

# VEHICLE TO VEHICLE COMMUNICATION USING NODE MCU

Dr. YNS Vamsi Mohan<sup>1</sup>, Veeravalli Brahma Teja<sup>2</sup>, Shaik Saidavali<sup>3</sup>, Potluri Veerendra Babu<sup>4</sup>, Tangirala Chandra Shekar Reddy<sup>5</sup>,

<sup>2,3,4,5</sup>UG Student,ECE,Chalapathi Institute Of Engineering&Technology Guntur-Andhra Pradesh,India

<sup>1</sup>Associate Professor ECE,Chalapathi Institute Of Engineering&Technology Guntur-Andhra Pradesh,India

**Abstract**—This project presents the design and implementation of a Vehicle-to-Vehicle (V2V) communication system using NodeMCU (ESP8266) to enhance road safety and reduce traffic accidents. With the rapid increase in the number of vehicles, the lack of real-time communication between vehicles has become a major cause of collisions, especially in situations involving sudden obstacles or limited visibility. The proposed system enables direct wireless communication between two vehicles using Wi-Fi technology. Each vehicle is equipped with an ultrasonic sensor to detect nearby obstacles and measure the distance between vehicles. The collected data is processed by the NodeMCU and transmitted in real time to the other vehicle, ensuring continuous awareness of surrounding conditions. Additionally, an LCD display provides real-time information to the driver, while a buzzer generates alerts when a potential collision is detected. A motor driver is also incorporated to demonstrate automatic control actions such as slowing down or stopping the vehicle in critical situations. The system is cost-effective, reliable, and easy to implement, making it suitable for modern intelligent transportation systems. By enabling real-time data exchange and early warning mechanisms, the proposed solution improves driver response time, enhances situational awareness, and significantly reduces the risk of road accidents.

**Keywords**— Vehicle-to-Vehicle Communication (V2V), NodeMCU (ESP8266), Wireless Communication, Ultrasonic Sensor, Collision Avoidance, Intelligent Transportation System (ITS), Internet of Things (IoT), Real-Time Monitoring, Embedded Systems.

## I. INTRODUCTION

The rapid growth in the number of vehicles on roads has significantly increased traffic congestion and the risk of accidents. One of the primary causes of road accidents is the

lack of real-time communication between vehicles, particularly in situations involving sudden braking, unexpected obstacles, or poor visibility conditions. Traditional safety systems mainly depend on driver awareness and reaction time, which may not always be sufficient to prevent collisions. This highlights the need for intelligent systems that can assist drivers by providing timely information and alerts.

Vehicle-to-Vehicle (V2V) communication is an emerging technology in the field of intelligent transportation systems (ITS) that enables vehicles to exchange critical information such as distance, speed, and obstacle presence. By sharing real-time data, V2V systems improve situational awareness and help drivers make better decisions, thereby enhancing overall road safety. With advancements in embedded systems and wireless communication technologies, cost-effective solutions can now be developed using modules like NodeMCU (ESP8266), which supports Wi-Fi-based communication.

In this project, a V2V communication system is developed using NodeMCU, where two vehicles are interconnected wirelessly. Each vehicle is equipped with an ultrasonic sensor to detect obstacles and measure the distance from nearby vehicles. The NodeMCU processes this data and transmits it to the other vehicle in real time. The system also incorporates an LCD display to provide live information to the driver and a buzzer to generate alerts in case of potential danger. Additionally, a motor driver is used to demonstrate automatic actions such as slowing down or stopping the vehicle under critical conditions.

The proposed system aims to provide a simple, cost-effective, and efficient solution for improving road safety. By enabling direct communication between vehicles, it reduces reaction time, enhances driver awareness, and contributes to the development of smart and intelligent transportation systems.

## II. REVIEW & LITERATURE SURVEY

In recent years, Vehicle-to-Vehicle (V2V) communication has gained significant attention as a promising solution for improving road safety and reducing traffic congestion. Various researchers have explored different technologies and methodologies to enable effective communication between vehicles.

A study by Rashmirani Samantary et al. proposed a V2V communication system using RF technology, where vehicles exchange information such as speed and position to enhance driver awareness. The research emphasized that real-time data sharing between vehicles can significantly reduce accident rates by providing early warnings and improving decision-making.

Prathamesh Jadhav et al. focused on wireless communication-based systems for real-time interaction between vehicles. Their work highlighted the importance of continuous data exchange regarding traffic conditions and obstacles, enabling drivers to respond more effectively in critical situations. The study demonstrated that timely alerts can greatly enhance transportation safety.

