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Real Time Vehicle to Vehicle Communication

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***Abstract*— In present times, individuals tend to drive at high speeds, leading to frequent accidents in various areas such as zones, hills, and highways. To prevent such mishaps and notify drivers about speed limits in such locations, signboards have been installed by the highways department. However, there are instances where these signboards may not be visible, increasing the chances of accidents. To address this issue and automatically detect crashes, a smart device has been installed in every vehicle for communication with incoming vehicles. Sensors have been placed at the front and rear of the vehicles to notify nearby vehicles in case of an accident. In every vehicle, an IR sensor and LCD display have been utilized for alert and indication purposes, all of which are controlled by ESP-32. The driver can receive four types of alert signals, including accidents, landslides, roadblocks, and traffic, to notify nearby vehicles. The proposed protocol has proven to be highly effective in delivering emergency warnings and optimizing bandwidth usage in stressful road scenarios.**

Keywords*— *Accident, Vehicle, Communication, Smart Device, Alert, Warning

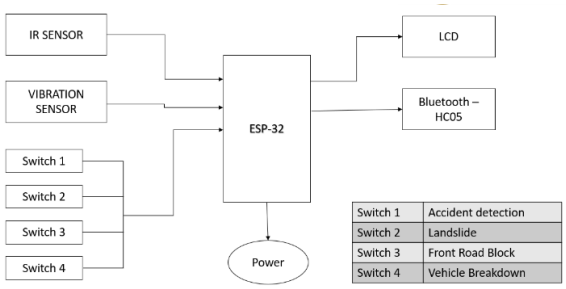
I. INTRODUCTION

In today's world, everyone desires a guarantee of secure transportation. With the advancements in digital technology, there is a growing trend towards Vehicle-to-Vehicle Communication, which can assist in achieving this goal. The primary objective of car-to-car communication systems is to enhance safety and prevent accidents resulting from collisions. According to the World Health Organization (WHO), road accidents cause approximately 1.2 million deaths worldwide each year, accounting for one-fourth of all injury-related deaths. Additionally, around 50 million individuals suffer injuries in traffic accidents. The vehicle-to-vehicle communication system is universally applicable and can be integrated into any vehicle with minimal modifications. The system is designed to be user-friendly and accessible to the average driver. Although automobiles have been one of mankind's most significant commercial accomplishments over the past century, they are unfortunately susceptible to accidents and can become victims on the road. Studies conducted by numerous scholars have revealed that 57% of accidents are entirely attributable to driver factors such as their behavior, decision-making ability, reaction speed, and alertness. While much has been accomplished in terms of vehicle design, there has been a lack of robust solutions that can provide drivers with alerts, collision-detection warnings, and threat directions. A smart vehicle is always vigilant and monitors all of its components regularly.

II. OBJEECTIVES

i. To intimate the driver about the conditions of vehicles nearby & surroundings
ii. To avoid accidents

III. BLOCK DIAGRAM



A. Block Diagram Explanation

i. The core of our system is the ESP-32.
ii. To communicate with nearby vehicles at a distance, we employ the HC-05 Bluetooth module.
iii. The vibration sensor is positioned in front of the vehicle. If an accident occurs, the vibration sensor triggers Bluetooth to communicate with nearby vehicles.
iv. To detect obstacles in roadways, we use the IR sensor.
v. This module features four types of switches: S1 for accidents, S2 for landslides, S3 for front roadblocks, and S4 for vehicle breakdowns.
vi. The LCD display serves to indicate switching and information from nearby vehicles.
vii. Additionally, it is primarily utilized to divert vehicles from entering crowded areas.
viii. This module is employed to ensure that collision or other important information reaches its intended destination based on priority.
ix. This component is utilized to enhance the convergence or any other data to arrive at any required destination according to precedence.

