LIFI based vehicle to vehicle communication to prevent accidents

Omar Zidan K[1], Mohomed Shuraih[2], Vishnuraj A[3], Prakhyath J[4], Swaroop Gannamani[5] Irwin Felix Dsouza[6]

[1234]*UG student, Dept. of Mechanical Engineering, Mangalore Institute of Technology & Engineering, Moodabidri, Karnataka, India*

[5]*Assistant Professor, Dept. of Mechanical Engineering, Mangalore Institute of Technology & Engineering, Moodabidri, Karnataka, India*

[6]*Graduate Engineer Trainee, Process Engineering department, Autoliv*

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Abstract - *The The rapid development of technology has revolutionized the way we live, especially with the interconnectivity of devices and the advent of smart systems. LiFi, also known as Light Fidelity, is a cutting-edge technology that utilizes light as a communication medium and is a form of Visible Light Communication (VLC) that simplifies the complexities of cable communication. The benefits of LiFi are numerous, including being secure, efficient, and capable of transmitting data at high rates. This paper proposes a novel approach to vehicle-to-vehicle (V2V) communication using LiFi, complementing the existing Internet of Things (IoT) connected vehicles solution. V2V communication has enormous potential to exchange information about the speed and position of surrounding vehicles, reducing crashes, easing traffic congestion, and improving the environment. However, to realize the full potential of V2V communication, all vehicles must be able to communicate with each other. This system can ensure real-time data transfers between vehicles as they enter range, promoting safer and better driving conditions for all. LiFi communication has been developed for this purpose, offering a new paradigm for V2V communication.*

Key Words: Lifi; VLC; vehicles; IoT

1. INTRODUCTION

Vehicle-to-vehicle communication (V2V communication) refers to the wireless exchange of data between motor vehicles. The primary objective of V2V communication is to prevent accidents by facilitating the transmission of position and speed data among vehicles through an ad hoc mesh network. The implementation of this technology may involve either warning the driver of an impending collision or taking pre-emptive actions, such as applying brakes to decelerate the vehicle. V2V communication is expected to outperform existing automotive original equipment manufacturer (OEM) embedded systems, including lane departure warnings, adaptive cruise control, blind spot detection, rear parking sonar, and backup camera, due to its ability to provide a comprehensive 360-degree awareness of surrounding risks. The intelligent transport system (ITS), a concept supported by the National Highway Traffic Safety Administration (NHTSA) and the United States Department of Transportation (DOT), includes vehicle-to-vehicle (V2V) communication as a key component.

The implementation of an intelligent transport system will rely on the data obtained from V2V communication to enhance traffic management by enabling vehicles to communicate with roadside infrastructure, such as traffic lights and signs. The adoption of this technology may become mandatory in the near future, facilitating the introduction of driverless cars on American highways. Nonetheless, the successful implementation of V2V communication and an intelligent transport system requires the resolution of three major challenges: the agreement upon standards among automotive manufacturers, data privacy concerns, and funding. At present, it remains unclear whether the creation and maintenance of the supporting network will be publicly or privately funded. Major automotive manufacturers actively working on ITS and V2V include Audi, BMW, Daimler, GM, and Volvo.

This paper explores the use of Li-Fi for vehicle-to-vehicle communication. Li-Fi, short for Light Fidelity, is a visible light communication technology developed by a research team at the University of Edinburgh, led by Professor Harald Haas. It enables the remote transmission of data using LED light, relying on the ability of solid-state lighting systems to create binary code with imperceptible LED illumination.

The aim of this study is to use Li-Fi technology to prevent accidents on the road and provide drivers with real-time information and alerts. By utilizing sensors, information about the driving conditions of the vehicle behind can be collected, allowing drivers to maintain a safe distance without the need for distracting phone calls. This new mechanism for conveying information between vehicles has the potential to greatly improve road safety.

