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Li-Fi Empowered Vehicle-to-Vehicle Communication: A Path to Enhanced Road Safety and Intelligent Traffic Management

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Abstract

Li-Fi is the advanced technology of the world. This project is brief about the vehicle to vehicle communication to avoid major accidents. To enrich the mentioned feature we use the following sensors are listed as ultrasonic sensor, gas sensor, vibration sensor, normal robot mechanism, and Li-Fi Communicators. The ultrasonic sensor is used to find the distance between the vehicle in front and measuring the vibration level due to speed and road platform of the vehicle. The gas sensor is used to measuring the alcohol level of the vehicle driver and this data is sent to the nearby vehicles through the Li-Fi communicator. Integrating Li- Fi into V2V communication systems holds great potential for improving road safety and traffic management. This paper delves into the key aspects of this integration, such as the design and implementation of Li-Fi transceivers in vehicles for enhancing the road transport, the development of communication protocols tailored for V2V scenarios, and the assessment of the system performance in dynamic and challenging vehicular ambience. The research aims to contribute valuable insights into the feasibility and benefits of employing Li-Fi for enhancing communication between vehicles, thereby paving the way for more robust and efficient intelligent transportation systems.The proposed description for Li-Fi (Light Fidelity) in the context of Vehicle-to-Vehicle (V2V) communication outlines an innovative solution that leverages visible light as a medium for seamless and high-speed data exchange between vehicles. This cutting-edge technology involves integrating Li-Fi transceivers into vehicles, enabling them to communicate through modulated light signals. Additionally, the proposal delves into the intricacies of designing communication protocols tailored specifically for dynamic V2V scenarios, ensuring optimal performance in diverse driving environments. By exploring the potential of Li-Fi in V2V communication, the description aims to contribute to the development of intelligent transportation systems that prioritize efficiency, safety, and the advancement of connected vehicle technologies. This proposed framework envisions a future where Li-Fi plays a pivotal role in transforming how vehicles communicate, fostering a new era of smart and interconnected mobility.

I. INTRODUCTION

The overview of Li-Fi employing Vehicle-to-Vehicle (V2V) communication provides a comprehensive utilizing visible light for data transmission, presents a promising alternative to conventional insight into the intersection of Li-Fi technology and the automotive domain. Li-Fi, an innovative communication paradigm radio frequency-based methods. In the context of V2V communication, this overview explores the potential applications and benefits of integrating Li-Fi into vehicular networks. Key considerations include the deployment of Li-Fi transceivers within

vehicles, the development of communication protocols tailored to V2V scenarios, and the optimization of data transfer rates in dynamic driving environments. The overview also addresses challenges such as line-of-sight requirements and the impact of ambient lighting conditions on Li-Fi performance. By presenting a holistic perspective, this overview aims to elucidate the transformative possibilities of incorporating Li-Fi into V2V communication systems, offering a glimpse into the future of intelligent and connected transportation.

Unfortunately, most counties in the world has an alarming record in number of death/disability due to tremendous number of accident. Accidents are occurred because of unawareness of the people. found that 57% of accidents where due to solely driver factors, which include his behavior, decision making ability, reaction speed and alertness. The studies the accidents can be avoided if driver was provided with warning message few seconds before so that, they can take some alternative route or be cautious to avoid traffic congestion or accidents.The vehicular adhoc network was adopted to mimic the adhoc nature of highly dynamic network. In this network two vehicles can communicate with each other. For Vehicle safety a new technique can be created. VANET Communication is classified into two different types Vehicle to Vehicle communication and Vehicle to Infrastructure Communication. The vehicle to vehicle communication is a communication between two vehicles (i.e.) one hop communication such as car to car communication. The vehicle to Infrastructure communication is communication between vehicle and road side Infrastructure. It acts as a multi hop communication. The vehicle to vehicle communication is a system designed to transfer basic safety related with vehicles to provide warning to drivers concerning accidents. The main objective of this system is to alert drivers when he closes to front vehicle. The communication between the vehicles takes place by means of LI-FI. The distance between two vehicles is measured using Ultrasonic sensor. The microcontroller controls the entire circuit and is programmed to notify the driver with a message when the vehicle comes within the Line of sight . There are several obstacles that hinder the safety while driving. The vehicle such as car or buses may break down in middle of the road especially during the night time these becomes a serious obstacles mainly in highways were the roads are not lighted. The vehicle coming behind may not judge the stationary vehicle and may cause accident; the vehicle coming behind may hit hardly to the back of stationary vehicle and may lead to greater damage. Many scenarios were considered for the design of the system.

