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DESIGN AND IMPLEMENTATION OF EMBEDDED-BASED VEHICLE-TO-VEHICLE TO COMMUNICATION SYSTEM

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***Abstract*:** This project introduces a real-time embedded Vehicle-to-Vehicle (V2V) Communication System using Arduino units, Zigbee modules, GSM connectivity, and various sensors. It aims to bolster road safety, aid breakdown assistance, and facilitate critical information exchange during emergencies. By employing Zigbee technology, seamless communication between vehicles is established. In instances such as breakdowns, accidents, or roadblocks, drivers can activate switches to instantly alert nearby vehicles, enhancing overall safety. Ultrasonic sensors monitor fuel levels and distances, allowing for convenient location of fuel stations. In emergencies, automatic GSM alerts containing the location and type of emergency are dispatched, ensuring swift response from authorities or nearby drivers. Vibration sensors detect road obstacles, while IR sensors help detect pedestrians and vehicles in blind spots. Additionally, MQ3 Alcohol gas sensors detect alcohol levels in drivers' breath, triggering automatic alerts. LCDs provide real-time updates on fuel levels, emergency alerts, and obstacle warnings, making transportation safer and more efficient.

Keywords: Arduino, LCD, Zigbee, GSM, Ultrasonic sensor, IR Sensor, Red LED, Buzzer, MQ3 Alcohol Gas sensor

I. Introduction

Every year, car crashes claim thousands of lives, surpassing casualties from many diseases or natural disasters. Research suggests that approximately 60% of these accidents could be prevented if drivers were alerted just 30 seconds prior. However, human reaction times often delay these warnings, rendering them ineffective. Consider a typical scenario where a car suddenly veers into another lane, escalating the risk of a collision. The human response involves recognizing the danger, processing the information, and physically reacting by steering or braking. Unfortunately, this process is time-consuming and frequently exceeds the crucial half-second window, potentially resulting in accidents already unfolding.

The implementation of Vehicle-to-Vehicle (V2V) systems presents a promising solution to this predicament. These systems facilitate real-time communication between vehicles, enabling instant alerts regarding potential hazards on the road. Such warnings could include sudden lane changes, abrupt braking by nearby vehicles, or imminent collisions at intersections. By sharing data such as speed, location, and direction, vehicles equipped with V2V technology can anticipate and address potential dangers more effectively than human drivers alone.

Several factors influence the adoption of V2V technology. Firstly, its ability to reduce fatalities and injuries resulting from car accidents is paramount. Studies demonstrate that timely warnings significantly diminish the severity of crashes or prevent them altogether. Secondly, the utility of the technology, considering factors like cost, reliability, and efficacy, is crucial. V2V systems must be robust, affordable, and dependable across various driving conditions. Thirdly, the availability of objective testing methods is essential for accurately assessing the performance of V2V technology. Rigorous testing protocols ensure uniform functionality across different vehicle models and environments, validating its effectiveness.

In summary, V2V technology holds immense potential to revolutionize road safety by providing drivers with timely alerts and preventing numerous accidents. However, widespread adoption hinges on addressing significant concerns such as utility, testability, and efficacy. Stakeholders must prioritize these considerations to create a safer and more efficient transportation environment.

II.Literature Survey

In recent years, there has been a significant focus on developing intelligent systems for vehicular communication to enhance road safety, particularly in the context of collision avoidance. Vehicle-to-vehicle (V2V) communication has emerged as a promising approach to enable real-time information exchange between vehicles, enabling them to cooperate and avoid potential collisions. This literature review explores several research efforts in this domain, highlighting different methodologies, technologies, and algorithms proposed for V2V communication systems.

ARM and Zigbee-Based Intelligent Vehicle Communication for Collision Avoidance: One notable study by D. Daya Priyanka and T. Sathish Kumar [1] introduces an ARM and Zigbee-based system for intelligent vehicle communication aimed at collision avoidance. The authors present a framework leveraging ARM processors and Zigbee modules to facilitate seamless communication between vehicles. By integrating collision detection algorithms and real-time data exchange protocols, this approach offers a practical solution for enhancing road safety through V2V communication.

IEEE 802.11p for Vehicle-to-Vehicle (V2V) Communication: Another significant contribution comes from Zijun Zhao and Xiang Cheng [2], who explore the use of the IEEE 802.11p standard for V2V communication. Their research, conducted at the School of Electronics Engineering and Computer Science, Peking University, Beijing, China, highlights the potential of IEEE 802.11p in enabling high-speed, reliable communication between vehicles. By leveraging this standard, the study aims to improve the efficiency and effectiveness of collision avoidance systems through enhanced data exchange capabilities.

