IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Vehicle-to-Vehicle Data Communication Through Light Fidelity (Li-Fi) Technology

Dr. T. M. Sathish Kumar[1], Jaichandru. S[2], Kamaleshkanna. P [3], Mathiyazhagan. D[4], Sathish Kumar. G[5]

[1] Associate Prof. in Department of ECE, KSRCE, TIRUCHENGODE, NAMAKKAL, TAMIL NADU, INDIA

[2,3,4,5] Students in the Department of ECE, KSRCE, TIRUCHENGODE, NAMAKKAL, TAMIL NADU, INDIA

Abstract-- The twenty-first century is characterized by technological advancements and automation, enhancing comfort and convenience in life. Smart cars have gained popularity due to advancements in automation and embedded systems. Traditional automotive patterns are being modernized by smart cars, leading businesses worldwide to invest in their development and manufacturing. Here, data is transferred between cars using a Li-Fi transmitter and receiver circuit, with the transmitter mounted on the tail lights of front-running vehicle and the receiver circuit on the front side. In order to avoid crashes, second car's receiver circuit modifies its speed after receiving the computed speed that the transmitter relayed via visible light communication. This paper proposes a method to identify and prevent car collisions and accidents.

Intex terms: Li-Fi, Transmitter, Receiver.

I. INTRODUCTION

This article describes the design of a Li-Fi-powered smart car accident detection system. Data is sent between automobiles using a Li-Fi transmitter and receiver circuit, which makes up the system. The leading vehicle's tail lights house the transmitter circuit, and visible light communication is used by the reception circuit to receive the calculated speed that the transmitter transmits. The second vehicle uses the information it has received to modify its speed to avoid colliding. Using LED headlights as transmitters and photosensors as receivers, this initiative aims to improve road safety. Utilizing photodetectors for short-range communication, white LEDs in head and tail lights may effectively control the speed of a vehicle. LEDs are cheap, which lowers the cost of the application and offers straightforward techniques for producing and transmitting signals. In addition, the technology communicates with other vehicles to avoid collisions and sends out alert signals to oncoming autos. By using Li-Fi transmitter and receiver, the data have been successfully sent to rear vehicles. Based on distance, which is sent to a programmable integrated circuit, the driver's circuit automatically controls the vehicle's speed.

II. LITERATURE SURVEY

Harald Haas et al (2020), Published a journal to create a financially sustainable Li-Fi network, where two extra Wi-Fi APs which serve through seven study halls were installed in addition to eight Li-Fi AT cell APs within a single study hall. Depending on their mode of operation and the transmission speed, each Wi-Fi AP be able to improve information transmission rates by 310 to 877 Mbps. A circular inclusion zone along with a 2.7 to 3.5-metre length may fit within any Li-Fi AP. Up to eight clients may be connected to a single Li-Fi AP, for a highest cumulative information throughput of 354 Mbps per study hall. Standard, unmodified LED luminaires with an electrical transmission speed of about 2 MHz are used in this idea validation system. The main engine that powers the frame along with the help of two more Wi-Fi APs and eight Li-Fi attocell APs, an economically viable Li-Fi network that can service seven study halls in one study room was established. Information rates can be increased by 300 to 867 Mbps with each Wi-Fi AP, depending on how they operate and how fast they transport data. Any Li-Fi AP may contain a circular inclusion zone that is between 2.8 and 3.5 metres long. A single Li-Fi AP may support up to eight clients, resulting in a maximum total data capacity of 344 Mbps per study hall. Standard, unmodified LED luminaires with an electrical transmission speed of about 2 MHz are used in this idea validation system[1].

