© December 2021| IJIRT | Volume 8 Issue 7 | ISSN: 2349-6002

Review based on Highway Road Safety Using Sensors

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***Abstract* - The Road Safety measures is a never-ending process done for assessing the accident potential and safety performance of new and existing roads. RS (Road Safety) is a proactive, efficient, and cost-effective means of improving road safety. The study's aims are to discuss collected data on road safety for bicycles, motors, pedestrians' walkers, and other cars using infrared Sensors, Ultrasonic Detectors etc. that have been investigated by the researchers in the past and help to identify the road safety factor that is causing the risk on the highway, roadways, bridges and other traffic areas. The researchers' systems or preparations are also being studied for development. The safety assessment had been useful in creation of safety measures.**

1.INTRODUCTION

1.1. ITS and Road Technical Specifications

ITS strategies aim to reduce travel time, ease delays and congestion, improve safety, and reduce pollutant emissions without the need for new roadway construction. Users and managers of transportation systems benefit from ITS strategies that include electronic surveillance, communications, and traffic analysis and control technologies. ITS sensors frequently serve as data-gathering elements of an ITS, dictating ITS operating characteristics, data types provided, and installation requirements. Through access to industry-standard in-vehicle interfaces, ITS and Telematics departments in particular have gradually increased their interest in vehicle data. Depending on the type of roadway and collecting sensors used in the service, this attempt to gather vehicular information and access can be determined differently. The flow of a road is classified into two types: uninterrupted and interrupted. Uninterrupted flow facilities do not have fixed elements, such as traffic signals, that are external to the traffic stream and can disrupt the flow. Traffic flow conditions are determined by interactions between vehicles in a traffic stream, as well as interactions between vehicles and the geometric and environmental characteristics of the roadway. Interrupted flow facilities include fixed elements such as traffic signals, stop and yield signs, and other types of controls that can disrupt traffic flow. A road sensor is required at each type of facility to capture vehicle movement in real time. Sensors are classified into two types: infrastructure-based sensors and OBDII-based vehicle sensors. Pressure detectors, inductive loop detectors, magnetic detectors, ultrasonic detectors, microwave detectors, infrared detectors, and image detectors are examples of infrastructure-based sensors. These sensors are used as part of an ITS's signal control and traffic operation. Vehicle sensors, on the other hand, include GPS, automatic vehicle identification (AVI) via radio frequency identification (RFID) tags, and on-board diagnostics II (OBD)-based vehicle sensors linked to an in-vehicle network.

1.2. Sensor based on Infrastructure

Infrastructure-based sensors, in general, have strengths and weaknesses based on their features, operation, and installation types. Recent trends in other IT technologies, however, include special traffic sensors for traffic detection due to their low cost of installation and operation. T-sensor nodes, for example, are randomly deployed around a target area where approaching lanes cross at an intersection. In other words, T-sensor nodes can collect data from their surroundings and transmit it to a roadside server via their neighbors using a predetermined automatic mechanism; the user can then access a database to create a new service. These sensors include in-lane T-sensor nodes, roadside T-sink nodes, and local roadside equipment (RSE) servers. An RSE server in the center of a crossroad collects vehicular information from sensor nodes and transmits it to approaching vehicles. Using this data collection and processing procedure, each vehicle approaching a crossroad can be provided with a new real-time service to help avoid potential traffic accidents.

1.3. Vehicle sensor based on OBDII

An OBDII-based vehicle sensor is a device within a vehicle that continuously senses the conditions inside the vehicle. The controller area network (CAN) bus provides data from a vehicle sensor such as speed, revolutions per minute (RPM), battery voltage, coolant temperature, coordinates, direction, distance travelled, Diagnostic Trouble Codes (DTC), and fuel consumption. Vehicle sensor data can be formatted as probe data or messages via a vehicle sensor installed in each vehicle, and then processed, formatted, and transmitted to a smart road server for further processing to create a clear understanding of the driving environment.

A vehicle sensor based on OBD II is linked to the vehicle domain architecture designed by the vehicle manufacturer via any gateway. The gateway is a vehicle interface device that serves as a mobile gateway between the vehicle's engine control unit (ECU) and an external device [ISO/DTR 13185-1.3].

1.4. Road with smart feature and sensor framework

A smart road server and sensor system framework. Infrastructure-based sensors, vehicle sensors, smart roadside servers, wireless communication, and traffic service providers are the five components of the framework. A road and vehicle system's processes include data collection, data fusion and processing, and information provisioning. Infrastructure-based sensors collect certain obstacle data, work zone data, incidents, and traffic signal times, but vehicle sensors also collect emission data, as well as vehicle speed, location, and RPM. These data can be sent to a smart roadside server via infrastructure-to-infrastructure (I2I) and vehicle-to-infrastructure (V2I) communication networks like DSRC and Wireless Access for Vehicular Environments (WAVE).

