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Review on Accident Detection and Alerting System

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Abstract - This project aims to address the critical issue of individuals being left without assistance in the event of an accident while riding vehicle. With the implementation of an accident detection and alert system, this project seeks to provides solution to this problem. The system utilizes an Arduino, GPS Receiver, and GSM module to control the entire process. The GPS Receiver identifies the vehicle's direction, while the GSM module sends an SMS containing the directions and a link to Google Maps to the assigned contact. The system can detect accidents using a Vibration sensor. The microcontroller sends this information to the GSM module, which transmits the data, including the victim's precise location, to the assigned contact. The contact can then use the GPS MODEM to locate the victim and provide immediate assistance. The implementation of the Accident Detection and Alert System using Arduino is a highly effective solution, particularly in developing nations such as Nepal, India, and Bangladesh where the number of vehicles on the road is rapidly increasing. With the rise in vehicular accidents, fatalities have also been on the rise. This system is a valuable investment in ensuring the safety of drivers and passengers alike.

Key Words: GSM module, GPS MODEM, Accident Detection, Arduino.

I.INTRODUCTION

The provided passage outlines the context of road safety issues, particularly the increase in accidents due to the growth of the automobile industry in the twentieth century. It emphasizes the alarming statistics of road accident deaths in India and highlights the need for advanced technology to address these concerns. The proposed solution involves the integration of modern navigation technology, specifically GPS, into vehicle systems to enhance accident detection and response mechanisms. The passage introduces the concept of Map Matching algorithms, which play a crucial role in accurately determining a vehicle's location on the road network by integrating GPS data with spatial road network data. This integration enables the identification of the correct road link and, consequently, the precise physical location of the vehicle. The focus is on utilizing this technology to detect accidents and promptly alert Rescue Service Centers, providing immediate assistance to accident victims. The passage then introduces a new system designed to automatically detect accidents and alert the nearest hospital or medical services about the exact location of the incident. The system comprises a device equipped with sensors that, upon activation, send relevant information to a microcontroller. The microcontroller then triggers an alert message, including geographical coordinates, time, and angle of the accident. Key components of the system include a GPS module for accurate location tracking and a GSM module for communication purposes.

II. LITERATURE SURVEY

In [1] The methodology comprises a Path Replanning Controller for real-time collision-free path generation, a Path Tracking Controller to minimize tracking deviation error, and a Stability Controller to control sideslip angles for improved handling stability. The advantages include enhanced collision avoidance, path tracking, and safety for autonomous vehicles. Real-time path generation and deviation error minimization contribute to improved vehicle performance. However, specific limitations of the control strategy are not explicitly outlined in the provided excerpts, requiring a comprehensive review for further details.

In [2] The accident detection and alerting system integrate sensors, GPS, and GSM modules for efficient accident detection and notification. Advantages include cost-effective implementation, quick emergency response, low power consumption, accuracy, and reduced human error. Limitations involve potential false reporting at low speeds, vulnerability to sensor damage, communication challenges in GSM-lacking areas, lack of an offline mode, and signal transmission blockage in specific environments.

In [3] Methodologies involve GPS, GSM modules, machine learning, MEMS sensors, and agent-based frameworks to enhance accident alert and detection systems. Advantages include improved accuracy, efficient road hazard alerts, reduced investigation time, and integrated medical history for faster treatment. Limitations include reliance on smartphone

sensors with potential failures, network connectivity issues in remote areas, and the absence of measures to prevent false alarms in certain systems.

In [4] The Smart Collision Avoidance and Detection System utilizes sensors (pulse, vibration, accelerometer) to prevent accidents, incorporating a GSM module for communication. Advantages include alcohol consumption detection, immediate accident alerts, information on vehicle orientation changes, and accurate force detection during crashes. Limitations involve potential oversight of accidents unrelated to alcohol, inability to prevent certain accidents due to external factors, vehicle-specific modifications, and the need for regular maintenance.