Harald Haas et al (2016), Published a journal about how to validate potential collaboration between remote system management and the lighting. In the suggested post, we tried to emphasize how these three frameworks have the advantage of instantly correlating. There isn't much available radio spectrum below 10 GHz (for cm wave communication) due to the increasing need for remote information sharing. The distant correspondence industry started taking into account radio frequencies higher than 10 GHz (for mm-wave correspondence) in reaction to this test. Bad luck spreads by the higher frequencies, f, according to the Friis free space condition. Furthermore, when frequencies increase, it becomes more difficult to remove shadowing and obstructions in terrestrial correspondences. The next phase in the pattern is Light-Fidelity (Li-Fi). Utilizing the lighting system, a Li-Fi attocell setup provides fully coordinated (multiuser access and handover) remote access. This research looks at the underlying implications of the system's downlink operation and compares a DCO-OFDM-based Li-Fi photocell system on top RF femtocell systems in its class[2].

DeepaliJavale et al (2018), In an international conference, said The recommended structure consists of an Arduino, a drive, a photodiode, and a 16x2 LCD. This study's design may be able to create a dependable device delivery system by using the light sources already existent on Earth. This system is meant to demonstrate how it is possible to have a light-dependent system setup. If everything is working as it should, any light source may act as a path to the information communication office. The approach was used to evaluate its presentation in a variety of contexts. This approach has the advantage of ensuring successful distant communication[3]

EvangelosPikasis and WasiuO.Popool (2018), Explained its efficiency By using various Li-Fi control techniques and keeping an eye on the fluctuations in the resultant optical quality measurements, this framework enhances Li-Fi control over LEDs. This implies that we may concentrate on the effects of This is a potentially required, costly, and time-consuming process. It is therefore interesting to think about developing a simple model or tool to evaluate the effect of Li-Fi on LED illumination quality. It is possible to quantify how Li-Fi affects LED light quality. This type of model allows for a direct correlation to be established between transmitted light quality measures and LED driving current. It is feasible to precisely assess variations in the quality of transmitted light resulting from individual driving currents by using this kind of model. The greatest range of fluctuation in light quality ratings is over the LED's whole output range. An optical spectrometer is used to test each LED's CRI, CCT, and chromaticity at different driving currents to develop the current light quality model. Each estimate requires the collection of at least 2000 samples, and the sample mean serves as both an information point within a shared workstation and an information point in the exchange working diagram[4].

Mosaif Rakrak (2017), The system suggests transmitting image and video data from a camera source to a sink via an indoor remote connection via Li-Fi. Every camera comes with a Li-Fi handset; double ceilings are advised to allow for data transfer via optic threads and light flow. Phones are integrated into camera hubs to facilitate Li-Fi data transmission and battery recharge. Sensors must minimize data to save energy and storage space since they gather a large volume of visual information. The video coding standard H.264 is used to package the visual data that the hubs acquire, guaranteeing that no one will be negatively impacted. This method provides an indoor communication option that is both more environmentally friendly and efficient.

III. PROPOSED SYSTEMS

A novel strategy to improve road safety and efficiency is presented via a suggested Li-Fi-based V2V communication system. With its high bandwidth and resilience to electromagnetic interference, Li-Fi—is a wireless communication technology which utilize light to transport information—that is perfect for vehicle-to-vehicle (V2V) applications. Each car in this system would have a Li-Fi transceiver installed, enabling real-time communication between them on location, speed, and direction. Vehicles may quickly and securely connect by using Li-Fi, which provides real-time updates on traffic patterns, possible risks, and road conditions. This real-time data interchange helps drivers make proactive decisions and lowers the risk of accidents by improving their situational awareness. Furthermore, Li-Fi offers a strong defense against cyber attacks and unauthorized access because of its built-in security characteristics, which include its restricted range and inability to pass through opaque obstructions. Li-Fi-based V2V communication has the power to completely transform transportation networks, opening the door to improved traffic flow, safer roads, and less congestion. This project exemplifies how cutting-edge technology may be integrated with transportation infrastructure, paving the way for a day when continuous vehicle communication will guarantee safer and more effective travel for all users of the road.

IV. EXISTING SYSTEMS

Driver weariness is the primary cause of most traffic accidents. There are hundreds of automobiles on the road every day, which makes it difficult to manually track the drowsy driver. As a result, we want a function that, should it detect that the driver is tired, must cause the automobile to quickly lower speed. Furthermore, it makes use of infrared sensors to track the user's eye movements and project them onto the LCD. The eye blink and pressure measurements are significant since they show the driver's level of sleepiness. Drivers are alerted by these buzzers if they seem to be asleep.