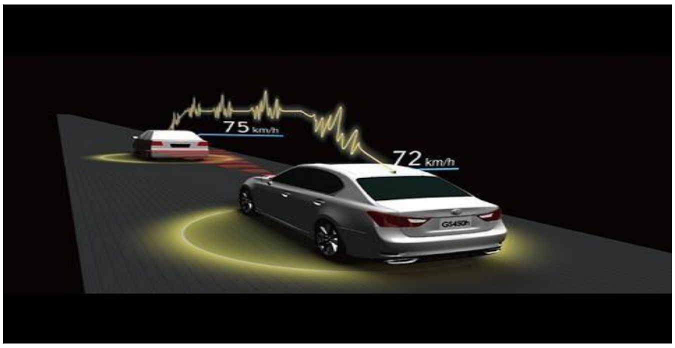

Fig 1: V2V Communication

2. WORKING OF LIFI SYSTEM

2.1 Transmitting and receiving serial data

Digital data is converted into individual bits and transmitted in a sequential manner using a UART (universal asynchronous receiver/transmitter), which serves this purpose. A shift register, a key element of the UART, is used to perform this conversion between serial and parallel types of data. Due to the fact that serial data transmission uses fewer cables than parallel data transmission, it is typically more economical.

Although the UART is a crucial component of a serial communication system, it is unable to send or receive outside signals on its own. The UART's logic level signals must be converted into external signalling levels with the aid of other interface devices. Depending on the communication protocol utilised, a different type of external signalling level may be used. Examples are RS232, RS-422, and RS-485 are some of the voltages signaling standards from the Electronic Industries Alliance (EIA).

Other signalling technologies, such as optical, infrared (IrDA), and wireless Bluetooth in its Serial Port Profile (SPP), can also be used for data transmission in addition to electrical cables. The choice of communication medium is made easier by the availability of many signalling methods. Some signalling protocols use carrier signal modulation, either with or without wires. Examples include the DC-LIN for power line communication, RF modulation with data radios, and modulation of audio signals with phone line modems.

The UART requires bytes of data to operate, sending each bit one at a time. At the receiving end, a second UART reassembles the bits into whole bytes. Each bit is transferred and received in the proper order thanks to the shift register used by the UART, which permits accurate and effective data transport. The UART's functionality is further improved by the use of double buffering and FIFO buffer memory, which allow it to hold the most recent character while receiving the next one and prevent data loss during transmission.

Although the UART is a crucial part of serial communication, it only has a little amount of power to send or receive outside signals. The UART's logic level signals must therefore be converted to and from the external signalling levels required by the specific communication protocol using extra interface devices. This conversion is necessary to guarantee accurate and dependable data transmission between various devices. Between devices, information can be transferred through a number of different communication channels. Simplex is one mode where data is only delivered in one direction. Full duplex is a different mode in which data can be sent and received concurrently by both devices. Half-duplex is the third mode, in which data is transmitted and received by devices alternately. in an idle state, where no data is being transmitted,a high voltage or power is indicated.

In a UART transmission, a start bit with a logic low value is sent prior to each character. An optional parity bit and one or more stop bits with a logic high value are delivered after the character. Normally, there are 8 data bits between the start and stop bits, but if fewer than 9 bits are needed, a parity bit may be inserted. Although the sequence in which the bits are communicated can vary, it is often the least important data bit that is delivered first.

The start bit alerts the receiver that a new character is coming when it is received. The following 5 to 9 bits reflect the character that is being conveyed, depending on the coding set. When used, a parity bit is broadcast following all the data bits. The character is complete when one or two stop bits with a logic high value are communicated to the recipient. A logic low (0) value is always sent for the start bit and a logic high value for the stop bit.

To ensure reliable communication between devices, the UART ensures that there are at least two signal changes between characters. Additionally, if the line remains in a low-voltage state for a duration longer than the time taken to transmit a character, the UART can detect a break condition. The UART ensures that there are at least two signal changes between characters. Moreover, if the line remains in the low-voltage state for a duration longer than the time taken to transmit a character, the UART can detect a break condition.

2.2 Transmitter and Reciever

Transmitter:

The UART transmits data by inserting a character into the shift register and producing a start bit. The optional parity bit (if utilised) and stop bits are then pushed out to the line after the necessary amount of data bits. The process is made simpler because the timing of gearbox is not based on the state of the line or predetermined intervals. The host system cannot transmit a new character for transmission until the preceding one has finished sending, which allows the UART to function more effectively. Another option is to use an interrupt signal to let the user know when the UART is prepared to receive a new character.