In [5] The methodology involves a comprehensive analysis of algorithms and models for road accident analysis, focusing on data mining and machine learning from 2015 onwards. Advantages include extensive coverage, integration of heterogeneous data sources, and the combination of analytic techniques for improved prediction reliability. Limitations include the omission of relevant factors in some research, coarse-grained model output, and the challenge of replicating the complexity of human behavior in available datasets and algorithms.

In [6] The methodology reviews accident detection and prevention techniques, encompassing conventional methods, ML/AI approaches, and IoT integration. Advantages of IoT-based systems for smart vehicles include casualty reduction, effective implementation through vehicle system integration, and valuable insights from data mining. Limitations involve security and privacy concerns in VANETs, routing issues due to dynamic topology, and the necessity to consider external environmental factors impacting system performance.

In [7] The research on collision avoidance systems for intelligent vehicles proposes a behavior-based switching system, establishes collision avoidance models, and employs a two-layer fuzzy controller. Advantages include adaptability to driving conditions and improved collision avoidance effective ness. The study emphasizes potential real vehicle verification and the need to consider other traffic lanes and extreme road conditions in future research. Limitations involve the necessity for further validation through real vehicle testing and additional investigation into the impact of various factors on the collision avoidance system. The research underscores the significance of driver behavior, considering factors like overlap rate, road adhesion coefficient, and initial vehicle speed in influencing collision avoidance methods.

In [8] The Low Power Smart Vehicle Tracking, Monitoring, Collision Avoidance, and Antitheft System methodology involves GPS, GSM, MEMS accelerometer, ultrasonic sensor, and Node MCU components, utilizing IoT for cloud-based data storage. Advantages include real-time tracking, accident detection, low power consumption, IoT integration, and antitheft features. Limitations include reliance on GSM network coverage, GPS signal accuracy, potential constraints in ultrasonic sensor range and accuracy, and the necessity for periodic maintenance and updates.

In [9] The Automotive Smart Black-Box Monitoring system utilizes sensors for continuous vehicle parameter monitoring, storing data in a black box and cloud database for live tracking and accident analysis. Advantages include real-time data transmission to emergency services, improved vehicle safety through live monitoring, and IoT technology for remote system control. Limitations involve potential cost increase due to sensor installation, the need for regular maintenance, and challenges in areas with poor network connectivity, raising privacy concerns related to personal data collection and storage.

In [10] The accident identification and alerting system employ a microcontroller, accelerometer, GSM, and GPS modules for quick accident detection and emergency alerts. Advantages include automatic detection, immediate alerting, low cost, portability, and addressing poor emergency facilities. Limitations involve potential false detections due to vehicle vibrations, dependency on GSM network availability, limitations in detecting accidents in remote areas with weak GPS signals, and challenges in detecting low-speed or minimal impact accidents.

Table 1: Summarization of various Authors

Authors	Title	Research focus	Remarks
Yong Chen, Sizhong Chen, Hongbin Ren, Zepeng Gao [1], 2020	Path Tracking and Handling Stability Control Strategy with Collision Avoidance for the Autonomous Vehicle under Extreme Conditions	On optimizing path planning algorithms for highly automate vehicles, prioritizing real-time generation of collision-free trajectories while considering vehicle dynamics, environmental constraints, and computational efficiency	It highlights the ongoing challenges and advancements in the field of automated driving systems. It shows the importance of considering various factors such as vehicle dynamics, environmental constraints, and computational efficiency to ensure the safety and stability of highly automated vehicles, especially in emergency scenarios.
Abdulkadir Shehu Bari, Muhammad Abubakar Falalu, Muhammad Auwal Umar, Yakubu Yunusa Sulaiman [2], 2022	Accident Detection and Alerting Systems	It addresses the need for improving emergency response systems for vehicle accidents, and it explores the use of unmanned aerial vehicles (UAVs) to enhance accident tracking capabilities, providing faster and more efficient assistance to victims.	It emphasizes the pivotal role of swift emergency response facilitated by technological advancements such as accident detection systems and UAVs in mitigating accident severity and saving lives, particularly in remote areas with limited access to immediate assistance.
Sharmila Gaikwad , Mahek Khanna ,Shreyans Kothari , Ashutosh Kudale [3], 2021	Systematic Literature Survey on Accident Alert & Detection System	In combating the rising incidence of road accidents, by implementing effective accident detection systems utilizing technologies such as smartphones, GSM, GPS, vehicular ad-hoc networks, and mobile apps to improve emergency response and mitigate accident severity.	It emphasizes the urgent need to address the growing problem of road accidents, by implementing advanced accident detection systems to improve emergency response.
Bhardwaj Ankush Singh, RUday Kumar andHarika Pendli [4], 2021	Smart collision avoidance and detection system	This focus on improving road safety through the development of systems to detect alcohol consumption while driving, monitor driver's heart rate for medical emergencies, and implement accident detection systems using sensors and communication modules for timely assistance in the event of a crash.	The technology may not always be foolproof or accessible to all drivers.
Camilo Gutierrez-Osorio, Cesar Pedraza [5], 2020	Modern data sources and techniques for analysis and forecast of road accidents	It analyzes and evaluates algorithms and models utilized for the analysis, characterization, and prediction of road accidents, with a specific emphasis on data mining and machine learning techniques.	Limitations observed is lack of incorporation of relevant factors such as traffic flow and human mobility.