V. LI-FI MODEM

Li-Fi is a quick wireless technology that transmits data by using visible light. Though they are both wireless technologies, Li-Fi and Wi-Fi are not the same as Wi-Fi consumes radio waves and Li-Fi employs along with light-emitting diodes (VLCs), which generate infrared and near-ultraviolet radiation. An LED emits tiny quantities of energy (called photons) when it is switched on at a steady voltage. LEDs are semiconductor devices, thus they can rapidly adjust the current flow and output (the light they generate). The light output varies with modest changes in LED power.

VI. BLOCK DIAGRAM

6.1 Transmitter module

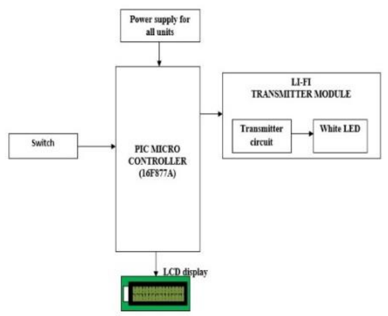

Fig 1. Schematic representation of Transmitter

6.2. Receiver module

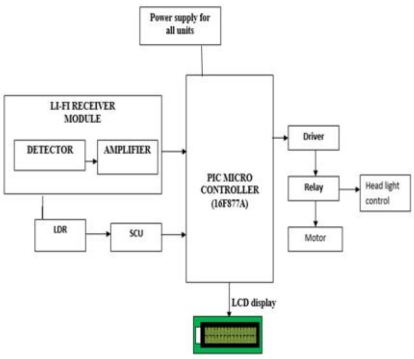

Fig 2. Schematic representation of Receiver

VII. BLOCK DIAGRAM DESCRIPTION

7.1. Li-Fi Transmitter

Li-Fi transfers data using visible light instead of radio waves, as does Wi-Fi. The Li-Fi transmitter uses powerful LEDs to transform digital data into barely noticeable light flickers. More complex transmitters depend on microcontrollers and signal processing methods, whereas simpler transmitters have larger bandwidths, replaceable lenses, and compatibility with different research platforms. Li-Fi technology will advance, providing greater security, quicker data transfer rates, and a greater range of applications across several industries. With these developments, Li-Fi will realize its full potential and provide greater security, quicker data rates, and a greater range of applications.

7.2. Li-Fi Receiver

Light Fidelity, or Li-Fi, is a more rapid and secure wireless information broadcast technology that utilizes the light waves instead of Wi-Fi. An essential component of this technology is the Li-Fi receiver, which functions as the system's eyes by generating electrical impulses from fluctuations in invisible light. To get the encoded data, the receiver's circuitry decodes these signals. Li-Fi receivers are available in a variety of forms, including USB (universal Serial Bus) dongles for PCs and integrated modules for mobile devices. Some can move smoothly inside the light cone. Although Li-Fi technology is still in its infancy, receivers are essential if Li-Fi is to achieve its full potential and open the door for further light-based information flow.

7.3. PIC Microcontroller

The PIC1640 architectural microcontroller, originally created by General Instruments' Microelectronics Division, is the basis for Microchip Technology's PIC series of microcontrollers. PIC was originally known as a "programmable interface controller." Because of their inexpensive cost, wide availability, abundance of application notes, availability of low-cost or free development tools, and capacity for serial programming (and reprogramming using flash memory), PICs are popular with both industrial developers and amateurs. In February 2008, Microchip declared the arrival of its sixth billionth PIC processor.

7.4 The following characteristics define PIC architecture:

- Other than the PIC32, which has a Von Neumann architecture, data sections (Harvard architecture) and separate code are used. A limited quantity of instructions with set lengths.
- The majority of instructions execute in one cycle (two clock cycles), with branches and skips requiring a single delay cycle.
- W0, an accumulator, is presumed to be used as a source operand; that is, nothing in the opcode encodes it.
- Every RAM location serves like a register, which may be used as a source or destination for arithmetic and other operations.
- A stack of hardware designed to store coming back addresses.
- Here relatively tiny volume of accessible information space that can be expanded by banking, usually 256 bytes.
- Peripheral registers, port, and Mapped CPU to data space.
- To implement indirect jumps, the program counter is writable and plotted into data space.
- RAM functions as both memory and registers, hence there is no difference between memory space and register space. RAM is sometimes referred to as simply registers or the register file.

