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Li-Fi Based V2V Communication Technology

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Abstract: *This paper presents the latest technology called as LI-FI which has been developing a lot in few years. Using the concept of LI-FI two vehicle are communicated with the help of LEDs bulbs with the help of transmitter and receiver circuit. With the help of this technology the road accident can be controlled and much human life can be saved. A very chip device called as ultrasonic sensor which is used to measure the distance is used here just to communicate the two vehicles when they come in the contact in some range which is preferred for the ultrasonic sensor. Using this LI-FI the data are transmitted from one vehicle to another the data that is transmitted through LIFI can be any data like audio, video or text. This concept can be implemented at very low cost and with higher efficiency. The data that is transmitted through LIFI can be any data like audio, video or text. This technology was introduced few years back, which needs more systematic enquiry on its sustain ability for traffic control purpose. This concept can be implemented at very low cost and with higher efficiency.*

Keywords: LI-FI, Transmitter, Receiver, Efficiency, Sustainability

I. INTRODUCTION

Nowadays, there are many concerns about vehicle accidents in our society. This is a result of poor vehicle communication. So, in order to prevent such collisions, we are introducing a clever data communication system that uses visible light between the vehicles. Li-Fi-based (V2V) vehicle-to-vehicle communication is the name of this smart technology. The signal is received by a light-sensitive device (LDR Sensor), which then converts it back into the original data, which is then displayed in the vehicle's receiver part. This method of sending and receiving the necessary data between vehicles refers to Visible Light Communication (VLC).

II. LITERATURESURVEY

Devices installed in vehicles that use dedicated short-range radio communication (DSRC) to exchange messages containing vehicle information, such as the vehicle's speed, heading, and braking status, make up V2V communications systems. V2V devices us this information from other vehicles and determine if a warning to the vehicle’s driver is needed, which could prevent a vehicle crash.

The range of V2V messages is about 300 metres, which is greater than the capabilities of systems with ultrasonic sensors, cameras, and radar — in some cases, by nearly twice the distance. This gives drivers more time to be warned. These radio messages can also "see" around corners or "through" other cars, addressing situations like when a car is coming from behind a truck or possibly from a blind alley.

V2V communications can identify threats in those circumstances much earlier than radar or camera sensors.

In addition, V2V technology can be used in conjunction with current radar and cameras to offer even more advantages than either strategy alone. This combined strategy could also improve system accuracy, serving as the cornerstone for implementing automated vehicles on the nation's roads.

The primary goal is to use DSRC to exchange some important real-time data between the vehicles (Dedicated Short Range Communication). Here, we're utilising infrared communication to prevent collisions, enable emergency breaking, and offer 360-degree information sharing.

III. EXISTING METHOD

The existing system requires a transmitter and a receiver in each vehicle in both rear and front sides of the vehicle using WI-FI module. Thus more scenarios will be applicable. For the time being, only two scenarios will be studied in this

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paper. 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 display. The 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. All the details of the road conditions from the first vehicle can be known only when the user is inside the car. The exact latitude & longitude parameters of the vehicle cannot be known as shown in Fig The challenges faced by WiFi in today's time are:

- Capacity.
- Availability.
- Time Efficiency.
- Security.

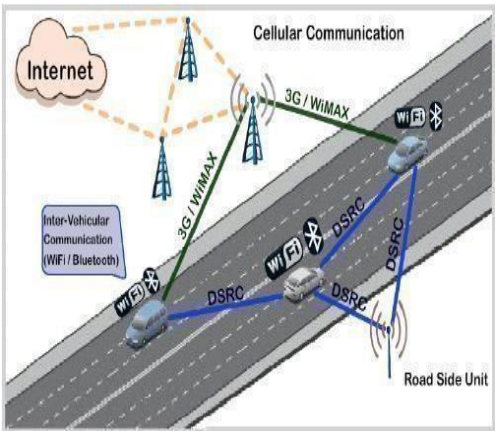

Fig 3.1: V2V Communication using WI-FI

Drawbacks of Existing system:

Theabovedetailsmethodshaveseveraldrawbacksandthedominantonesaredetailedfurther.