An Embedded Node Operating System for Real-Time Information Interaction: Sheng Zhang, Ying Wu, and Yantong Wang [3] present an embedded node operating system tailored for real-time information interaction in V2V communication systems. Their work, presented at the 19th International Conference on Intelligent Transportation Systems (ITSC), China, focuses on developing a lightweight, efficient operating system suitable for embedded devices deployed in vehicles. By optimizing resource utilization and prioritizing real-time data processing, this approach aims to enhance the responsiveness and reliability of V2V communication systems.

Secure Message Transmission Algorithm for Vehicle-to-Vehicle (V2V) Communication: Trupil Limbasiya and Debasis Das [4] propose a secure message transmission algorithm designed specifically for V2V communication scenarios. Conducted at the Department of Computer Science & Information Systems, BITS Pilani, their research addresses the critical need for securing data exchange between vehicles to prevent malicious attacks and unauthorized access. By employing cryptographic techniques and authentication mechanisms, the proposed algorithm ensures the integrity and confidentiality of communication channels, thereby enhancing the trustworthiness of V2V systems.

Integration and Synthesis: Overall, these studies collectively contribute to the advancement of V2V communication systems for collision avoidance. While each research effort focuses on different aspects such as technology, protocols, algorithms, and security, they share a common goal of improving road safety through enhanced information exchange between vehicles. By leveraging diverse methodologies and technologies, researchers aim to overcome the challenges associated with V2V communication, paving the way for safer and more efficient transportation systems in the future.

In conclusion, V2V communication holds great potential for revolutionizing road safety by enabling vehicles to collaborate and avoid collisions through real-time information exchange. The literature surveyed in this review highlights various approaches and technologies aimed at enhancing V2V communication systems, ranging from hardware implementations to communication protocols and security algorithms. Moving forward, continued research and development in this field are essential to realizing the full benefits of V2V communication in mitigating accidents and improving overall traffic management.

III.EXISTING SYSTEM

The proposed plan of action for our project is to initiate an optical wireless communication model that gives high data rates (in the order of MHz) and transmission distances of up to 1 m. This model should effectively be able to transmit data from one device to another using LEDs, thereby initiating a Li-Fi network in a localized environment. It consists of a transmitter and a receiver. Vehicle to Vehicle data transmission through visible LED light Thus, installation cost and environmental effects are much less in this proposed system. Vehicle-to-vehicle communication is the most effective solution we have used to reduce accidents that come on the daily news. In Li-Fi technology for vehicle-to-vehicle data transmission, we use LED light. In Li-Fi technology, the elimination of certain protocols reduces complexity. The goal of designing this system is to achieve highly reliable data transmission between the transmitter and receiver installed on the vehicle.
Disadvantages:

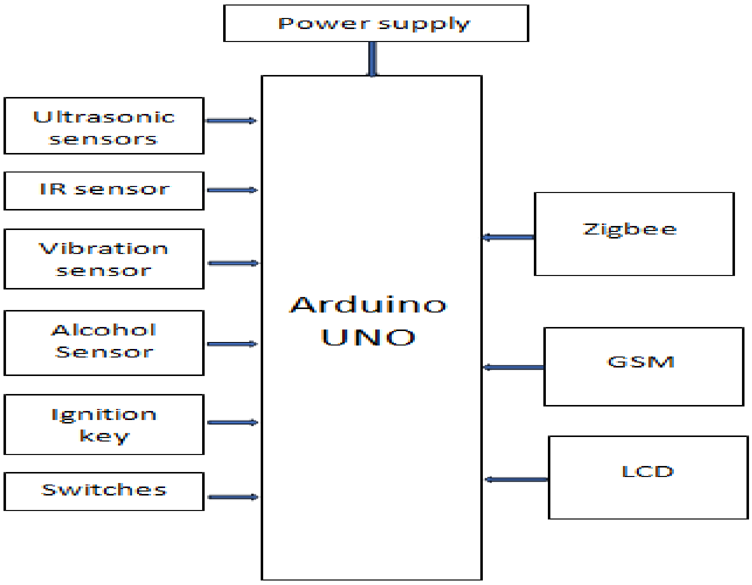
- Limited Range
- Line-of –Sight Requirement
- Weather Conditions
- Integration Issues
- Infrastructure Cost
- Security and Privacy Issues
- In an Existing System Did not Detect Blind Spot Detection of Driver's vehicle
- The Drive Alcohol Detection System

IV.PROPOSED SYSTEM AND WORKING METHODOLOGY:

