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INTELLIGENT TRANSPORT SYSTEM IN INDIAN HIGHWAY

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***Abstract*—Advanced applications that don't really contain intelligence, intelligent transportation systems (ITS) seek to offer novel services related to various transport networks and traffic control, allowing different users to be better informed and make safer, more coordinated, and "smarter" use of them. Highway transport is essential to contemporary industrialized countries. Most peak-hour driving on highways is slowed to less than 60 kilometres per hour due to heavy usage on the main roadways around the major cities. Every year, excessive traffic wastes countless gallons of gasoline increases exhaust emissions needlessly and delays more than five billion hours. Making driving less stressful and accident-prone, particularly on lengthy trips, is the goal of this article. One method to do this is by creating a highway.**

***Keywords*—intelligent transportation systems (ITS) throttle, braking control, steering control.**

I. INTRODUCTION

Intelligent transportation systems use a range of technologies, from simple management systems like navigation in cars to traffic signal control systems and container management. systems, variable message signs, speed cameras or automatic number plate recognition for monitoring applications, like security CCTV systems; and more sophisticated applications that incorporate real-time data and feedback from a variety of diverse sources, like parking guidance and information systems, weather data, bridge de-icing (US de-icing) systems, and the like.

Predictive methods are also being developed to enable sophisticated modelling and comparison with baseline datafromthepast.The sections that follow provide descriptions of a few of these technologies. Nobody could have predicted how much the internal combustion engine and, subsequently, the vehicle would impact day-to-day living when they were first made available to the general public. Even in this day and age of the information age, it is still difficult to comprehend how computers and technology.

The latest embedded system platforms facilitate the implementation of more advanced software applications, encompassing model-based process control, artificial intelligence, and ubiquitous computing. Among these, artificial intelligence stands

out as particularly significant for Intelligent Transportation Systems. Many individuals may not be aware that numerous systems within their vehicles are already subject to monitoring and control by computers. Examples of such systems include fuel delivery, ignition, emissions control, air conditioning, and automatic transmission, all of which are computer-controlled or assisted in daily automotive use. An illustration of an automated vehicle is presented in Figure 1. In the current information age, there is a growing awareness of various driver assistance technologies, including mobile phones and in-vehicle navigation systems.

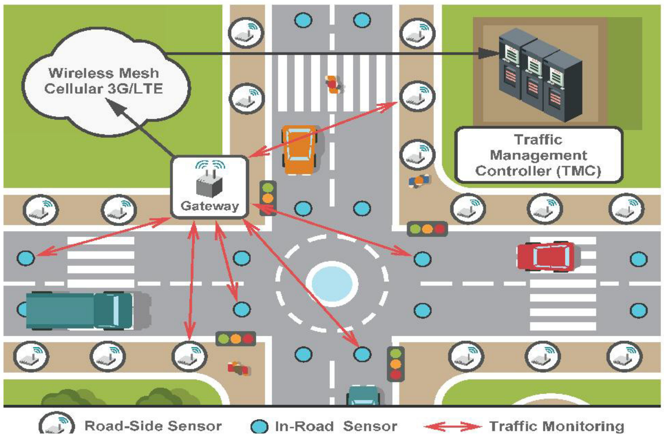

Figure 1: Smart Transportation

II.SURVEILLANCE OF THE ROAD

Intervals along the centerline of the lane are monitored by magnetometers installed beneath the vehicle's bumpers. The measurements of the magnetic field are interpreted to ascertain the lateral position and elevation of each bumper with an accuracy of less than one centimetre. Furthermore, the orientation of the magnets (either with the North Pole or the South Pole facing upwards) conveys a binary code (either 0 or 1) that signifies the precise milepost location of the road's geometric features, such as curvature and gradient. The vehicle's control computer software utilizes this data to ascertain the vehicle's absolute position and to predict forthcoming alterations in the roadway.

In contrast, other researchers have employed computer vision systems to monitor the road. While these systems are susceptible to weather-related issues and yield less precise measurements, they do not necessitate specialized roadway installations, aside from well-maintained lane markings. Both automated highway lanes and intelligent vehicles will require dedicated sensors, controllers, and communication devices to effectively manage traffic flow. A national consortium focused on automated highways is illustrated in Figure 2.

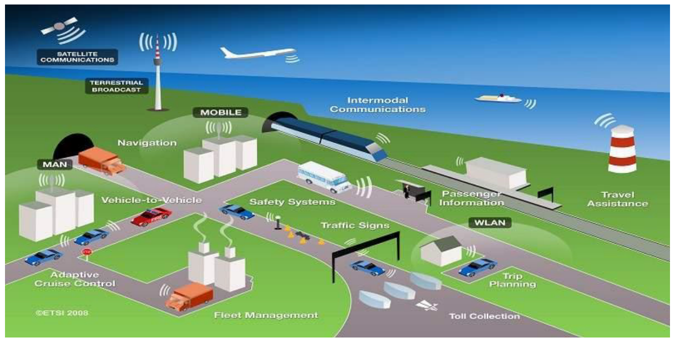

Figure 2: Smart Cities of The Future

III. OBJECTIVES

The measurement of distance and closing rates to preceding vehicles can be accomplished using either millimetre-wave radar or a laser rangefinder. Both of these technologies have been integrated into commercially available adaptive cruise control systems in Japan and Europe. Currently, laser systems are more cost-effective; however, radar systems demonstrate superior performance in detecting obscured vehicles and functioning under adverse weather conditions. As production volumes rise and unit costs decline, it is anticipated that radar systems will gain greater acceptance.