7.5 Performance

The PIC architecture was among the initial designs of scalar CPUs. It is a simple and cost-effective design that uses microcircuit design and timing simplification to increase cost, power consumption, and clock speed. It requires one instruction and two instruction cycles, but it enables quick lookup tables in program space. Optimization is made easier by the vast program space and consistent support found in the instruction set. The number of instructions multiplied by two cycles yields an accurate estimate of the execution time. When external disturbances fail to synchronize with the instruction cycle of four clocks, mistakes of one instruction cycle are prevented since there is no change in interrupt latency beyond three instruction cycles. Because of their constant interrupt delay, PICs may generate low-jitter timing sequences that are interrupt-driven, such as visual sync pulses.

7.6 Limits

- There should be only a single accumulator.
- It must contain a small instruction set.
- Registers and operations must not be orthogonal; certain instructions may use the accumulator alone, while others can target RAM and/or instantaneous constants.
- Arithmetic and logic operations require direct memory references, although indirect addressing is possible through two extra registers.
- Conditional skip instructions are employed, as opposed to the majority of other designs' conditional jump instructions. The indexing addressing mechanism is really basic.

7.7 Device variants

Depending on the hardware resources the chip features, there can be a lot of device variations even within a series.

- Synchronous/Asynchronous Serial Interface USART
- I/O pins that are used for general purpose.
- Bit Timers like 8/16/32.
- EEPROM Memory mounted internally.
- Internal clock oscillators.
- PWM and Compare/Capture modules.
- MSSP Peripheral used for SPI and I²C Communications.
- ADC up to ~1.0 MHz (Analog-to-digital converter).
- External memory interface.
- Integrated analog radio frequency (RF) front ends (PIC16F639, and rfPIC).
- CAN interfacing support, Ethernet, and Universal Serial Bus.
- KEELOQ Rolling code encryption peripherals for both encode and decode process, and many more.

7.8 Features

The generic features of PIC devices:

- It will be sleep mode to save power.
- It contains watchdog timer.
- RC oscillator for configurations or various crystal are available, or an external clock.

7.9 Trends

Flash memory chips can replace EPROM-storing PICs, and the 12-bit PIC1650 instruction set has been replaced by 14-bit and 16-bit sets. Where the microchip provides EPROM-based PICs in windowed (UV-erasable) and OTP (one-time programmable) variants for bulk orders and legacy compatibility. PICs that cannot be erased electrically are designated as OTP on the microchip online.

VIII. DEVELOPMENT TOOLS

8.1. Commercial supported

Microchip's shareware IDE MPLAB comes with software simulator, assembler, debugger, and linker. Additionally, it provides fully functional student versions of its C compilers for PIC18 and dsPIC. The open versions, however, may expire in next 60 days. For the programming languages Pascal, C, and BASIC, third parties provide compilers; many of these compilers come with their own IDEs and MPLAB integration. A fully complete PICBASIC compiler for PIC microcontrollers has been offered by MeLabs, Inc. using a block set on behalf of Matlab or Simulink, a Simulink model may be translated into C and binary files.

8.2. Open Source

For the PIC family, the following development tools are available below the General Public License or other open-source or the software that are available with free licenses.

