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Vehicle To Vehicle Communication Using Li-Fi Technology

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ABSTRACT -: Vehicle to Vehicle (V2V) Communication is a developing technology which helps make our transportation system intelligent. The system can also avoid accidents and traffic congestion. In this paper, we employ Light Fidelity (Li-Fi) for data communication among vehicles. Li-Fi falls under the category of Visible Light Communication (VLC). We present initial designs and results of a small-scale prototype using light fidelity (Li-Fi) technology, a new technology that was developed in the last few years, which still needs more systematic inquiry on its sustainability for outdoor vehicular networks.

Keywords-: Light Fidelity (LiFi); Visible Light Communication (VLC).

I. INTRODUCTION

Due to the increase in the number of vehicles on road, traffic control has become a great challenge for the present day. As of 2022, there were more than 7 billion vehicles in use. The rate of vehicles on the road is increasing exponentially day by day. It also reflects the number of accidents occurring in the world. Road accidents caused a death of around 1.25 million people globally in 2021. In order to prevent heavy traffic and accidents we need to make our transportation system intelligent. One feature of the Intelligent Transportation System (ITS) would be Connected Vehicles.

Autonomous vehicles are another domain in which most of them are working. In order to make a vehicle autonomous, we need to keep track of vehicles present nearby. In order to do this we need to exchange data with our nearby vehicles. So, keeping vehicles connected is an important part of making vehicles autonomous. V2V (Vehicle to Vehicle) communication comes into picture to have vehicles connected. V2V communication can be simply thought of vehicles connected to each other to exchange data which also has the potential to avoid a crash and prevent traffic. In order to achieve data communication , we use Li-Fi (Light Fidelity) technology. Li-Fi makes use of the unused visible light spectrum. This efficient data communication technology has a data rate in terms of Gbps.

Li-Fi not only is efficient in this application but also provides an electromagnetic free environment which is healthy. Because of its high speed there would be no risks of data loss or hacking.

II. WORKFLOW

System is divided into three parts. Sender, Receiver, and according touser input. The sender will send the message to the microcontroller which converts the normal message to ASCII then this ASCII message is given to the NPN switching circuit which is used to boost the signal. Then this signal is given to the PNP switching module which reverts the message which was inverted in the NPN switching circuit. Then this reverted message is given to syska LED which transfers the ASCII message into the LED spectrum. Now at the receiver side the photo transistor will receive a message obtained by LED. Then the phototransistor passes a message to the impedance matching circuit which sensing data in proper format. This signal is given to TTL to USB circuit which convert ASCII message into normal message.

2.1 Algorithm

Sender

- 1. Start
  Transfer message to micro controller
- 2. i.e E=mc2
  Microcontroller sends msg to NPN
- 3. switching

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cktIc = Ie – Ib 4. NPN ckt send msg to PNP cktIc = Ie + Ib

- 5. PNP ckt send msg to LED(syska)

Receiver

- 1. LED sends msg to the photo transistor.
- 2. Active mode |Vcc| ≥ |R L |x |I c |
- 3. switch mode |Vcc| ≤ |R L |x |I c |
- Phototransistor send msg to
- 4. impedance matching. Z s = Z * L

- 5. Impedance matching sends msg to TTL to the USB converter.
- 6. TTL to USB convert msg into normal form E=mc 2
- 7. Stop

A. First Scenario

As shown in Fig 1 when vehicle 1 is braking, the speed meter in the vehicle will be sensing that the current speed is lower than the previous speed. Thus, a message will be sent through the transmitter which is placed in the rear lights to vehicle 2. The message will be received by vehicle 2 using the photodiode which is placed at the front of vehicle 2. A notice of (Slow DOWN) will be displayed in vehicle 2 using an LCD.

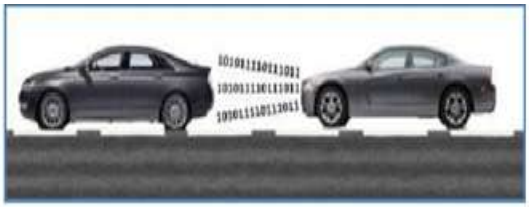

Fig-1

B. Second Scenario

As shown in Fig 2 when vehicle 1 is in T-junction, it will keep sending its speed-information to vehicle 2 using the LED at the headlights. The speed-information will be received by the photodiode in vehicle 2 and compared to vehicle 2 speeds. If vehicle 2 is about to cross the junction while vehicle 1 is moving with a high speed, the driver will be alerted to check the other vehicle which is around in the area.