IV. AHS BENEFITS

According to research, ITS 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 ITS:

- 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 shortly 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 ITS can help with future fuel and propulsion concepts for vehicles.

- Roads won't need to occupy as much space since ITS 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.

V. REVIEW LITERATURE

The concept of visualizing your journey on an automated highway system is now more tangible than ever. Picture this: at the end of your workday, you need only to drive to the nearest on-ramp of the local automated highway. Upon reaching the on-ramp, you simply press a button on your dashboard to select the off-ramp nearest to your residence, allowing you to relax as your vehicle's electronic systems, in conjunction with roadside technology and similar systems in other vehicles, navigate you smoothly, safely, and effortlessly to your destination. This innovation enables you to save time by maintaining full speed, even during peak traffic hours. Once you reach the end of the off-ramp, you regain normal control and complete the final stretch to your home, feeling more rested and less stressed than if you had driven the entire distance yourself. This capability is equally applicable for longer journeys, such as family vacations, ensuring that all passengers, including the "DRIVER," arrive relaxed and well-rested, even after extended travel in challenging weather conditions. While numerous technical advancements are essential to realize this vision, none involve complex technologies; rather, they can be built upon systems and components that are already under active development within the global automotive industry. These advancements could serve as substitutes for the various tasks that drivers perform daily, such as monitoring the road, observing preceding vehicles, steering, accelerating, braking, and making decisions regarding course changes.

VI.RESEARCH GAPS

The forthcoming research directions identified through this literature survey are characterized by the following objectives:

- To reduce the incidence of accidents by analyzing the sequence of events surrounding these incidents through Data Mining techniques.
- To alleviate traffic congestion by employing Machine Learning algorithms.
- To improve the efficiency of shipment movements through the application of optimization algorithms.
- To ensure road safety.

VII. METHODOLOGY

The functions of driver muscles are mirrored by electromechanical actuators integrated into automated vehicles. These actuators interpret electronic signals from the onboard control computer and subsequently adjust the steering angle, throttle position, and brake pressure through the use of compact electric motors. A diagram illustrating automated communication is presented in Figure 3. Initial iterations of these actuators are already being implemented in production vehicles, where they directly respond to the driver's inputs via the steering wheel and pedals. The motivations behind these developments are primarily not linked to automation; instead, they focus on minimizing energy consumption, streamlining vehicle design, facilitating easier vehicle assembly, enhancing the capability to tailor performance to driver preferences, and achieving cost reductions in comparison to conventional direct mechanical control systems.

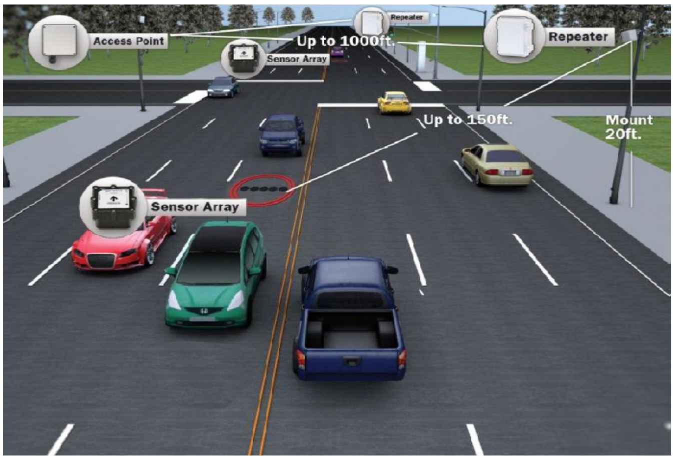

Figure 3: MEMS sensor solutions

The roadway is divided into segments and lanes, with vehicles assigned to various lanes within a multilane automated facility. The primary objective is to ensure a balanced flow across the lanes while preventing obstacles or incidents that could obstruct any lane. The onboard computers of the vehicles are particularly adept at making decisions regarding the precise timing and location for lane changes, thereby minimizing interference with other vehicles.

Additionally, some functions do not have direct equivalents in current driving practices. Notably, wireless communication technology facilitates interaction among adjacent vehicles. This feature allows vehicles to maintain proximity with high precision and safety, enabling them to execute cooperative manoeuvres, such as lane changes, to enhance both system efficiency and safety. Any malfunction in a vehicle can be immediately communicated to nearby vehicles, allowing them to take appropriate measures to avert potential collisions.