- The PIC18F and dsPIC30F series come with a native Forth operating system called Flash Forth. With an interpreter, compiler, assembler, and multitasker built in, it turns the PIC into a stand-alone computer.
- A miniature real-time kernel called Free RTOS has been ported with dsPIC, PIC18, PIC24, and PIC32 architectures.
- The GNU Compiler Collection and GNU Binutils, as well as Microchip's MPLAB C30 compiler and MPLAB ASM30 assembler, have been ported to the PIC24, dsPIC30F, and dsPIC33F.
- An Open Source PIC microcontroller simulator called GPSIM comes with hardware modules that simulate certain connected devices, such as LCDs.
- GPUTLS is a collection of PIC utilities that includes an object file viewer, an assembler, a disassembler, and a linker.
- GC Basic, or Great Cow Basic Great Cow BASIC's syntax is derived from QBASIC/Free BASIC. Almost all PIC chips in the 10, 12, 16, and 18 series may be constructed and operated using the assembly code that is generated

IX. DEBUGGING

9.1. Software Emulation

Although MPLAB offers a free PIC software emulator, its capabilities for simulating device interactions are limited. A commercial software package called Proteus VSM bridges the gap between traditional debugging and emulation by enabling the modeling of various PIC microdevices and external devices. For KDE, KDE, and Digital Electro Soft, there are three open-source circuit simulators: K Tech Lab, Pik Lab, and Real Pic Simulator. Real Pic Simulator is the most potent simulation engine on the market; Pik Lab uses GPSIM to design PIC applications; and K Tech Lab simulates a variety of PIC microcontrollers. These instruments facilitate the transition from conventional in-circuit debugging to simulating

9.1. Debugging through In-Circuit

A built-in ICD (in-circuit debugging) interface is a feature of PICs from later models. Where, three lines can be used to connect to this interface by ICD debuggers, such as MPLAB ICD2. The drawbacks of this straightforward, low-cost debugging technique are as follows: fewer breakpoints (three on more modern PICs as opposed to one on early PICs), loss of some IO (except from 44-pin surface mount PICs, which have dedicated lines for debugging), and loss of some chip capabilities. PICs with extra pins for debugging are used to generate custom headers; this is particularly true for small PICs, for whom the IO loss from this method would be unacceptable.

9.2. In-Circuit Emulators

Three complete in-circuit emulators are available from Microchip: MPLAB ICE2000, MPLAB ICE4000, and REAL ICE. To debug programs at the source level, these tools may be used in conjunction with the MPLAB IDE. Test hardware is connected to either a production device or an emulator module via the ICE2000, which makes use of emulator modules. For in-circuit simulation, the REAL ICE may be linked directly to production equipment or via a high-speed connection with two additional ports. Most flash-memory-based PIC, PIC24, and DS PIC processors are compatible with it. On its website, Microchip no longer endorses the ICE4000 and cautions against new designs.

9.3. MAX232

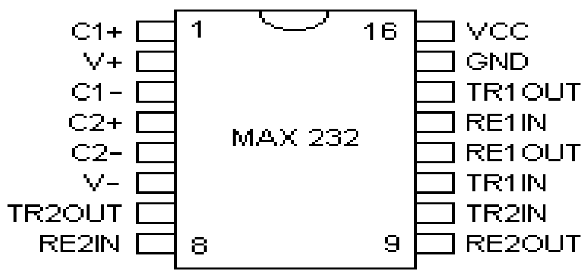

Fig 3. MAX 232 Pin Configuration

circuit called the MAX232 transforms signals through the RS-232 serial connection into TTL-compatible digital logic circuits. This helps implement RS-232 in the devices where it doesn't require voltages from outside of the 0V to +5V ranges hence it employs the dual driver/receiver MAX232 to give RS-232 voltage level outcomes through a single +5V power supply. The receivers reduces RS-232 inputs to the standard TTL levels of 5V, with a 0.5V hysteresis and a 1.3V threshold. The updated MAX232A is still backward compatible along with original MAX232, on the other hand it will work at higher baud rates along with lesser external capacitors. An MAX232 IC alters TTL Logic 0 and TTL Logic 1 for conversion when it receives a TTL level.