These data are processed appropriately, such as data fusion, at a roadside server. The best information is then provided to drivers via Telematics. The following capabilities and requirements should be met by the framework of a smart road server and sensor system:

- Context-aware computing in real time and event stream processing
- Interoperability of different types of road sensors and vehicle data sensors
- Wireless and seamless communication (V2I) technologies such as DSRC, WAVE, and Wi-Fi are examples of V2I technologies.
- Data distribution and transmission to a central server
- Policy and optimal database design

2. LITERATURE REVIEW

According to Nikheel Soni,[1] the Internet of Vehicles approach is being used to develop a novel low-cost sensor-based system for road safety applications in intelligent transportation systems. Weather-related factors, poor road surfaces, and the presence of sharp turns were discovered to be major hazards that jeopardize road safety. A wireless sensor network-based solution, comprised of embedded systems for vehicular clients and infrastructure waypoints, is being developed for detecting road safety hazards and warning users about potentially hazardous events caused by factors such as the presence of speed bumps, sharp turns, and weather-related factors such as rain and fog. Hazards detected by embedded systems are communicated to the user via the Vehicle-to-Vehicle and Vehicle-to-Infrastructure communication interfaces developed in this study for inter-vehicle communication and obtaining sensory information from infrastructure waypoints, respectively. The accuracy achieved was 88 percent for speed bump detection, 73.86 percent for sharp turns, and 100 percent for rain and fog detection. The designed solution optimizes communication systems by reducing the size of packets exchanged, which improves transmission speed, packet losses, and network congestion. As a result, the designed solution is capable of improving road safety through the use of an Internet of Vehicles approach.

F. Garcal et al. [2] discussed how recent developments in applications designed to improve road safety necessitate the use of reliable and trustworthy sensors. Keeping this in mind, recent research in the field of automotive technologies has revealed that LIDARs are a very dependable sensor family. A novel approach to road obstacle classification is proposed and tested in this paper. Two different LIDAR sensors are compared with a focus on their main characteristics in terms of road applications. The viability of these sensors in real-world applications has been investigated, and the results of this investigation are presented.

According to Aya Hamdy Ali et al [3]., road traffic accidents kill 1.25 million people worldwide each year. This paper introduces a method for recognizing driving events in order to improve road safety and reduce accidents. Based on smartphone sensors, the proposed method detected and classified both driving behaviors and road anomaly patterns (accelerometer and gyroscope). For method evaluation, the k-Nearest Neighbor and Dynamic Time Warping algorithms were used. Experiments were carried out to assess the accuracy of the k-nearest neighbor and dynamic time warping algorithms for detecting road anomalies and driving behaviors, as well as classifying driving behaviors. According to the evaluation results, the k-nearest neighbor algorithm detected road anomalies and driving behaviors with a total accuracy of 98.67 percent. With a total accuracy of 96.75 percent, the dynamic time warping algorithm classified (normal and abnormal) driving behaviors.

Krzysztof Okarma et al.[4] proposed that various research groups specializing in various aspects of ITS solutions share their ideas and recent achievements. It includes papers on newly developed methods and ideas for combining data from various sensors, including cameras, as well as other research projects and works in the field of Intelligent Transportation Systems, with an emphasis on sensor-based innovations that address challenges in tracking, localization, road and weather prediction, sensor fusion algorithms, road safety, and anomaly detection.

Giuseppe Guido [5] investigated the extraction of vehicle tracking data from smartphone sensors and its application in the estimation of safety performance indicators. The precision of tracking data from smartphone sensors is measured in relation to GPS tracking measurements. The results of this analysis identify potentially dangerous interactions and highlight high risk zones that reflect locations with high vehicular interactions.

Aldona Jaraniene et al. [6] investigated whether intelligent Vehicle Safety Systems, whether vehicle-based or infrastructure-related, provide superior road safety. These are classified as passive and active safety applications, with the former assisting people in staying alive and uninjured in a crash and the latter assisting drivers in avoiding accidents. The paper delves deeper into some of the most promising (e-call) and widely used (ABS, ESP) systems. There is also discussion of potential solutions for deploying intelligent transportation systems in Lithuania.

Karim Ismail et.al [7] examined numerous applications of computer vision techniques in the disciplines of traffic engineering and road safety, and they effectively address long-standing challenges in these fields. Traditionally, traffic conflict techniques (TCT) have been advocated to compensate for the shortcomings of collision data by relying on more frequent and low-cost events. Since their inception, traffic conflict techniques have been challenged by observer subjectivity and the high cost of conducting field surveys. The authors have advocated for and demonstrated the use of computer vision techniques in TCT in a number of successful applications. This study demonstrates a comprehensive before-and-after analysis for assessing a pedestrian safety treatment. The results obtained with the automated video analysis system are consistent with previously published results obtained with human observers.

Kshitij Pawar et al. [8] presented a method for such a system, which uses an accelerometer and a gyroscope, both of which are built into modern smartphones, to detect potholes. Pothole-induced vibrations can be distinguished by measuring them on the axis reading. Our proposed Neural Network model is trained and evaluated on sensor data and distinguishes potholes from non-potholes. The neural network has a classification accuracy of 94.78%. It also has a good precision-recall trade-off, with 0.71 precision and 0.81 recall, which is quite high for a class imbalance problem. The findings suggest that the method is appropriate for developing an accurate and sensitive supervised model for pothole detection.

3. CONCLUSION

The study is all about the road safety using sensor in various sector of transportation industries. The review paper has helped us to identify the major risk and also the remedies for resolving such risk for the betterment of the areas which has not yet worked out.

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