Moreover, electronic "check-in" and "check-out" stations should be established at the entry and exit points of the automated lane, similar to toll booths where a ticket is obtained upon entry and a toll is paid upon exit based on the distance travelled. At the check-in station, wireless communication between vehicles and roadside infrastructure would confirm that the vehicle is in proper working order before it enters the automated lane. Likewise, the check-out system would ensure that the driver is prepared to regain control upon exiting. The traffic management system for an automated highway would also encompass a broader scope than current traffic systems, as it would determine the optimal route for each vehicle in the system, continuously balancing travel demand with system capacity and directing vehicles accordingly.

VIIIDESIGN CHALLENGES

The challenges that are not technical in nature encompass issues related to liability, costs, and public perception. The automation of vehicle control reallocates liability for the majority of accidents from individual drivers and their insurance providers to the designers, developers, and vendors of the vehicle and roadway control systems. If these systems prove to be safer than the current driver-vehicle highway framework, the overall liability exposure should decrease. However, the financial burden will transition from automobile insurance premiums to the purchase or leasing costs of automated vehicles, as well as tolls for utilizing automated highway facilities.

Typically, new technologies are expensive when first introduced in limited quantities, but their costs tend to decrease as production scales up and the technology matures. It is reasonable to anticipate that vehicle automation technologies will exhibit a similar trend. Initially, they may only be economically feasible for larger vehicles, such as transit buses and commercial trucks, as well as high-end passenger cars. Nevertheless, it is expected that the costs will soon become accessible to a broader spectrum of vehicle owners and operators, particularly since many of the necessary enabling technologies are already being produced for mass consumption.

It is also crucial to acknowledge that automated vehicles are currently transporting millions of passengers daily. Numerous major airports feature automated people movers that facilitate the transfer of passengers between terminal buildings. Cities such as Paris, London, Vancouver, Lyon, and Lille have urban transit lines that operate entirely with automated, driverless vehicles, some of which have been in operation for over a decade. Additionally, modern commercial aircraft frequently operate on autopilot and are capable of landing under automatic control at appropriately equipped airports.

IX.MAJOR COMPONENTS

The infrared proximity detector employs technology similar to that utilized in television remote controls. It emits modulated infrared light and monitors the reflected light that returns. When the amount of received light is sufficient to activate the detector circuit, it generates a high signal on the output line. The emitted light consists of a continuous series of modulated square wave bursts, alternating between the left and right LEDs. A microprocessor is responsible for generating these bursts and correlating the output from the receiver with the bursts. The infrared proximity detector utilizes the Panasonic Pna4602M infrared sensor in conjunction with two infrared LEDs to identify obstacles. This Panasonic module incorporates integrated amplifiers, filters, and limiters. The detector is designed to respond to a modulated carrier signal, which aids in reducing background noise from sunlight and various artificial lighting sources. The LEDs are modulated by an adjustable free-running oscillator, and the sensor's sensitivity is managed by modifying the drive current to the LEDs. The microcontroller alternately activates the LEDs and checks for reflections.

Three reflective sensors are constructed from a single unit comprising an infrared LED and a photodetector, oriented towards the surface beneath the vehicle. Each sensor detects the reflected infrared light. When a sensor is positioned over a dark or black surface, it generates a high output signal. The line detector operates effectively when the thickness of the line falls within the range of 1/4 to 3/4 inches, which can be represented by either white tape on a black background or black tape on a white background. The sensor can be positioned at a maximum height of 0.5 inches above the ground. The three pairs of infrared detectors are illustrated on the right side of the circuit diagram. The base of each transistor is connected to an inverter. The outputs from the inverter are routed to a microcontroller and to the LEDs that indicate the position of the detector on the roadway. As the emitted light from the infrared LED reflects off the road back to the transistor, current begins to flow through the emitter, resulting in a low signal at the base. This base is linked to the inverter, which subsequently alters the output line. Since the output lines are also connected to the LEDs, the corresponding LED illuminates when the specific output line is high.

VII CONCLUSION

The National Highway Traffic Safety Administration is conducting ongoing research focused on collision avoidance and the interaction between drivers and vehicles. The Advanced Highway System (AHS) represents a robust collaboration between public and private sectors aimed at developing a prototype system. While numerous enhancements can be implemented within vehicles, executing certain improvements on roadways may yield greater efficiency and potentially lower costs. Initial estimates indicate that systems designed to prevent rear-end collisions, lane changes, and roadway departures could reduce motor vehicle accidents by approximately one-sixth, equating to around 1.2 million incidents annually. These systems may include features such as driver alerts, recommendations for control actions, and the introduction of temporary or partial automation in dangerous scenarios. Although the AHS discussed in this document is operational, there remains significant potential for enhancement. Further research is essential to identify any dependencies that may affect vehicle speed and the maintenance of appropriate following distances while navigating a designated path. If such a system were to be fully developed, it could transform the traditional concept of individual car travel into a model resembling mass transit.Future research will focus on creating real-time hardware for this suggested system.

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