For full-duplex operation, where characters must be sent and received simultaneously, separate shift registers are used for transmitted and received characters.Irjet template sample paragraph, Irjet template sample paragraph .Irjet template sample paragraph. Irjet template sample paragraph

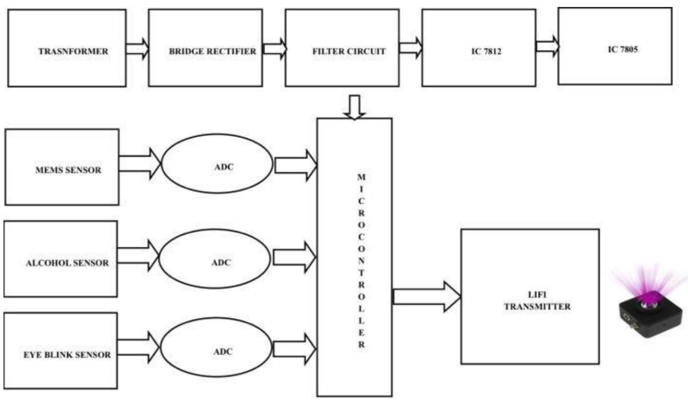

Fig 2: Transmitter unit block diagram

Reciever:
In serial communication between devices, the Universal Asynchronous Receiver/Transmitter (UART) hardware is essential. A clock signal that operates at a frequency multiple of the data rate is crucial for its proper operation. The UART's transmitter and receiver both use this clock signal as a point of reference.
The receiver component of the UART is responsible for detecting the incoming signal and processing it accordingly. In doing so, it checks the status of the incoming signal at each clock pulse to determine the start bit of the next character. This process involves checking the duration of the start bit and verifying that it lasts for at least half of the bit duration. If the start bit meets this criterion, it is identified as a valid signal and marks the start of a new character. Any signal that does not meet this requirement is considered a spurious pulse and is ignored.
Following a bit duration wait, the status of the line is sampled once again after determining the start bit, and the output is then placed in a shift register. Once the character length, which typically lasts between 5 and 8 bits, has passed, the shift register's parallel output is made accessible to the receiving system. The UART then sets a flag to indicate the presence of fresh data and may also produce an interrupt to notify the host CPU that data has been received.
The communication signal is typically the only timing scheme that two UARTs exchange when communicating. To resynchronize their internal clocks, they therefore rely on the detection of data line changes that aren't false pulses. Even if the transmitter sends at a little different pace than usual, this resynchronization ensures dependable data receipt. Simpler UARTs can only read the center of each expected data bit and resynchronize on the falling edge of the start bit. If the broadcast data rate is accurate enough to enable the stop bits to be sampled reliably, then this method will function.
In order to increase their functionality, many UARTs employ a process known as "double buffering," which enables them to hold the most recent character while receiving the following one. This gives the receiving computer the entire character transmission time to retrieve the received character. In order to avoid losing received data, especially at high speeds, many UARTs also employ a tiny FIFO buffer memory between the receiver shift register and the host system interface. This buffer memory guarantees that no data is lost during transmission and gives the host CPU more time to respond to a UART interrupt.

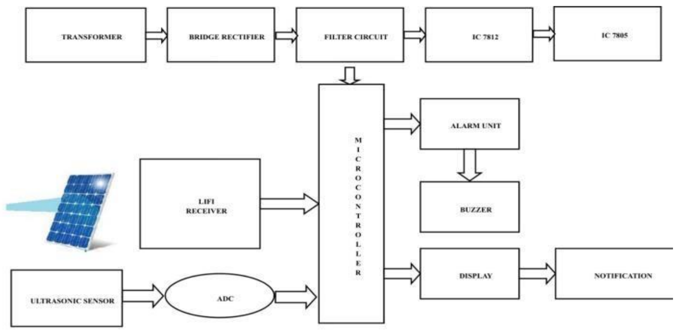

Fig 3: Reciever unit block diagram

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3. EXISTING AND PROPOSED SYSTEM

3.1 Existing System

Easy SMS is a secure messaging system that guarantees end-to-end SMS message encryption between two end users. In order to cypher the message using a symmetric key technique, the protocol first establishes a symmetric shared key between the two mobile stations (MS). The SMSSec and PK-SIM protocols, which rely on the client-server paradigm, are used as two separate situations to show how the protocol functions.
The SMSSec protocol is a security protocol used to secure SMS communication transmitted via Java's Wireless Messaging API. The protocol uses AES/MAES cryptographic encryption algorithm to ensure end-to-end confidentiality of the messages sent over the network. The encryption guarantees that the message content can only be accessed and understood by the intended recipient, thereby safeguarding it from unauthorized access.
The PK-SIM protocol, which suggests a normal SIM card with additional Public Key Infrastructure (PKI) features, is another technology that aims to improve SMS security. The AES/MAES encryption technique is also used by this protocol to safeguard SMS messages sent over the network.