A.First Scenario

Vehicle1 slows down the speedometer senses the speed if lower than the previous speed an Ultrasonic Sensor attached in the bonnet using Doppler-effect is made to sense continuously. When the distance between the two vehicles decreases a warning message is transferred to back vehicle using the transmitter attached in the front vehicle it is received by the photo-detector attached to the back vehicle so he can take necessary steps to ensure that collision is avoided.

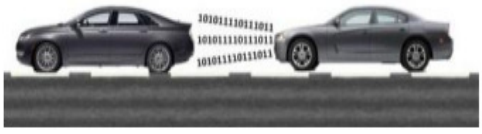


Fig1.1 First Scenario of Vehicle to Vehicle Communication Using VLC

B.Second Scenario

The major reasons for accidents are due to the negligence of the driver who might be under the influence of alcohol or might be sleeping while driver. The vehicles are interfaced with an Alcohol as well as an Eye-blink sensor to monitor driver. If the driver is under the influence of alcohol or is sleeping this information is transferred to vehicle within the line of sight so vehicle can speed up or allow the vehicle to go ahead without causing any damage.

Fig 1.2. Second Scenario of Vehicle to Vehicle Communication Using VLC

The organization of paper is as follows section 2 provides information about the system design. The results and experimental setup are discussed in section 3. The conclusion and future scope is discussed in section 4.

II.Existing System

The study proposes the use of optical intelligent reflecting surfaces (O-IRS) at road intersections to improve safety message dissemination for vehicular visible light communication (V-VLC) systems. O-IRS offers significant performance enhancements compared to baseline scenarios, achieving longer communication range and ensuring quality-of-service (QoS). The research also explores the use of millimeter wave (mmWave) bands for improved automated driving and data rate and latency requirements in automotive applications. The study validates the proposed mmWave path loss models for the NR-V2X system using link-level simulation. The study also explores AI and ML cyber security solutions, focusing on the challenges of big data collection, fast and efficient communication, and handling privacy in IoV systems. The disadvantages of existing systems include cost, logistical challenges, interference issues, interoperability issues, and the potential for cybersecurity incidents or accidents.

The proposed Li-Fi (Light Fidelity) system is an innovative solution for Vehicle-to-Vehicle (V2V) communication, leveraging visible light as a medium for seamless and high-speed data exchange between vehicles. This cutting-edge technology integrates Li-Fi transceivers into vehicles, enabling them to communicate through modulated light signals. The system offers potential advantages such as enhanced data transfer rates, reduced electromagnetic interference, and improved security compared to traditional radio frequency-based communication systems. The system is designed for two vehicles, with the Vehicle Module (VM) embedded with the vehicle acting as moving nodes. It consists of various sensors, microcontrollers, Light emitting diodes, and photo diodes to retrieve data.

The system includes an ultrasonic sensor, alcohol sensor, and eye blink sensor. Challenges in designing the system include processing delay and line of sight limitations. Advantages of the proposed system include reduced electromagnetic interference, increased bandwidth efficiency, inherent security benefits, and high data transfer rates.

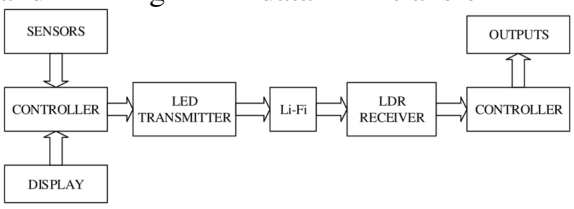


Fig 3.1 Block Diagram

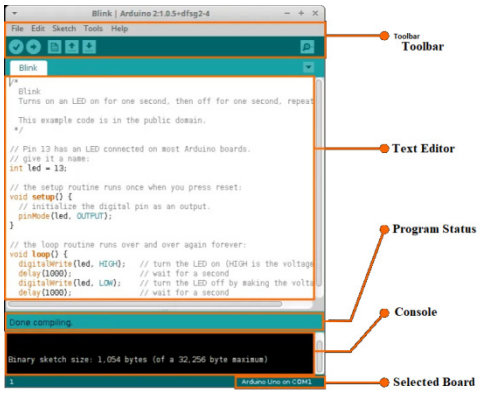
The Li-Fi system consists of two parts: the Li-Fi transmitter and the Arduino board. The transmitter is connected to the Arduino board, while the Arduino board is connected to the Li-Fi module. The system aims to contribute to the development of intelligent transportation systems that prioritize efficiency, safety, and the advancement of connected vehicle technologies.