Suma M. R. introduced a system using NodeMCU (ESP8266) integrated with cloud platforms and MQTT protocol for efficient communication. The system utilized sensors to detect proximity and transmit real-time alerts between vehicles. This approach showed the potential of combining IoT and cloud technologies to build scalable and intelligent transportation systems.

Another study by Ramya Daddanala et al. discussed the overall architecture, benefits, and challenges of V2V communication systems. The research explained how vehicles exchange data such as location and traffic conditions to prevent accidents and improve traffic flow. It also highlighted challenges such as communication delays, security concerns, and network reliability.

Sahil Mahajan developed a low-cost prototype of a V2V communication system using NodeMCU (ESP8266). His work demonstrated how wireless communication between vehicles can be implemented effectively using affordable components. The study concluded that such systems are highly beneficial for smart city applications and can significantly reduce collision risks.

From the above studies, it is evident that V2V communication systems play a crucial role in enhancing road safety and supporting intelligent

transportation systems. However, many existing solutions either involve high costs, complex architectures, or lack proper integration of sensing and alert mechanisms. Therefore, there is a need for a simple, cost-effective, and reliable system that integrates sensing, communication, and alert features efficiently.

### III. RESEARCH METHODOLOGY

The proposed Vehicle-to-Vehicle (V2V) communication system is developed using a structured embedded systems approach combined with wireless communication technology. The methodology focuses on designing a reliable and cost-effective system capable of enabling real-time communication between vehicles to enhance road safety. The overall system is based on a dual-vehicle model, where each vehicle is equipped with identical hardware components that work together to detect obstacles, process data, and communicate with nearby vehicles.

The hardware implementation of the system includes a NodeMCU (ESP8266), which acts as the central processing and communication unit. It is responsible for collecting data from sensors, processing the information, and transmitting it wirelessly to another vehicle using Wi-Fi technology. An ultrasonic sensor is used to measure the distance between vehicles or detect obstacles in front of the vehicle. The measured data is continuously monitored and sent to the NodeMCU for further processing. An LCD display is integrated into the system to provide real-time feedback to the driver, such as distance values and warning messages. Additionally, a buzzer is used to alert the driver when the detected distance falls below a predefined safety threshold, indicating a potential collision risk.

The software implementation is carried out using the Arduino IDE, where the system is programmed to read sensor data, process it, and transmit it between vehicles in real time. The NodeMCU establishes a wireless connection using its built-in Wi-Fi module and ensures continuous communication between both vehicles. The program logic is designed in such a way that whenever a critical condition is detected, such as a reduced distance between vehicles, an alert signal is generated and transmitted instantly. The receiving vehicle then displays the warning and activates the buzzer to notify the driver.

The working methodology of the system begins with the ultrasonic sensor detecting the distance

between vehicles or obstacles. This data is then processed by the NodeMCU and transmitted wirelessly to the other vehicle. Both vehicles continuously exchange information, ensuring that each driver is aware of the surrounding conditions in real time. When the system detects a dangerous situation, it triggers alerts through the buzzer and displays warning messages on the LCD. In addition, a motor driver is used to simulate automatic control actions such as slowing down or stopping the vehicle under critical conditions.

Overall, the methodology ensures seamless integration of sensing, processing, communication, and alert mechanisms. This approach enables efficient real-time data exchange between vehicles, reduces driver reaction time, and enhances safety, making the system suitable for implementation in intelligent transportation systems.

#### **IV. EXISTING SYSTEM**

The existing vehicle safety systems primarily rely on driver awareness and basic onboard technologies such as braking systems, airbags, and simple proximity sensors. These systems are mainly designed to minimize the impact of accidents rather than prevent them. Since they do not support communication between vehicles, they are limited in providing early warnings about potential hazards on the road. In many cases, the effectiveness of these systems depends heavily on the driver's reaction time, which may not always be sufficient in critical situations.

Some modern vehicles are equipped with advanced driver assistance systems (ADAS) that use technologies such as radar, cameras, and sensors to detect obstacles and maintain safe distances. Although these systems improve safety, they are often expensive and not accessible in low-cost vehicles. Moreover, these systems operate independently within a single vehicle and do not share information with other vehicles, limiting their ability to respond to dynamic traffic conditions.

In addition, certain systems use ultrasonic sensors to detect obstacles and provide alerts to the driver. While these systems can measure the distance between vehicles, they function only locally and lack the capability to communicate with nearby vehicles. A few research-based models have attempted to use wireless communication technologies such as Wi-Fi or Zigbee for data exchange, but these systems often suffer from limitations such as short communication range, network instability, and lack of real-time responsiveness.