By allowing the SIM card to create a public and private key pair that is used to authenticate and encrypt messages transferred between devices, PKI technology adds an extra degree of security.

The integration of the AES/MAES encryption algorithm in both the SMSSec and PK-SIM protocols ensures that SMS communication is secure and private. The encryption of SMS messages provides a level of security that prevents unauthorized access to sensitive information, protecting the privacy of the user. Overall, these security protocols have become critical tools for protecting SMS communication and enhancing the overall security of modern communication systems.

3.2 Proposed system

• The proposed system is carried out using LIFI technology. The LIFI system has been connected to each vehicle. That lifi system is used to transmit and receive information form a vehicle.
• Here, in this proposed system we have used various sensor like eye blink sensor, ultrasonic sensor, mems sensor and alcohol sensor. This sensor has been connected with a microcontroller to each vehicle.
• If the rider consumes alcohol, then the alcohol sensor senses it and give that information to the nearest vehicle going in front of it through LIFI. Because while drunk and driving the rider may ride with over speed and it may hit the other vehicles which results accidents.
• The rider should follow a particular distance with another vehicle. When the vehicle really closes to next vehicle then the ultrasonic sensor detects it and transmit that information through LIFI. This will help to reduce the accidents.
• Mems sensor senses axis of the car, when there is a tilt in axis, it will send message. This mems sensor will help to detect in case of rash driving. And that information will be shared with the help of lifi technology.
• Here, we used one more sensor called eye blink sensor that detects the drowsiness of a rider which could alert the driver before mishap happens. We have connected an alarm system for that. Here we have used a liquid crystal display to monitor all these parameters

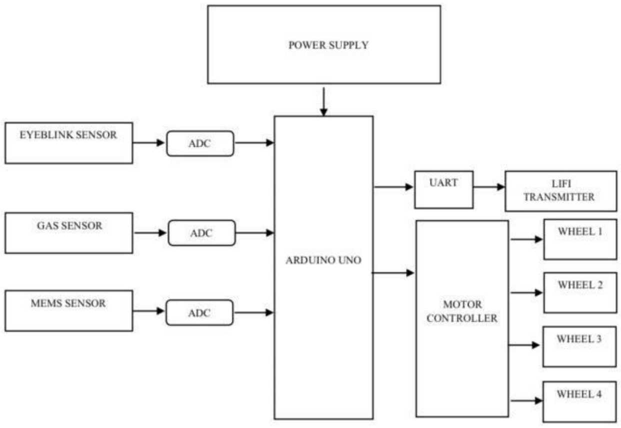

Fig 4: Block diagram for back vehicle

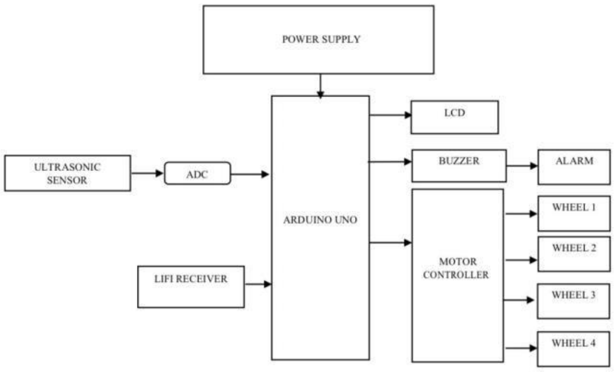

Fig 5: Block diagram for front vehicle

4. RESULT

Below are the results of our project that incorporates a drowsiness sensor, alcohol sensor, rash driving sensor, and proximity sensor (which displays the distance to nearby vehicles).