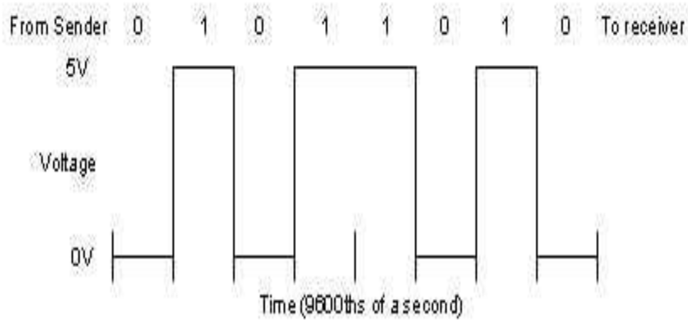

Fig 4. MAX 232 OUTPUT

X. CIRCUIT DIAGRAM

10.1. Transmitter Circuit

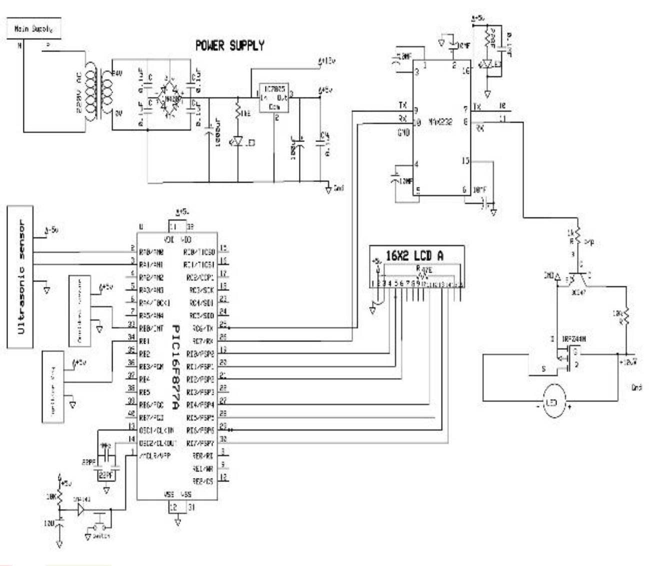

Fig 5. Circuit of Transmitter

10.2. Receiver Circuit

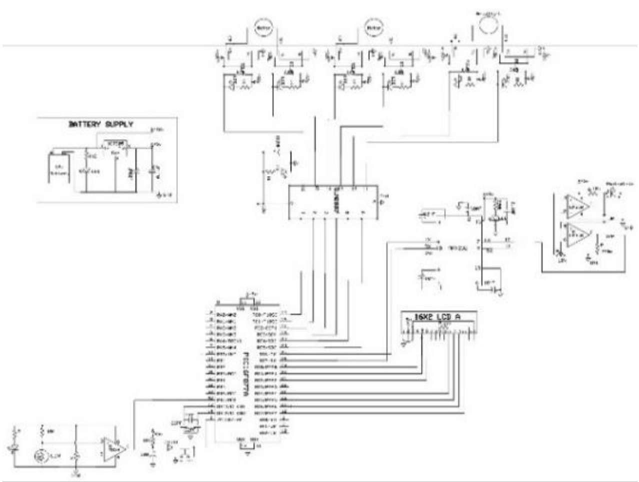

Fig 6. Circuit of Receiver

10.3. Circuit Description

The goal of this project is to construct a high-speed wireless communication system using a microcontroller, LCD, relay driver, switch LIFI transmitter, LDR sensor, and LIFI. For electrical devices, switching and linear power supply are the two primary varieties. For high-current devices, linear supplies are more straightforward but heavier. Relays are electrically driven switches that pull a lever in the direction of the magnetic field created by the coil's current flow. Double-throw connections and two switch locations are features of them. Similar to existing Wi-Fi technology but with notable differences, Li-Fi is a high-speed wireless communication system that employs visible light to carry data. Li-Fi employs near-UV and infrared-spectrum waves, while Wi-Fi produces radio waves. Information may be sent from the front automobile to the back car via this switch. By using the relay to lower the vehicle's speed, the receiver receives a corresponding signal from the transmitter. The LDR sensor detects when the light intensity is above a certain level and turns on the dim mode.