Overall, the existing systems have several drawbacks, including the absence of direct communication between

vehicles, limited real-time information sharing, high implementation costs for advanced systems, and insufficient integration of sensing and alert mechanisms. These limitations highlight the need for a more efficient, cost-effective, and integrated Vehicle-to-Vehicle communication system.

#### **V. PROPOSED METHODOLOGY**

The proposed system is a Vehicle-to-Vehicle (V2V) communication system developed using NodeMCU (ESP8266) to enable real-time data exchange between vehicles and enhance road safety. In this system, two vehicles are interconnected wirelessly through Wi-Fi communication, allowing them to continuously share important information. Each vehicle is equipped with an ultrasonic sensor that detects obstacles and measures the distance between nearby vehicles or objects. The sensed data is processed by the NodeMCU, which acts as the central controller of the system.

The processed information is transmitted wirelessly from one vehicle to another in real time, ensuring that both vehicles are constantly aware of each other's position and surroundings. To provide immediate feedback to the driver, an LCD display is integrated into each vehicle, which shows real-time distance values and warning messages. In addition, a buzzer is incorporated to generate alerts whenever the distance between vehicles becomes unsafe or when an obstacle is detected, thereby reducing the chances of collision.

Furthermore, the system includes a motor driver (L298N) to demonstrate automatic control actions such as slowing down or stopping the vehicle in critical situations. This feature enhances the safety mechanism by not only alerting the driver but also taking preventive action when necessary. The proposed system is designed to be cost-effective, simple to implement, and scalable, making it suitable for real-world applications in intelligent transportation systems.

Overall, the system improves driver awareness, reduces reaction time, and significantly minimizes the risk of accidents by enabling efficient and continuous communication between vehicles.

**VI. BLOCK DIAGRAM**

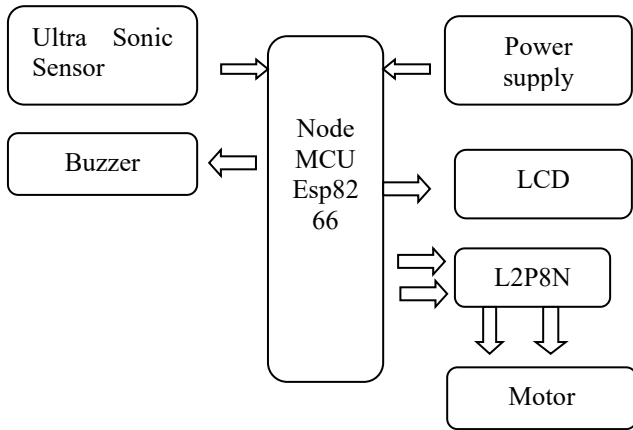


Fig. 6.1. Block Diagram A

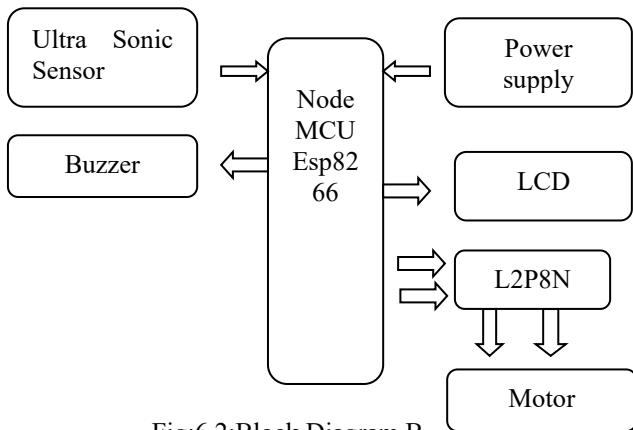


Fig:6.2:Block Diagram B

**VII. RESULTS AND OUTCOMES**

The implementation of the proposed Vehicle-to-Vehicle (V2V) communication system using NodeMCU (ESP8266) successfully demonstrated reliable real-time communication between two vehicle units. The system was able to accurately

detect the distance between vehicles using the ultrasonic sensor and continuously transmit this data wirelessly through Wi-Fi. The communication between the two NodeMCU modules was stable under normal operating conditions, ensuring timely data exchange without significant delay.