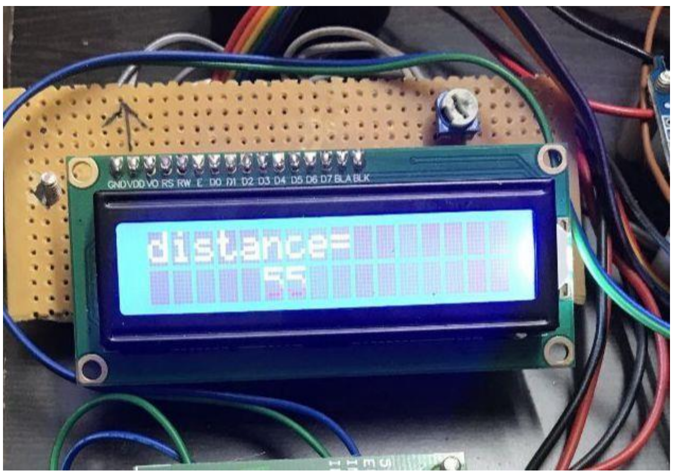

Fig 6: Monitor showing result 1

Fig 7: Monitor showing result 2

Fig 8: Monitor showing result 3

Fig 9: Monitor showing result 4

Fig 10: Monitor showing result 5

Fig 6 illustrates the proximity distance between our vehicle and the one behind us. Fig 7 indicates that the rear vehicle has come into close proximity to our vehicle. In Fig 8, it is evident that the driver in front of us is under the influence of alcohol. Fig 9 demonstrates that the driver ahead of us is drowsy. Lastly, Fig 10 displays the driver in front of us engaging in reckless driving behavior.

5. CONCLUSION AND FUTURE SCOPE

5.1 Conclusion

An innovative system has been developed that utilizes Li-Fi technology along with a range of sensors such as MQ3, vibration sensor, ultrasonic sensor, and PC camera, in addition to an Arduino board, LED light, and a solar panel, to facilitate communication between vehicles.

This system aims to reduce the occurrence of road accidents, and in the future, it has the potential to enhance safety for drivers and passengers by implementing the technology more widely. Li-Fi technology, which enables high-speed data transmission through its unique modulation techniques and comprehensive architecture, is employed as the communication system, with its benefits and limitations explained in detail. The system's transmission of data from one vehicle to another is made simple and efficient by utilizing LED light to transmit data through Li-Fi technology, which ultimately aids in preventing road accidents.

5.2 Future scope

Integrating this system in all vehicles can potentially provide safety not only to drivers but also to co-passengers. Furthermore, the implementation of a vehicle-to-vehicle (V2V) communication system can enable collaboration between vehicles on the road by forming platoons with other vehicles heading in the same direction.

The emergence of LiFi technology has opened up new opportunities for vehicle-to-vehicle (V2V) communication, presenting several advantages over traditional communication technologies, such as Dedicated Short-Range Communications (DSRC) and Cellular-V2X (C-V2X). LiFi technology utilizes light waves to transmit data, offering higher data rates than DSRC and C-V2X, which enables the development of more data-intensive applications. This technology also provides reliable and secure communication, especially in areas where traditional RF-based communication technologies may not work effectively, such as tunnels, underground parking lots, and other locations with limited or no RF coverage.

The possibilities that LiFi-based V2V communication technology presents for the future are promising. With the ever-increasing demand for connected and autonomous vehicles, there is a growing need for high-speed, reliable, and secure communication between vehicles, making LiFi technology an essential component of next-generation V2V communication systems. The technology can facilitate real-time traffic updates, high-definition video streaming, augmented reality applications, and other advanced features that were not possible with traditional communication technologies.

As research and development efforts continue, the future of LiFi-based V2V communication technology looks bright, with a host of technical challenges already being addressed by scientists and engineers working in the field. The technology's potential to enhance road safety, increase vehicle efficiency, and reduce accidents has led to a growing interest in the technology among automotive industry stakeholders, policymakers, and researchers alike.
In conclusion, the future of LiFi-based V2V communication is poised for growth, with the technology evolving to meet the demands of the automotive industry. As the technology becomes more mature and is deployed on a large scale, we can expect to see a broader range of applications of LiFi-based V2V communication technology, contributing to the development of safer, more efficient, and more connected transportation systems in the years ahead.

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