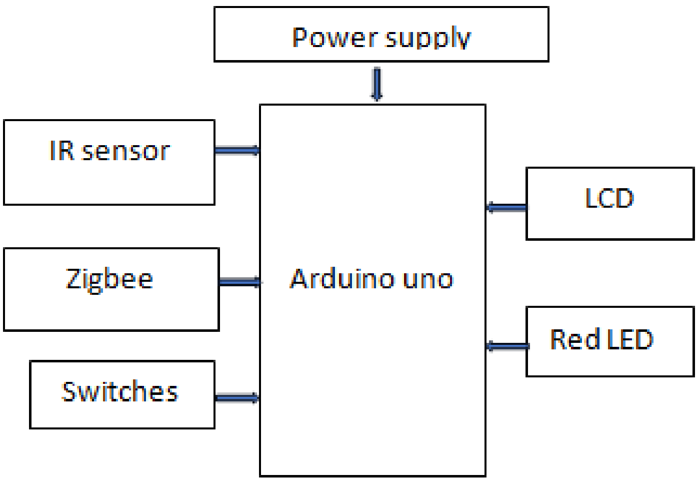
It works with both GSM and ZIGBEE for communication with the control room and a close vehicle. They also measure the amount of fuel in the tank in litters and look for obstacles. Standardizing the format and use of V2V transmissions is what the suggested system is all about. This will help manufacturers quickly get a certain number of vehicles equipped. 2V systems will use dedicated short-range communications (DSRC), which are two-way radio channels that let cars with V2V systems talk to each other at about 400 meters. It is up to the DSRCs to collect and share basic safety messages (BSMs) about a vehicle's speed, direction, position, and brake state so that they can decide if they need to send the driver an alert. The method lets people know right away when there are breakdowns, accidents, roadblocks, or natural disasters. Drivers can press certain buttons to let other drivers know when other cars are close, which makes the road safer overall. Ultrasonic sensors are used to keep an eye on fuel levels and see if the ignition is ready to go and if booze is present.

V.BLOCK DIAGRAM FOR THE PROPOSED MODEL

1. Block diagram of transmitter side



2. Block diagram of the receiver side



VI.RESULTS

outcomes at the TX side :

Fig. 1 Before the system starts

Fig. 2 After the ignition key is started

Fig. 3 If alcohol detected

Fig. 4 If fuel level is low

Fig. 5 Accident/sudden break occur

Fig. 6 Obstacle in front side

Outcomes at RX side:

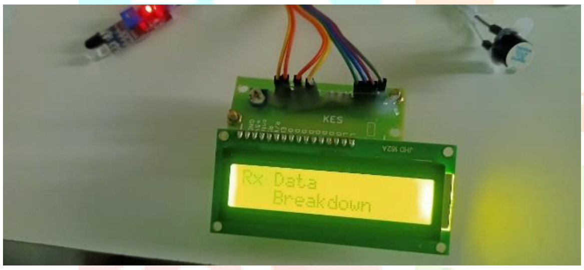


Fig. 7 RX data breakdown

Fig. 8 RX data see a rare side

Fig. 9 RX data accident/break

Fig. 10 RX data SOS

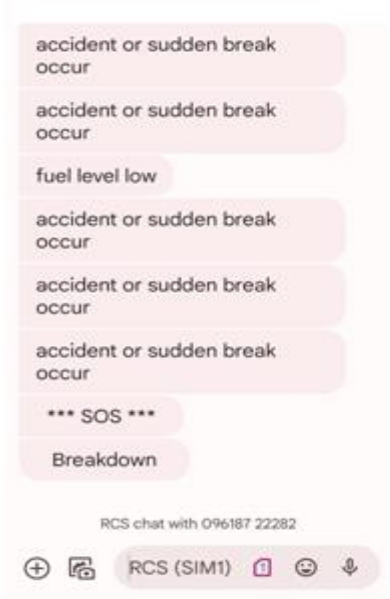


Fig. 11 GSM outcome

VII.CONCLUSION:

In conclusion, the wireless system for car safety and communication is meant to improve road safety with a simple module and allow vehicles to talk to each other in case of an emergency on the roads, making it easier to get off the road right away. The speed limit sign would help the car or rider follow the safety rules. The ability for cars to talk to each other would help drivers stay in their lanes and help with emergencies. This device would show the data more clearly on a screen instead of just using LEDs. It would also count with a buzzer. The driver can switch between any of the information, such as the distance traveled and the distance between the car and the driver.

VIII.FUTURE SCOPE:

The future scope for this vehicle's safety and communication system might get better by adding advanced driver aid systems (ADAS) like adaptive cruise control, lane departure warnings, and systems that help drivers avoid accidents. Adding vehicle-to-infrastructure (V2I) connection for real-time traffic updates and better route planning would also make the roads safer and more efficient. Using artificial intelligence (AI) to predict what will happen on the road and how people will behave could lead to proactive safety steps. Adding new technologies like 5G networks and self-driving cars would allow for more connected and self-driving transportation systems, which would make roads safer and more efficient in the long run.

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