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B. Component Specification

[i] ***ESP-32:*** Espressif Systems has developed ESP32, a cost-effective SoC (System on a Chip) and module series that consumes less power. ESP32 is an upgraded version of the renowned ESP8266 that gained popularity due to its built-in WiFi. However, ESP32 offers more features than its predecessor as it not only has WiFi but also Bluetooth and Bluetooth Low Energy. In simpler terms, ESP32 can be described as an enhanced version of ESP8266. The ESP32-D0WDQ6 chip is equipped with a Tensilica Xtensa LX6 dual-core microprocessor that can operate at a frequency of up to 240 MHz. Despite its small size, the ESP32 package has a high level of integration, including:

- antenna switches
- RF control balun
- power amplifier
- low noise reception amplifier
- filters
- power management modules

Furthermore, it consumes very little power due to its power-saving features such as clock synchronization and multiple modes of operation. The quiescent current of the ESP32 chip is less than 5 μA, which makes it an excellent choice for battery-powered projects or IoT applications.

[ii] ***LCD***: An electronic display module, the LCD (Liquid Crystal Display) screen has a multitude of uses. The 16x2 LCD display is a fundamental module and is extensively utilized in numerous devices and circuits. These modules are favored over multi-segment LEDs and seven segments for a few reasons.LCDs are cost-effective, easily programmable, and have no restrictions in displaying unique and even personalized characters (unlike seven segments), animations, and more.

[iii] ***HC-05:*** The HC-05 Bluetooth module is specifically created for wireless communication purposes. It can operate as either a master or a slave configuration. In order to facilitate data transmission and reception between a smartphone and the HC-05 Bluetooth module, a Bluetooth terminal application must be installed on the smartphone. Therefore, to establish communication between the HC-05 Bluetooth module and a smartphone, it is necessary to connect the module to a PC using a serial to USB converter.

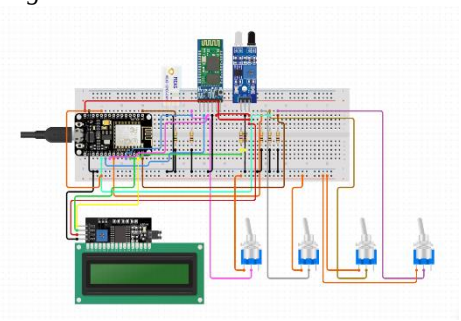
[iv] ***IR Sensor***: We have used IR sensor to detect objects. Infrared transmitter is one type of LED which emits infrared rays generally called as IR Transmitter. Similarly, IR Receiver (photo diode) is used to receive the IR rays transmitted by the IR transmitter. One important point is both IR transmitter and receiver should be placed straight line to each other.

[v] ***Vibration Sensor***: The Grove - Vibration Sensor (SW-420) is a high sensitivity non-directional vibration sensor. When the module is stable, the circuit is turned on and the output is high. When the movement or vibration occurs, the circuit will be briefly disconnected and output low. At the same time, you can also adjust the sensitivity according to your own needs. All in all, this is a perfect module for vibration or tilt sensor. Features: -

- non-directional
- High sensitivity
- Respond to vibration, tilt.
- Waterproof
- Compression resistance

[vi] **Push Button Switches:** A Push Button is a type of switch that works on a simple mechanism called "Push-to-make". Initially, it remains in off state or normally open state but when it is pressed, it allows the current to pass through it or we can say it makes the circuit when pressed. Normally their body is made up of plastic or metal in some types. Push Button structure has four legs, two on one side and other two on another side. So, we can operate two lines of the circuit by single Push Button. Two legs on both the sides are internally connected.

C. Circuit Diagram



D. Circuit Diagram Explanation

i. For vehicle-to-vehicle communication for autonomous vehicles, hardware and software part is required. The proposed circuit is built in the hardware part, which deals with hardware assembly, and the proposed system is programmed in the software part.

ii. The circuit diagram is composed of an ESP32 controller, a Bluetooth module, an IR sensor, a Vibration sensor, LCD and a battery.

iii. With an app connected via a Bluetooth module, the vehicle may go left, right, forward, and reverse.

iv. To find the obstruction, an IR sensor is employed.

v. To detect the vibration, Vibration sensor is used.

vi. LCD will display if it discovers any obstructions. Also, notifications will be sent to IOT which is built in ESP32.So that the driver can be informed.

IV. METHODOLOGIES

The proposed system utilizes the HC-05 Bluetooth module for communicating with neighboring vehicles. Its main objective is to standardize the format and deployment of vehicle-to-vehicle (V2V) transmissions, thereby enabling manufacturers to effectively boost the number of equipped vehicles to a critical mass.