- Requires a lot of time efficiency
- Security Problems

IV. PROPOSED METHOD

Vehicle to Vehicle Communication using Li-Fi system consists of mainly two parts, the transmitter and the receiver attached to both the vehicles. The data transmission is done through binary codes which involve switching on LED can be done by logic 1 and switch OFF using logic 0. The transmitter part modulates the input signal (messages) with the required time period and transmits the data in the form of 1s and 0s using a LED bulb. The receiver part catches these message signals using a photodiode and amplifies the signal and presents the output. Light emitting diodes can be switched on and off very much faster than the human eye allowing the light source to appear continuously. The concept of this system which is used to provide clearance to any emergency vehicle when it struck in traffic jam. Here we clear the path of the emergency vehicle hence it can reach the destination in time. Emergency vehicle stuck in a heavy traffic condition it will send an information to the next vehicle through light medium from head light to indicator of next vehicle.

Working of Block Diagram:

This system has Microcontroller, 3 keypad switches, 16*2 LCD display, LED's, LDR sensor, power supply. The microcontroller is used to store the messages that has to be communicated between the vehicles and transmits the messages whenever required using serial communication. The 3 key button switches represents the type of messages that has to be transmitted. The LCD is to display the messages.

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Block Diagram:

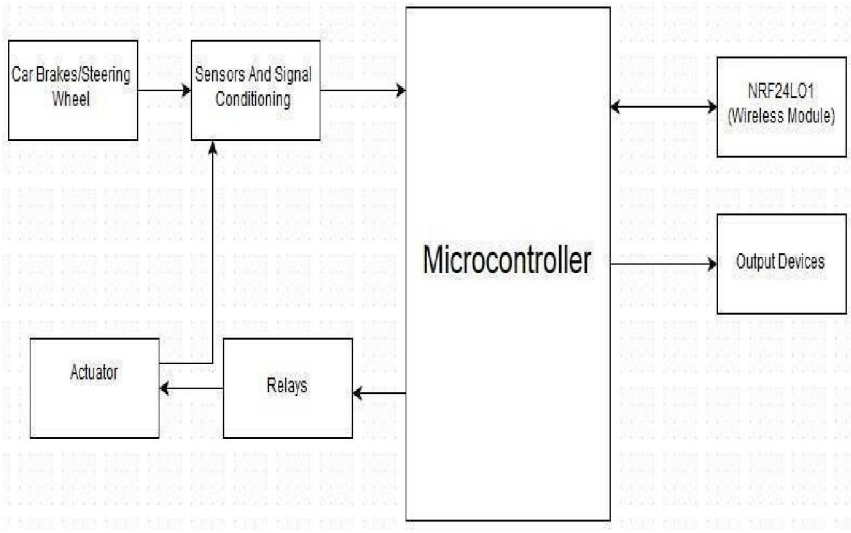

Fig. 4.1: Block Diagram

V2V Communication and Traffic Signal Controlling Using Li-fi

The concept of this system which is used to provide clearance to any emergency vehicle when it struck in traffic jam. Here we clear the path of the emergency vehicle hence it can reach the destination in time. Emergency vehicle stuck in a heavy traffic condition it will send an information to the next vehicle through light medium from headlight to indicator of next vehicle in fig 4.2. The information received by the next vehicle and it transmit to the another vehicle next to it. The LIFI based transreceiver will be adopted to each vehicle for transmit the information. This project helps to reach the emergency vehicle in minimum time. We can also use this system the entire system is based on LIFI system which is a booming technology. Light Fidelity (Li-Fi) is a form of bi-directional Visible Light Communication (VLC) in which light is modulated at speeds greater than a human eye can follow.

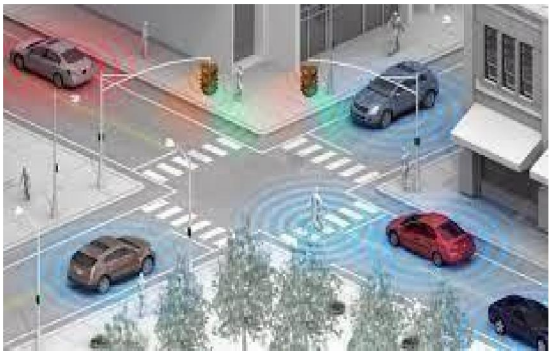

Fig 4.2 : Vehicle to vehicle communication during traffic

In this paper, a V2V communication system is proposed in which the headlight and tail light of a vehicle are made as Li-Fi transmitter and Li-Fi receiver respectively. The proposed system was designed, implemented and tested for its operation. Li-Fi communication can be done through several modulation techniques. We have used ONOFF keying modulation technique and Morse encoding and decoding technique. Morse code as an on-off series is happening so fast, that it is invisible to human eye. LI-FI uses white LED bulbs at the downlink transmitter. Normally, a constant current is applied across the LEDs to use them.But by varying the current very fast, the optical output can be made to vary at very highspeeds.