Unaiza Alvi , Muazzam A. Khan Khattak , Balwal Shabir , Asad Waqar Malik, Sher Ramzan Muhammad [6], 2022	A Comprehensive Study on IoT Based Accident Detection Systems for Smart Vehicles	It involves various accident detection and prevention techniques, including conventional methods, ML/AI-based approaches, and the integration of IoT technologies.	This includes security and privacy issues in Vehicular Ad-Hoc Networks (VANETs), dynamic topology leading to routing issues.
Guosi Liu , Shaoyi Bei , Bo Li , Tao Liu , Walid Daoud , Haoran Tang , Jinfei Guo and Zhaoxin Zhu [7], 2023	Research on Collision Avoidance Systems for Intelligent Vehicles Considering Driver Collision Avoidance Behaviour	It focuses on developing collision avoidance systems for intelligent vehicles by incorporating driver behavior-based collision avoidance switching, longitudinal and lane change collision avoidance models, and utilizing real traffic data to optimize collision avoidance strategies.	Limitation could be the complexity and variability of human driving behavior, which may pose challenges in accuracy prediction.
Saurabh S. Chakole and Neema A. Ukani [8], 2023	Low power Smart Vehicle Tracking, Monitoring, Collision avoidance and Antitheft System	This focus on integrating various components and IoT technology to develop a low-power smart vehicle tracking, monitoring, collision avoidance, and antitheft system.	Real-time tracking and monitoring of vehicle location and speed
P. Josephinshermila , S. Sharon priya , K. Malarvizhi, Ramakrishna hegde , S. Gokul Pran , B. Veerasamy [9], 2023	Accident detection using Automotive Smart Black-Box based Monitoring system	It is an Automotive Smart Black-Box based Monitoring system is to enhance vehicle safety, monitoring, and accident analysis through sensor integration, real-time data transmission, and emergency response coordination.	It has the ability to store data for future accident analysis and investigation.
Suraj Patil, Kamesh Patil , Swapnil Dhabekar , Mahendra Nirgude , Prof. Shashikant Renushe [10], 2020	Accident Identification and alerting system	To develop a low-cost, portable, and easy-to-install solution utilizing a microcontroller, accelerometer, GSM, GPS, and auxiliary components.	The system may give false detection of accidents due to vibrations that are common in vehicles.

III. CONCLUSION

This innovative system addresses gaps in emergency facilities for road accident victims, leveraging advanced technology to promptly alert relevant parties. However, its network dependency poses limitations in areas with poor coverage. Beneficial to the automotive industry, it enables swift medical responses, potentially saving lives. Vehicle tracking systems, crucial for fleet management, enhance safety, security, communication, and productivity for personal and business use. Anticipated to play a significant role in daily life, the accident alert project aims to reduce fatalities by promptly notifying paramedics. Yet, challenges arise in areas without GSM network provision, impacting communication reliability

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