommodated on the highway, and the number of vehicles per hour per lane can be significantly increased.
- Driving safety will be significantly greater than present; while the human error factor will be removed.

- It is possible to drive at high speeds regardless of the weather or other environmental factors. Conditions that impair driver visibility, such as fog, haze, low sun angles, rain, blowing dirt, snow, and darkness, will no longer hinder progress and safety.

- All drivers using AHS can be safe, efficient drivers. AHS offers enhanced mobility for people with disabilities, the elderly, and less experienced drivers.
- Road space will be reduced and land may be used more effectively since AHS facilities should make it possible to use the right of way more effectively.

- improved transportation efficiency. Automating transport operations can boost service and patronage by increasing the transit option's flexibility and convenience.

VII. EXPERIMENTAL STUDY FOR NH-48

The objective is to analyze the yearly fluctuations in the accident rate on specific segments of two-lane roads. Tostudythemonthlyvariationof the accidentrate. To analyze the fluctuations in accident rates on an hourly basis.

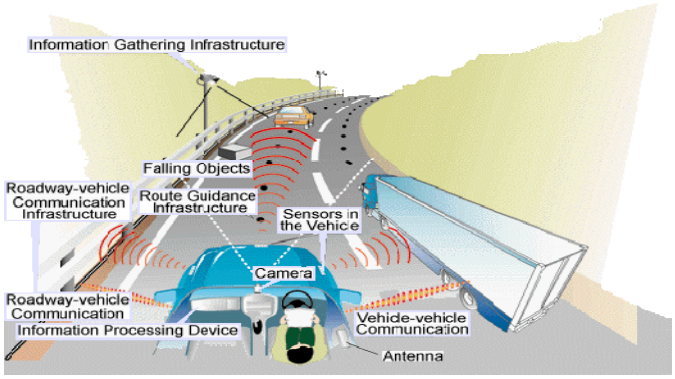


Figure 1: Automated Roadway Systemfeaturing AHS Vehicles.

1. DATA GATHERING AND RESEARCH EXTENSION

The primary source of information for accident studies is the FIRfiled at police stations. Data spanning the past eleven years (2012-2022) was gathered from FIR records associated with IPC sections 279, 337, 338, and 304(A). This includes details of the vehicles involved in accidents as documented in the FIRs. The vehicle classifications encompass tempos, automobiles, various two-wheeled vehicles, cars, mini-trucks, minibuses, motorcycles, tankers, trucks, and buses. The following

data was collected.

7.1 ROAD CHOSEN FOR ANALYSIS

A two-lane roadway approximately 20 kilometers long, connecting Choudhary Hotel to Gujrati Hotel along NH-48, was selected for this study. The road was segmented into four sections, each measuring 5 kilometers. The specific sections chosen for data collection are as follows.

Stretch 1 – Choudhary Hotel to Saket hotel & restaurant

Stretch 2 – Saket hotel & restaurant to Bhadana Hotel

Stretch3- Bhadana Hotel to Radhir Hotel & restaurant

Stretch4- Radhir Hotel & Restaurant to Gujrati Hotel

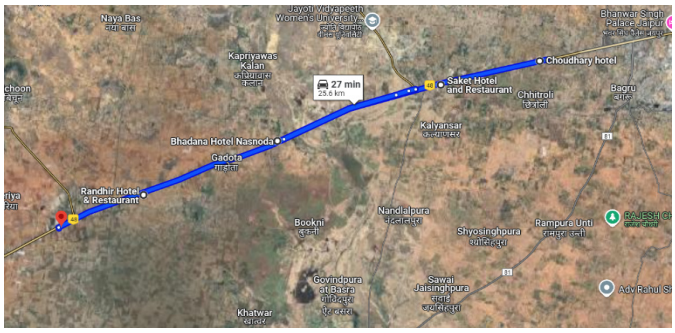


Figure: 2 Study Area Reference: Google Maps(NH-48)

Year	Fatal	Injury	
		Major	Minor
2012	10	10	26
2013	9	15	29
2014	3	2	42
2015	2	15	20
2016	12	14	50
2017	7	2	28
2018	4	5	30
2019	3	12	36
2020	3	6	38
2021	8	12	36
2022	7	5	39

VIII CONCLUSION

In order to accomplish its development objectives, it is critical to show that AHS offers significant transportation benefits in terms of safety, efficiency, cost and usability, and environment. The NAHSRP scenario, however, demonstrates that program acceptability is influenced by people's social, economic, and environmental concerns in addition to technology capabilities.In order for automated highway systems to meet their development objectives, they provide significant transportation benefits in terms of safety, efficiency, cost, usability, and the environment.

The division of the different control functions into discrete layers with clearly defined interfaces is a fundamental component of the control design architecture. After that, each layer is created using a model that is appropriate for the tasks it is in charge of. In addition to differing in their formal structure (differential equations, state machines, static graphs, etc.), the models at different levels also differ in the entities that are involved.

VIII REFRENCES

1. Alexander Novikov & Pavel Pribyl, "ITS Control of Highways Capacity," SPbOTSIC-2016, St. Petersburg, Russia, 28-30 September 2016, 12th International Conference "Organization and Traffic Safety Management in Large Cities".

2. Sangeeta Mishra and Ajinkya Bavane, "Automated Highway System (Pune to Mumbai) In India" by published in International Journal of Innovative Research in Science, Engineering, and Technology, Vol. 7, Issue 5, May 2018

3. Manivannan, P. V., &Ramakanth, P. (2018). Vision based intelligent vehicle steering control using single camera for automated highway system. Procedia computer science, 133, 839-846.

4. Nayan R. Wasekar and Asst. Prof. Feroz H. Khan "Automated Highway System," International Journal of Advance Engineering and Research Development (IJAERD), Volume,

5. Dr. Om Prakash and Sanju Meena, "The Study on Automated Highway Systems," January 2017, Volume 4, Number 1, e-ISSN 2348-4470 The 2017 ISSN for the Imperial Journal of Interdisciplinary Research (IJIR) is 2454-1362, Volume 3, Issue 4.

6. Vishnupriya R. and Dr. N.P. Ananthamoorthy (2017)The paper "AHS" by Petros A. Ioannou. includes an index and bibliographical references. ISBN 978-1- 4419-3264-8 DOI 10.1007/

7. Kore Lakkappa Subhash, Dr. Prakash Yalavatti , "Automated Highway Systems-An Intelligent Transportation System" , Palarch's Journal Of Archaeology Of Egypt/Egyptology 18(8), 4211-4219. ISSN 1567-214x.

8. Mrs. Kirti Sahu Tirpude, "Automated Highway Systems" , The 2023 ISSN for The International Journal of Scientific Research in Engineering and Management (IJSREM)is 2582-3930,volume:07 issue:05/may-2023.

9. Mohit John and Arun Joseph, "Zigbee Based Wireless Data Acquisition Using LabView For Implementing Smart Driving Skill Evaluation System", International Journal of Instrumentation and Control Systems (IJICS) Vol.3, No.3, July 2013.

10. Subhash, K. L., &Yalavatti, P. (2021). AUTOMATED HIGHWAY SYSTEMS-AN INTELLIGENT TRANSPORTATION SYSTEM. PalArch's Journal of Archaeology of Egypt/Egyptology, 18(08), 4211-4219.