Performance Of V2I Li-Fi Communication Systems in Traffic Lights

In this work, a mathematical analysis based on a CTMC is presented to model a vehicular crossing where traffic lights are used to convey information to vehicles passing by and waiting for the green light. A Li-Fi system is proposed to be

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used in order to make ab and width-efficient system by making use of different frequencies than the ones used in cellular, WiFi, and Bluetooth which are overcrowded and will experience even more traffic when 5G communication systems get deployed. The system is designed considering the normal car user can also use it. Speed and security is the major concern while transmittingdata.Theproposedsystemwasdesigned,implementedandtestedforitsoperation

Conversely, the proposed LiFi system takes advantage of visible light already used in traffic lights and front and tail lights in vehicles. The car communication system is not designed for a particular brand or vehicle. This can be used in every vehicle with a little modification. The system is designed considering the normal car user can also use it. Speed and security is the major concern while transmitting data.

The proposed system was designed, implemented and tested for its operation. Li-Fi communication can be done through several modulation techniques. We have used ON OFF keying modulation technique and Morse encoding and decoding technique.

We have used ON OFF keying modulation technique and Morse encoding and decoding technique as shown in below fig 4.3. But by varying the current very fast, the optical output can be made to vary at very high speeds. This project helps to reach the emergency vehicle in minimum time.

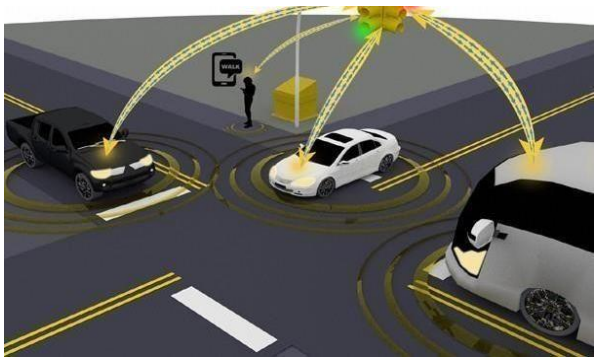

Fig 4.3: V2V Communication in traffic lights

Wi-Fi can be easily hacked as it penetrates through the walls. On the other hand Li-Fi requires a Line Of Sight (LOS), it does not penetrates through the walls and so provide smore security. The key technical difference is that WiFi uses radio frequency to transmit data but LiFi uses visible light. The main component of Li-Fi communication is the high speed LED which provides adatarateofgreaterthan100Mbps.

Vehicle to Vehicle Communication Using Li-Fi Technology

This paper presents the latest technology called as LI-FI which has been developing a lot in few years. Using the concept of LI-FI two vehicles are communicated with the help of LEDs bulbs with the help of transmitter and receiver circuit. With the help of this technology the road accident can be controlled and much human life can be saved. A very chip device called as ultrasonic sensor which is used to measure the distance is used here just to communicate the two vehicles when they comes in the contact in some range which is preferred for the ultrasonic sensor. The last century, radio was introduced and implemented and gave rise to the new wireless world. It will be very surprising to know that the first wireless transmission of voice was done by the help of light waves.

Alexander Graham Bell made the first wireless voice communication discovery in 1880, with a range greater than 213 metres. This was one of his finest inventions, but radio communication received high praise.

Radio communication encompassed priority and his innovation. The popularity of radio communication increased as mobile phones spread throughout the world and because so many mobile devices were seen by the general public. Fiber optics and an LED that changes in intensity are used in LiFi to transmit data via light at a quicker rate than the human eye can see. Data processing and amplification will be carried out via integrated processors within LEDs. Very slight changes in the outcomes can be used to control the light intensity to transmit data. The technology uses a unique modulation and demodulation technique to transfer thousands of data sets simultaneously at a higher rate. Li-Fi technology is high intensity brightness LEDs. Since the working speed of LEDs is even quicker than one second, which the human eye cannot detect, light-emitting diodes may be made to turn on and off more quickly, making the light source seem continually.