III.SOFTWARE DESCRIPTION

Arduino IDE is an open-source software platform designed to make it easy for users, particularly those with little to no programming experience, to program and develop projects using Arduino microcontroller boards. The IDE

features a user-friendly graphical interface, a code editor with syntax highlighting and auto-completion, and a message area for writing and editing code. Arduino boards can read inputs and turn them into outputs using the Arduino programming language (based on Wiring) and the Arduino Software (IDE), based on Processing.

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. Over the years, Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers has gathered around this open-source platform, contributing to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

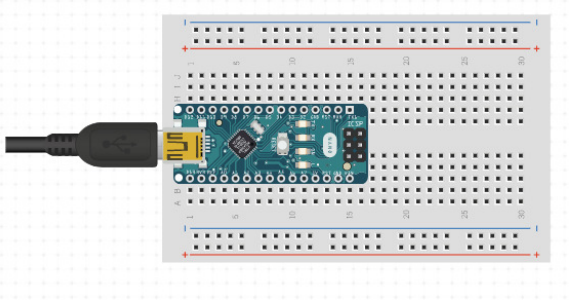


Arduino IDE

The Arduino IDE is relatively inexpensive compared to other microcontroller platforms, running on Windows, Macintosh OSX, and Linux operating systems. It is a simple, clear programming environment, open source and extensible software, and published under a Creative Commons license, allowing experienced circuit designers to make their own versions of the modules and extend them.

Programs written using Arduino Software (IDE) are called sketches, which are saved with the file extension.ino. The IDE uses the concept of a sketchbook, a standard place to store your programs or sketches. Sketches can be opened from the File > Sketchbook menu or from the Open button on the toolbar.

Tabs, multiple files, and compilation allow you to manage sketches with more than one file, including normal Arduino code files, C files, C++ files, or header files.
To upload a sketch to an Arduino Nano, select the correct items from the Tools >Board and Tools > Port menus. The boards are described below:

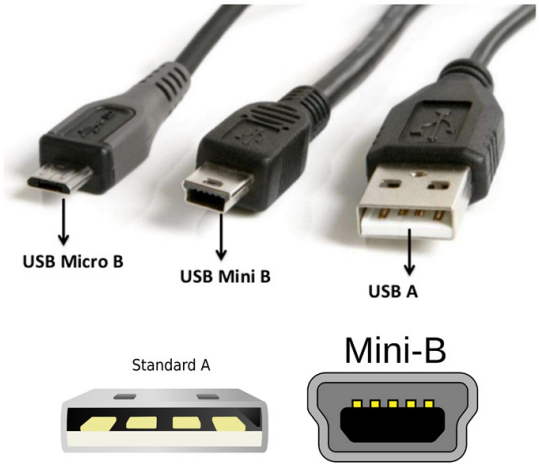


ARDUINO NANO INTERFACE

For Mac, the serial port is usually /dev/tty.usbmodem241 (for an Uno or Mega2560 or Leonardo), /dev/tty.usbserial-1B1 (for a Duemilanove or earlier USB board), or /dev/tty.USA19QW1b1P1.1 (for a serial board connected with a Keyspan USB-to-Serial adapter). On Windows, it's probably COM1 or COM2 (for a serial board) or COM4, COM5, COM7, or higher (for a USB board). On Linux, it

should be /dev/ttyACMx, /dev/ttyUSBx or similar.

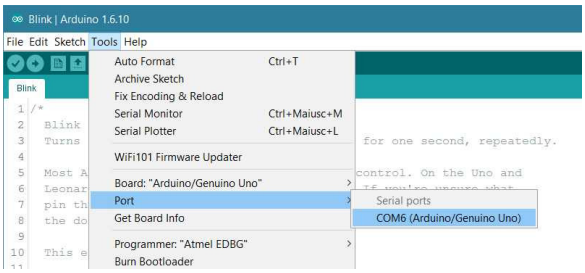
When uploading a sketch, you're using the Arduinobootloader, a small program that allows you to upload code without using any additional hardware. Libraries provide extra functionality for use in sketches, such as working with hardware or manipulating data. To use a library in a sketch, select it from the Sketch > Import Library menu.



NANO INTERFACING USB TYPES OF PORT

Third-party hardware can be added to the hardware directory of your sketchbook directory. Platforms installed there may include board definitions, core libraries, bootloaders, and programmer definitions. To install, create the hardware directory and unzip the third-party platform into its own sub-directory.