The V2V systems will employ dedicated short-range communications (DSRC), which are wireless channels that

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facilitate two-way communication between V2V-equipped cars within a range of approximately 30 meters. These channels broadcast updates 10 times per second.

DSRCs gather and exchange basic safety messages (BSMs) regarding a vehicle's speed, direction, braking status, and position to determine if a warning needs to be sent to the driver.

An efficient communication protocol is essential for delivering cooperative collision warning messages with low latency and minimal delay. The expected result of the proposed system is the development of prototype vehicle models that use wireless technology to communicate with each other and roadside units.

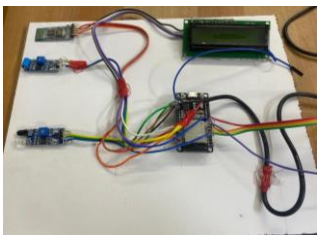
V. LITERATURE SURVEY

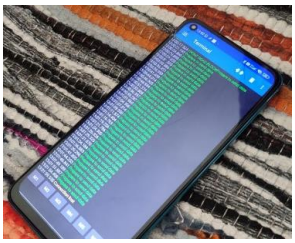
i. **Autotalks** was founded in 2008 and is a smart car company that specializes in V2V communication specifically for autonomous driving applications. The company's product comes in the form of a chipset that aims to provide V2X solutions that offer reliability, security, positioning accuracy and ease of installation. Their latest product is offering, the CRATON2.

ii. **Savari** Founded in 2008, Silicon Valley startup Savari aims to merge infrastructure communication and V2V communication to improve safety. In late 2016, Savari announced a lucrative partnership with China's SAIC Motor. The Company has placed a lot of focus on efficiency and safety. Their goal is to connect cars, traffic lights, smartphones and pedestrians to the same network using agnostic radio solutions. Some of their products that are being deployed now can be seen. The Company offers a variety of solutions that include vehicle-to-vehicle, vehicle-to-infrastructure, vehicle-to-phone, and infrastructure-to-phone. Savari has their sight set higher than V2V, aiming to be a platform for smart cities.

iii. **Cohda Wireless** is based in South Grafton, New South Wales and offers V2V solutions for automotive and public safety. Cohda provides chips that enhance wireless communications beyond that of off-the-shelf IEEE 802.11p transceivers. The Company boasts that their technology is the "world's most tested" in space, having performed over 800 dedicated short range communication comparative trials. Their products use an IEEE 802.11p compliant radio, designed for precision to deal with the constant mobility of driving conditions. As we mentioned earlier, they've partnered with Autotalks to develop a complete V2V product offering. Cohda's hardware and software products are used in more than 60 percent of all V2X field trials worldwide today. Customers include many carmakers, tier-one suppliers, automotive chipmakers, road authorities, and new market entrants.

VI. RESULTS





Vehicle communication systems are designed and mounted on a very simple and easily understandable model. The sensors can read distances that are at shorter range accurately. The system takes action automatically without any driver input. Hence this automatic braking system can stop the car to avoid an accident. The Controller will get parameter value from the sensor as long as the system is powered. The Controller will process, examine, and determine the next course of action in accordance with the software. A closed loop system is used in the provided algorithm.

Hardware end: Hardware is divided into.

- Sensing unit
- Control unit
- Actuating unit

[i] Sensing unit - The IR sensor and Bluetooth module that make up the sensing unit deliver the desired results.

[ii] Control unit - The Control Unit (ESP32) will deliver the required output by processing the sensor data to achieve real-time regulation of the vehicle-required parameter.

[iii] Actuating unit - The Actuating Unit is made up of a Bluetooth module and a sensor that periodically gives the Controller the necessary amount of data.

VII. CONCLUSION

i) The V2V Communication for Self-Driving Cars technology was constructed and installed on a simplistic and understandable prototype, then tested for efficiency.

ii) The sensor accurately detected shorter distances.

iii) However, an Infrared (IR) sensor capable of detecting objects at greater distances is necessary for real vehicles. Once the right materials are collected, it may enhance its features for automobile use. T

iv) his prototype can also aid in research for anti-collision warning systems.

v) The Vibration Sensor identified sudden axis changes in the vehicle, and the information was transmitted.

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vi) Initially, the switches had complications cooperating with the controller, but using only wires would have yielded favorable results.

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