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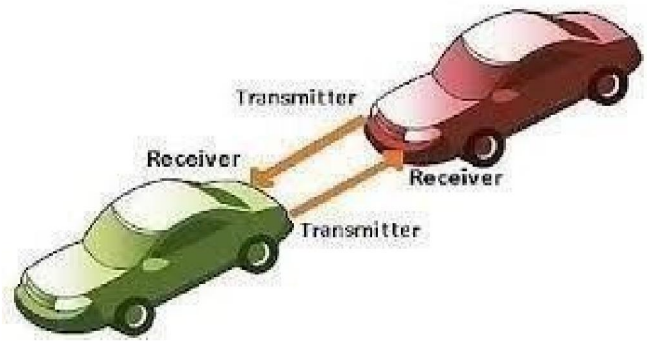

Fig. 4.4: V2V Communication using LI-FI

This on-off activity cannot be seen with the naked eyes of the human and that enables a kind of data transmission using binary codes. Switching on and LED is a logic 1,,, switch off is a logic 0,, the data can be encoded from the light wave and the exact information can be achieved as shown in fig 4.4. Modulation is so fast that human eye doesn't notice A light sensitive device (photo detector) receives the signal and converts it back into original data. This method of using the light waves and frequency in it and sending the required data refers as Visible Light Communication (VLC) though its potential to compete with conventional Wi-Fi has inspired the popular characteristics Li- Fi. Visible Light Communication Li-Fi is one of the very efficient versions of Wi-Fi, which is based on visible light communication(VLC). This Li-Fi uses light for data communications medium using visible light waves as optical carrier for data transmission and illumination. Integrated chips inside LED will do the processing and amplification of data. The technology transfers Thousands of data simultaneously in higher speed with the help of special modulation and demodulation technique. Li-Fi technology is high intensity brightness LED.

Fig 4.5: Proposed framework for V2V

However, Li-Fire needs a Line of Sight (LOS), does not pass through the walls, and so offers more security. The main technological distinction is that Li-Fi employs visible light instead of radio frequency to send data, as seen in fig. 4.5 above. With a data rate of more than 100Mbps, the high-speed LED serves as the primary Li-Fi communication component. Visible Light Communication (VLC) is the name given to the process of using light waves and frequency to send the necessary data, though its potential to compete with conventional Wi-Fi has inspired the well-known features of Li-Fi. Clear Communication with Light One of the most effective Wi-Fi variants is Li-Fi, which uses visible light for communication (VLC).

The Li-Fi idea has been presented alongside current methods and traditional patterns for vehicle-to-vehicle communication.

The suggested technique offers a cost-effective way to reduce accidents. This paper provides a clear explanation of the system's design. Sending data through Li-Fi prototype mode has served as the proof of concept in this paper. Ways of addressing the safety need

Scenarios addressed uniquely by vehicle-to-vehicle communications

V2V technology communicates via radio signals, which are Omni-directional (i.e., offer 360 degrees of coverage). Communicating via these signals allows two equipped vehicles to "see" each other at times when other vehicles that are only relying on their sensors are not able to detect the presence of another vehicle, let alone determine the other vehicle's heading, speed, or its operational status. Figure 4.6 depicts examples of safety applications and the scenarios they can address.