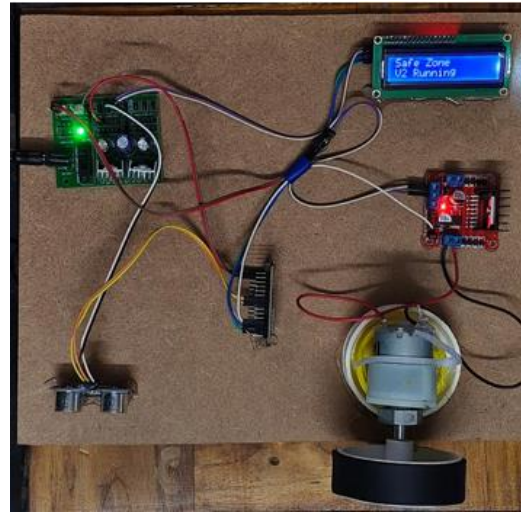


Fig:7.1: Output 1

During testing, the system effectively displayed real-time distance information and warning messages on the LCD, allowing the driver to monitor surrounding conditions. When the distance between vehicles dropped below the predefined safety threshold, the buzzer was activated instantly, providing an immediate alert to the driver. This quick response mechanism proved useful in reducing reaction time and improving driver awareness.

The integration of the motor driver further enhanced the system by demonstrating automatic control actions. In critical situations, the system was capable of simulating vehicle responses such as slowing down or stopping, which adds an additional layer of safety. The overall performance of the system showed that it is capable of preventing potential collisions by providing early warnings and enabling timely decision-making.

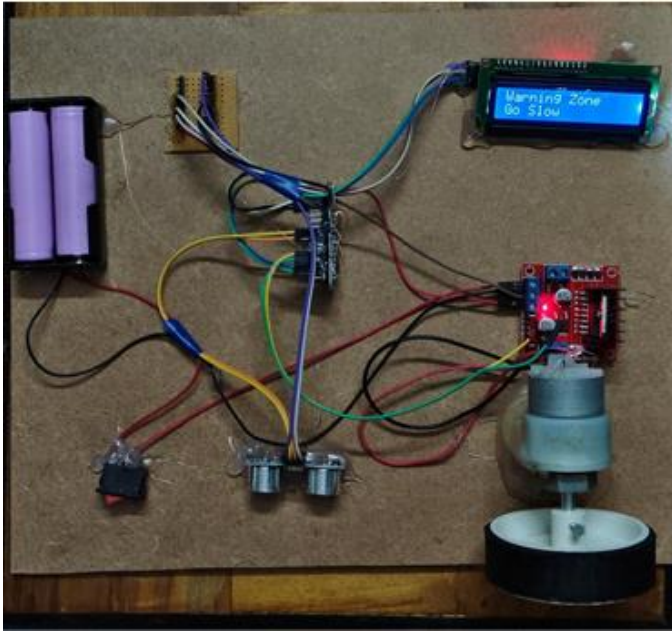


Fig:7.2: Output 2

The outcomes of this project indicate that the proposed system is cost-effective, efficient, and practical for real-world applications. It successfully integrates sensing, communication, and alert mechanisms into a single platform. The system can be further extended and improved for large-scale deployment in intelligent transportation systems, contributing to safer and smarter road environments.

## VIII.CONCLUSION

The proposed Vehicle-to-Vehicle (V2V) communication system using NodeMCU (ESP8266) has been successfully designed and implemented to enhance road safety and reduce the risk of accidents. This project addresses one of the major challenges in modern transportation systems, which is the lack of real-time communication between vehicles. By enabling direct wireless communication, the system allows vehicles to exchange critical information such as distance and obstacle detection in real time, thereby improving situational awareness for drivers.

The integration of ultrasonic sensors, LCD display, and buzzer ensures that the driver receives timely and clear information about surrounding conditions. The system effectively detects unsafe distances and immediately alerts the driver, reducing reaction time and helping prevent collisions. Furthermore, the inclusion of a motor driver to simulate

automatic control actions such as slowing down or stopping the vehicle adds an extra layer of safety, demonstrating the potential for automation in future transportation systems.

One of the key advantages of this system is its cost-effectiveness and simplicity. Unlike advanced driver assistance systems (ADAS), which are expensive and complex, the proposed solution uses affordable components like NodeMCU and basic sensors, making it accessible for wider adoption. The system is also scalable and can be extended to support multiple vehicles, integration with cloud platforms, and advanced IoT-based applications.

The results obtained from the implementation confirm that the system performs reliably under normal conditions and provides accurate, real-time communication between vehicles. Although there are some limitations such as dependency on Wi-Fi range and potential network delays, these can be addressed in future enhancements by using more advanced communication technologies and protocols.

In conclusion, this project demonstrates a practical and efficient approach to improving road safety through V2V communication. It not only reduces the chances of accidents but also contributes to the development of intelligent transportation systems and smart cities. Future work can focus on enhancing communication range, improving system reliability, incorporating GPS for location tracking, and integrating with autonomous driving technologies to create a more advanced and robust safety system.

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