Fig- 2

III. PROPOSED 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 the receiver. Vehicle to Vehicle data transmission through visible LED light Thus, installation cost and environmental effects are very less in this proposed system.

Vehicle to vehicle communication is the most effective solution we have used in order to reduce accidents that come on a daily news. In Li-Fi technology for vehicle-to-Vehicle data transmission we use LED light. In this technology there is elimination of protocols used so in Li-Fi technology complexity is not too much. The aim of designing this system is highly reliable which will give any desired data transmission between transmitter and receiver mounted on the vehicle.

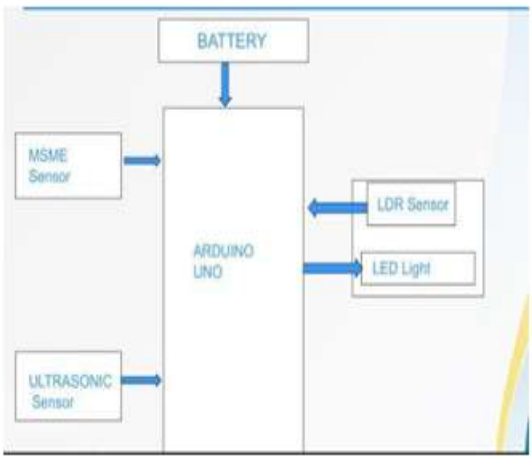

Fig-3

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IV. EXPERIMENTAL SETUP

The framework includes vehicles which use light as a medium for data communication. This data is helpful in many ways.

A. Li-Fi

Li-Fi stands for Light Fidelity. It is a technology which uses light as a medium of communication. It makes use of the unused visible spectrum and has a high speed in terms of Gbps.

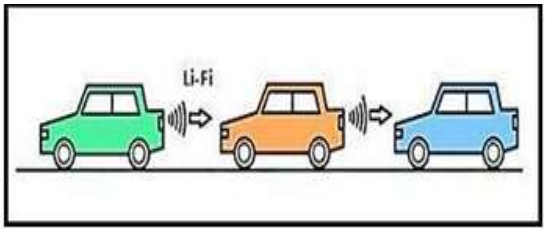

Fig-4

B. Implementation

A Light source is equipped in the vehicle. The data is transmitted through this source. Data can be any information related to that vehicle like velocity, load etc which would be important for other vehicles to know to avoid an accident. Variation in the intensity of light is made based on the data to be transmitted. The vehicles present in the vicinity of this vehicle are equipped with light detectors. These detectors capture the light variations and obtain the data. This is how communication can be done with light as a medium.
In this way we can connect vehicles using Li-Fi technology.
It is a safe, efficient and fast way of connecting vehicles.
Fig.5 . shows the block diagram of the transmitter.

. Fig. 2. Data at Transmission End

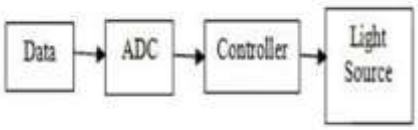

Fig-5 Data at Transmission End

Information about a vehicle needs to be transmitted. This analog data is converted into digital using an Analog to Digital Converter (ADC). This digital data is passed on to a controller. This controller then varies the intensity of the light source through which data transmission takes place. Fig.6. shows the block diagram of the receiver end.

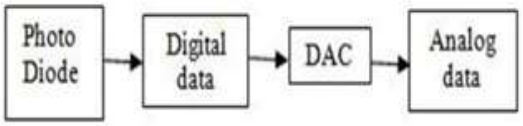

Fig-5 Data at Receiver End

The light from the source is received by the photodiode. This data is digital and is converted into analog using a Digital to Analog Converter (DAC). The output of DAC is analog data and thus data transfer occurs through light.

C. Data Capturing and Processing

V2V could capture and transmit the following inputs which can be considered important.

- Vehicle speed
- Vehicle position and its direction of travel
- Vehicle on-off throttle
- Lane changes
- Gear position
- Information regarding stability control, traction control
- Information related to brakes and Anti-Lock Braking.