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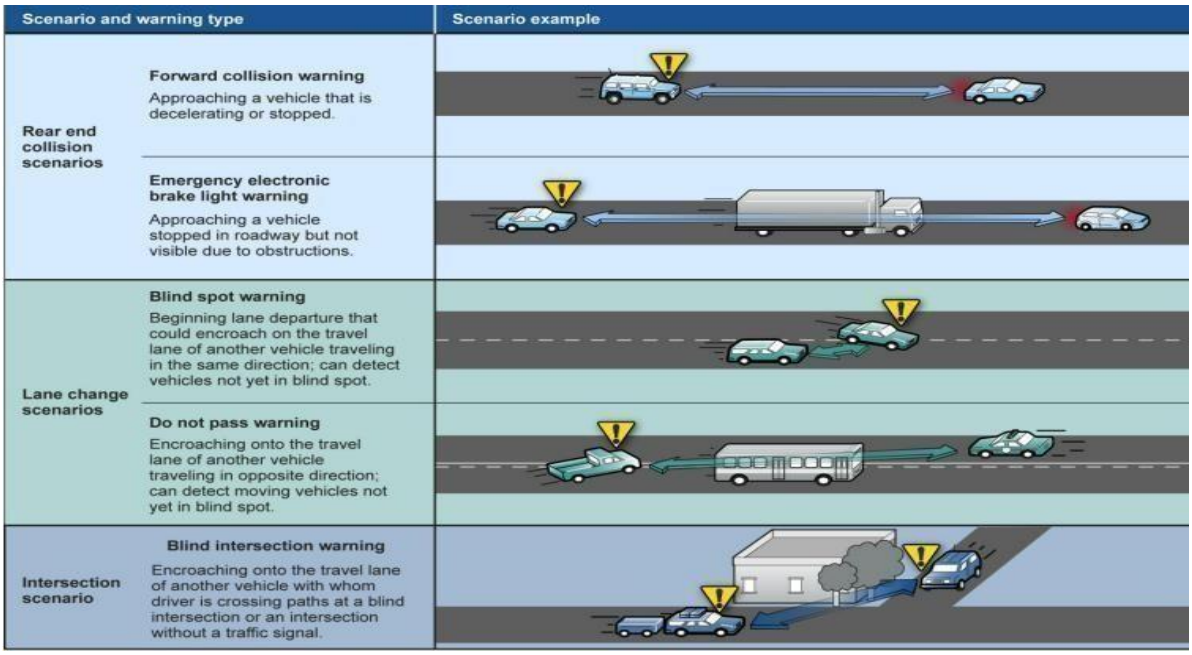

Fig 4.6: Crash Scenarios examples and Vehicle-to-Vehicle

V2V communications also offer an operational range of up to300 meters between vehicles to facilitate identification of intersecting paths that may potentially result in a crash if no driver or vehicle action is taken. Additionally, a V2V system is not subject to the same weather, light, or cleanliness constraints associated with vehicle-resident sensors (e.g., cameras, lidar), although it is subject to other issues (e.g., urban canyons, GPS signal). 36 There are three V2V safety applications that the agency believes are enabled by V2V alone and could not be replicated by any current, known vehicle-resident sensor- or camera based systems, as discussed below.

Intersection Movement Assist

IMA warns the driver of a vehicle when it is not safe to enteraninter section due to a high probability of colliding with one or more vehicles at intersections both where a signal is present (a "controlled" intersection) and those where only a stop or yield-sign is present(an "uncontrolled" intersection). Figure 4.7 illustrates one possible IMA scenario.

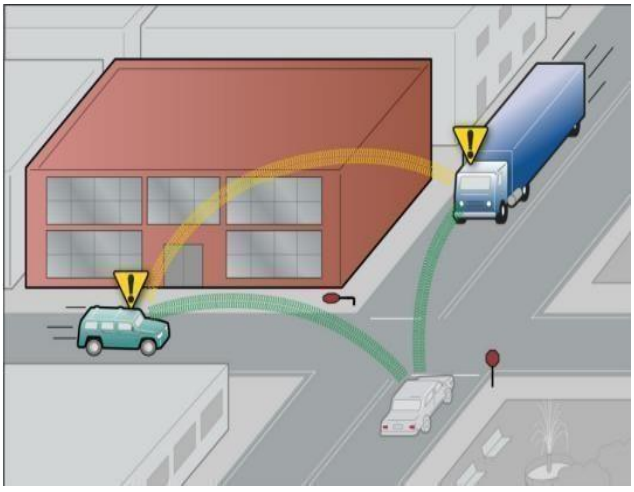

Fig 4.7: Example V2V Intersection Movement Assist Warning Scenario

Left Turn Assist

LTA warns the driver of a vehicle, when they are entering an intersection, not to turn left in front of another vehicle traveling in the opposite direction

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Emergency Electronic Brake Light

Emergency Electronic Brake Light enables a vehicle to warn its driver to brake in a situation where another V2V-equipped vehicle decelerates quickly but may not be directly in front of the warning vehicle. The EEBL warning is particularly useful when the driver's line of sight is obstructed by other vehicles or bad weather conditions, such as fog or heavy rain

Scenarios also Addressed by Vehicle Sensor-Based Systems

Two of the applications being evaluated by the agency are already available inproductionvehiclesusingvehicle-residentsensors:FCWandBSW.Theseapplicationshavebeen available in a small number of production vehicles for many years. They could be considered mature technologies, insofar as they have undergone multiple generations of sensor technologies and variations of sensing technology to achieve their implementation.V2V technology, however, could enable these applications independent of any vehicle resident sensors (e.g., cameras or lidar). At the same time, V2V could provide additional detection range for these applications, and/or detection agnostic to the weather, light orcleanlinessconstraintsassociatedwithvehicle-residentsensorssuchascamerasorlidar.