XI. RESULT

11.1Transmitter

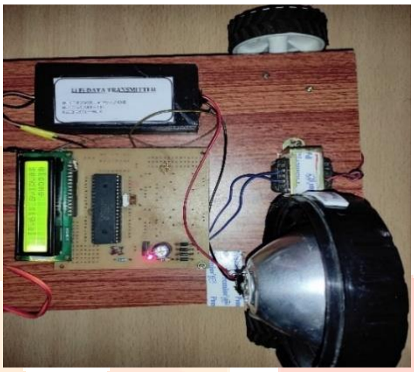

Fig 6. Transmitter kit

11.1 Receiver

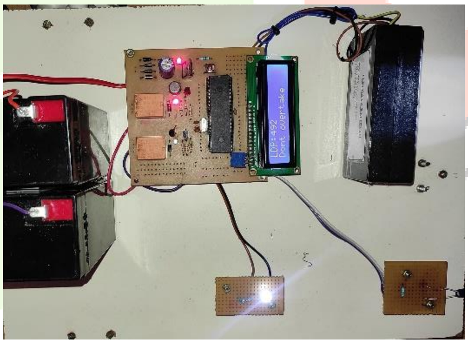

Fig 7. Receiver Kit

Through the use of sensor data, this system maintains control over the vehicle, therefore ensuring the protection of drivers and also other passengers those who are travelling in the vehicle. By doing this, we may encourage safe driving and prevent the majority of traffic incidents.

XII. CONCLUSION

An important development in smart transport systems is the integration of Li-Fi technology along with the Internet-of-Things for V2V communication. By improving real-time data exchange between vehicles, this technology fosters a more efficient and safe driving environment. Its dependability and speed allow for rapid information exchange, which is essential for traffic management, accident avoidance, and road safety maintenance. Automobiles may intelligently link to infrastructure and to one another via a complete network that is created by the synergy between the IoT and automobiles. This combination creates new opportunities for a network of intelligent and secure transportation.

XIII. FUTURE WORKS

There are chances to enhance scalability and security in future V2V communication research by merging Li-Fi with IoT. As advanced driving assistance systems (ADAS) progress, the main priorities should be on strengthening the system's scalability to accommodate larger networks, bolstering security protocols to fend off cyberattacks, and investigating the application of artificial intelligence algorithms to enhance cars' decision-making abilities in response to shifting traffic conditions.

XIV. REFERENCE

[1]. Harald Haas, Liang Yin, Cheng Chen, Stefan Videv, Damian Parol, Enrique Poves, Hamada Alshaer, Mohamed SufyanIslim," 2020. Introduction to indoor networking concepts and challenges in LiFi", IEEE/OSA Journal of Optical Communications and Networking. 12(2).

[2]. Harald Haas, Liang Yin, Yunlu Wang, Cheng Chen,"2016. What Is LiFi?", Journal of Lightwave Technology34(6)

[3]. DeepaliJavale, Sujata Wakchaure, Sahil Santosh Patil Ameya Milind Phadnis, Rohan Sanjay Shahane," A new approach to wireless data transmission using visible light",2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA).

[4]. Evangelos Pikasis and Wasiu O.Popoola "Understanding LiFi Effect on LED light Quality". 2018 IEEE Photonics Conference (IPC).

[5]. MOSAIF RAKRAK said "An Indoor Wireless Visual Sensor Network basing on Light-Fidelity Communications",2017 International Conference on Wireless Networks and Mobile Communications (WINCOM).

[6]. Niharika Mishra, Monika Rai , Riya Mandal Harjeet Kaur. "Navigation System using Light Fidelity "2018 2nd International Conference on Trends in Electronics and Informatics(ICOEI) Kumar Ranjan "The Lattice-An intelligent grid for connected car Industry".2017 IEEE Transportation Electrification Conference (ITEC-India) Asis Kumar Tripathy, Kumar Mishra, Tapan Kumar Das," Smart Lighting: Intelligent and Weather Adaptive Lighting in Street Lights using IOT", 2017 International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT).

[7]. Jaina Patel, Pranati Trivedi, Drashti Patel," A Performance Analysis of "Light Fidelity" and "Internet of Things" & Its Application", 2017 International Conference on Transforming Engineering Education (ICTEE).