Once this data is received by the surrounding cars, based on that data various actions can be taken in the surrounding cars.

V. COMPARISON OF WIRELESS COMMUNICATION TECHNOLOGIES

In this section, a comparison between the wireless protocols of LiFi, WiFi, Bluetooth and Zigbee are discussed in Table 1.

Feature	**Wifi [5-8]**	**LiFi**	**Bluetoo-th [5]**	**ZigBee [5]**
Mode of Operation	Using Radio waves	Using Light waves	Using UFH radio waves	Using radio waves
Coverage Distance	32 m	10 m	10 m to 100 m	10-100 m

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Frequency Of Operation	2.4GHz, 4.9GHz And 5GHz	1000 Times radio waves	2.4 - 2.485 GHz	2.4 GHz
Speed Of Transmission	150 Mbps	1 Gbps	25 Mbps	250 kbit/s

Table 1. Comparison of wireless communication Technologies

Advantages of LiFi

The advantages of LiFi are mentioned below:

1. Speed: LiFi can transmit data at the rate of 10 Gbit/s. This is almost 250i times faster than any other high speed broadband connection.

2. High-density coverage: LiFi is more ideal for a high density coverage. WiFi is more ideal for common purposes.

3. Secure: LiFi is more assured and dependable than WiFi. Light cannot pass through opaque objects hence it can be easily blocked by many surrounding objects.

4. Cost: LiFi technology is free.

5. Larger Spectrum: There are no restrictions to the capacity of LiFi. Visible light spectrum is about 10,000 times larger than the RF spectrum.

VI. CONCLUSION

The concept of Li-Fi will be introduced along with existing techniques and classical trends used for vehicle to vehicle communications. This project aims to propose a cost effective solution to reduce accidents. The hardware aspects regarding the development of a VLC communication system consisting of a commercial LED-based traffic light and a vehicle mount receiver. We will present the approach we follow, some of the difficulties we encounter and explain the choices we have made. Throughout the implementation process, we also make efforts on keeping the implementation cost as low as possible. Due to unavailability of all system components, sending data through Li-Fi small-scale prototype.

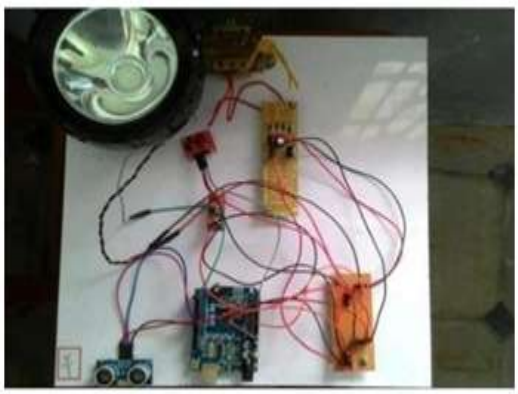
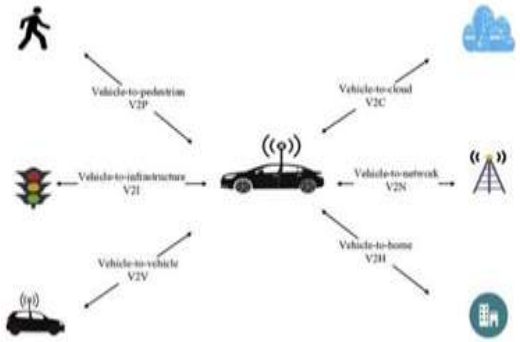


Fig-6

VII. FUTURE WORK



V2V is a trending domain in the automotive industry and its implementation using Li-Fi can be extended. The field has wide scope in real time as this application helps in making vehicle movement autonomous and thus transportation system smart.

Apart from V2V connected vehicles, the environment includes V2I and V2P communication as well. As a of future scope, Li-Fi can be enhanced to V2I and V2P communication as well. V2I stands for Vehicle to Infrastructure and V2P stands for Vehicle to Pedestrian communication. This offers a wide range of safety, mobility and environmental benefits.

V2I communication involves exchange of data related to safety and operations between vehicles and infrastructure. V2I signs and signals could transmit traffic and weather indicators. V2P communication includes pedestrians and bicyclists. These communications can be implemented using Li-Fi Technology.

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