Forward Collision Warning

FCW warns the driver of the host vehicle in case of an impending rear-end collision with a remote vehicle ahead in traffic in the same lane and direction of travel. The agency believes, based on current technology, that FCW systems using radar or cameras cannot provide a warning fast enough for very high speed rear end crashes. V2V, in contrast, has that capability based on its longer range (300 meters). Thus, fatal rear end crashes are one area where we believe V2V can provide some benefits not potentially covered by radar and camera-based systems. Radar and camera FCW systems also have a problem detecting stopped vehicles if the vehicle is stopped before coming into range of the radar and camera. Recently, dual radar and dual camera systems have been developed to provide detection of stopped vehicles. A V2V system could act as the redundant system and allow a single radar or single camera FCW system to detect stopped vehicles, thus reducing system cost as compared to dual radar or dual camera.

Software Requirement Basics of Programming Languages:

All sequential programming languages have four categories of instructions. Labels are used to reference locations in your program. They can be any combination used to mark allocation, follow the label with a colon. When referring to an address label in an instruction line,don'tusethecolon.Firstareoperationcommandsthatevaluateanexpression, perform arithmetic, toggle states of I/O lines, and many other operations. Second are jump commands that cause the program to jump immediately to another part of the program that is tagged with a label. Jumps are one way to break out of the normal line-by-line processing mode.

For example, if you want a program to repeat over and over without stopping, have the last line of the program is a jump command that takes the program back to its first line. Third are branch commands that evaluate a condition and jump if the condition is true.

For example, you might want to jump only if a number is greater than zero. Or, you might want to jump only if the state of an I/O line is low.

Fourth are loop commands that repeat a section of code a specified number of times. For example, with a loop you can have a light flash on and off exactly six times. Most programming languages contain a relatively small number of commands. The complexity of computers comes from combining and repeating the instructions several million times a second. Here's a generic program.

1. Do this
2. Do that
3. Jumptoinstruction6
4. Do the other thing
5. All done, sleep
6. If switch closed, do that thing you do

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The function apples is everything between the set of braces that follows “apples ()”. When the function completes, the program jumps back to the line following the line that called the function.

Labels are used to reference locations in your program. They can be any comminuted used to mark allocation, follow the label with a colon. When referring to an address label in an instruction line, don't use the colon. Use labels sparingly as they can actually make a program difficult to follow and challenging to debug. In fact, some C programmers will tell you to never use labels. Here’s an example repeat: Labels are used to reference locations in your program. They can be any combination used to mark allocation, follow the label with a colon. When referring to an address label in an instruction line, don't use the colon. Use labels sparingly as they can actually make a program difficult to follow and challenging to debug. In fact, some C programmers will tell you to never use labels. Variables are allocated by declaring them in the program. Every variable must be declared. If available is declared outside the braces of a function, it can be seen everywhere in the program. If it is declared inside the brace sofa function, the variable can only be seen within that function. Variables come in several flavors including byte (8-bit, unsigned, 0 to255), word (16bit, unsigned, 0 to 65,536), int (16-bit, signed, - 32,768 to 32,767), and long(32- bit, signed, 2,147,483,648 to 2,147,483,647). Use byte variables unless you need negative numbers or numbers larger than 255, then use int variables. Using larger sizes than needed fills up precious memory space. Variable declarations generally appearat

Variable names can be any combination of letters and numbers but must start with a letter. Names reserved for programming instructions cannot be used for variable names and will give you an error message Symbols are used to redefine how something is named and can be handy for making the code more readable. Labels are used to reference locations in your program. They can be any combination used to mark allocation, follow the label with a colon. When referring to an address label in an instruction line, don't use the colon. Use labels sparingly as they can actually make a program difficult to follow and challenging to debug. In fact, some C programmers will tell you to never use labels. Variables are allocated by declaring them in the program. Every variable must be declared. If available is declared outside the braces of a function, it can be seen everywhere in the program. The Arduino executes programs at about 300,000source code lines per sec. Symbols are defined with the #define" command and lines defining symbols should go at the beginning of your program. Labels are used to reference locations in your program. They can be any combination used to mark allocation, follow the label with a colon. When referring to an address label in an instruction line, don't use the colon. Here's an example without symbols for the case where an LED is connected to pin 2. Labels are used to reference locations in your program. They can be any combination used to mark allocation, follow the label with a color. The absolute, bare-minimum, do-nothing program that you can compile and run is void setup() {} voidloop() {}The program performs no function, but is useful for clearing out any old program. Note that the compiler does not care about line returns, which is why this program works if typed all on one line.

Advantages V2V Communication Using Li-Fi:

- The advantages of implementing this methodology are mentioned below:
- The V2V communication using Li-Fi provides assistance to driver.
- The safety travelling is ensured.
- The speed of transmission rate is very high. Thus, an efficient communication is obtained between the vehicles.
- This technology helps in reducing the rate of accidents which is occurring day by day.
- This technology of V2V communication helps in improving traffic management.
- The speed of the vehicle can be controlled using this technique.
- The behavior of the vehicle and driver can be known using this technology.
- Low cost solution for improving intelligent transportation system

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V. RESULTS

Vehicle to vehicle communication system (V2V) can send and receive the vehicle information by wireless communication, and can use as a safety driving assist for driver. Currently, it is investigated to clarify an appropriate activation timing for collision information, caution and warning. This study focused on the activation timing of collision information(Provideobjectiveinformationforsafedrivingtothedriver)onV2V,andaneffectiveactivationtiming of collision information, and the relationship between the activation timing and the accuracy of the vehicle position and the testing results as shown in fig [5.1]. In this project Li-Fi is introduced as a communication system with its modulation techniques and complete architecture explained. The challenges and advantages of Li-Fi are outlined with its purpose to provide high speed data transmission being one of its biggest pros. The implementation of Li-FiisintroducedasanapplicationV2VCommunicationtheprojectperformed in which the speed of two motors is controlled using Li-Fi. Data is transmitted from one control unit to the other and this controls the speed of the motor. The necessary analysis of the system with the block diagrams is also shown. It is hence concluded that Li-Fi is used as a communication tool and the control of two motor speeds is performed. This system uses Li-Fi technology whichincludesmanysensorssuchasMQ3,vibrationsensor,ultrasonicsensor,PCcameraalongwithan arduino board, LED light and a solar panel to communicate from one vehicle to another.

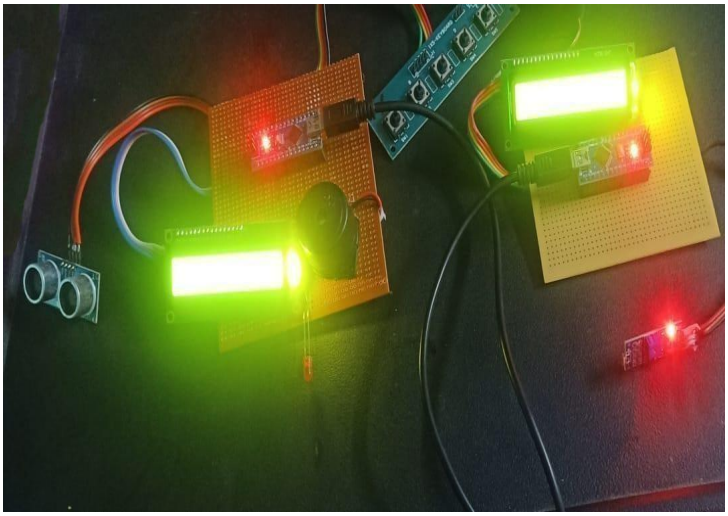

Fig 5.1: Testing Result

VI. CONCLUSION

In this work, Li-Fi is presented as a communication system, along with an explanation of its full architecture and modulation methods. The difficulties and benefits of LiFi are discussed, with one of its main benefits being the ability to transmit data at a rapid speed. TheimplementationofLi-FiisintroducedasanapplicationV2V LiFi is used to communicate the project that controls the speed of two motors. The speed of the motor is controlled by data transmission between the control units. The essential system analysis using block diagrams is also shown. Therefore, it can be said that Li-Fi is used as a communication tool and that two motor speeds are controlled. This system makes use of Li-Fi technology to communicate between vehicles using a variety of sensors, including MQ3, vibration sensors, ultrasonic sensors, PC cameras, an Arduino board, LED lights, and solar panels. By integrating this technology everywhere, it may reduce the number of traffic accidents while also ensuring the safety of drivers and other passengers in the future.

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