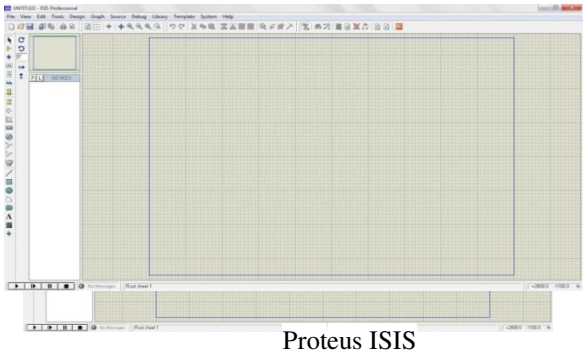
The Serial Monitor displays serial sent from the Arduino board over USB or serial connector. To send data to the board, enter text and click on the "send" button or press enter. Choose the baud rate from the drop-down menu that matches the rate passed to Serial.begin in your sketch.



SELECT BOARD TYPE

Preferences can be set in the preferences dialog or in the preferences file. Board selection affects parameters used when compiling and uploading sketches and file and fuse settings used by the burn bootloader command. The Arduino Software (IDE) includes built-in support for the boards based on the AVR Core.

Proteus ISIS Professional is a software tool set designed by Labcenter Electronics Ltd. for creating schematics, simulating electronics and embedded circuits, and designing PCB layouts. It is used by engineering students and professionals to create schematics and simulations of various electronic circuits. Proteus is lenient in circuit designing and works on ideal conditions, ensuring that circuits work without garbage value. It is also used for PCB designing, with Proteus ARES being used for this purpose.



Proteus ISIS

Proteus is also used for designing programming codes for different microcontrollers, such as Arduino, PIC Microcontroller, and 8051. In embedded projects, Proteus is a relief as it allows for testing without burning the microcontroller multiple times for typographical errors. The language was initially

created as a multiplatform system utility for manipulating text and binary files and creating CGI scripts. It later focused on Windows, adding specialized functions for network and serial communication, database interrogation, system service creation, console applications, keyboard emulation, and ISAPI scripting (for IIS).

IV.ADVANTAGES & RESULT

A.Result

The top view of the front vehicle and back vehicle is presented. The top view presents the various sensors interfaced with the control unit. The Top view of the front vehicle consists of a buzzer and a LCD monitor to notify the driver with a warning message. The Photodetector is used in front vehicle to receive the data transmitted by the LED.

The Back vehicle consists of Ultrasonic sensor to measure the distance between the two vehicles. An sensor is used to check if the driver is sleeping while driving and alcohol sensor is interfaced with control unit to find if the driver is intoxicated by alcohol and use the LED to transmit the safety related message so that the front vehicle can be notified.

B.Advantages

The advantages of employing Li-Fi in Vehicle-to-Vehicle (V2V) communication are substantial and transformative. Firstly, Li-Fi offers significantly higher data transfer rates compared to traditional wireless communication technologies, enabling rapid exchange of information between vehicles. This increased speed enhances the responsiveness of V2V communication systems, contributing to improved road safety and traffic management. Li-Fi's reliance on visible light also mitigates electromagnetic interference concerns, providing a more stable and reliable communication environment for vehicles. Moreover, the integration of Li-Fi supports the growing demand for bandwidth in connected vehicles, facilitating the seamless transmission of data for applications such as real-time navigation, traffic updates, and multimedia streaming. Additionally, Li-Fi's inherent security benefits, stemming from the confined nature of visible light, make it a robust solution for protecting sensitive V2V communication from external interference and cyber threats. Overall, the advantages of Li-Fi in V2V communication encompass speed, reliability, bandwidth efficiency, and enhanced security, paving the way for a more efficient and secure future of intelligent vehicular networks.

V.Conclusion

The integration of Li-Fi technology in Vehicle-to-Vehicle (V2V) communication holds immense promise for revolutionizing the landscape of intelligent transportation systems. With its capacity for high-speed data transfer, reduced electromagnetic interference, and enhanced security, Li-Fi addresses critical challenges in V2V communication, contributing to safer and more efficient road networks. The advantages of rapid data exchange, minimal interference, and increased bandwidth efficiency position Li-Fi as a key enabler for real-time applications in connected vehicles. As the automotive industry continues to evolve towards smarter and interconnected mobility solutions, Li-Fi emerges as a compelling technology, offering a robust foundation for the future of V2V communication. The potential impact of Li-Fi extends beyond mere connectivity, shaping a landscape where vehicles can communicate seamlessly, ensuring not only enhanced safety but also paving the way for a more efficient and intelligent transportation ecosystem. As research and development in this domain progress, Li-Fi's role in V2V communication represents a paradigm shift towards a more connected, secure, and technologically advanced future for vehicular networks. Vehicle-to-Vehicle Communication is easy and simple to use. With the proposed system warning messages can be transmitted at faster rates that foster drivers to

make strategic decision at faster rate which is vital in making strategic decision avoiding accidents and congestion. In future the project can be extended to communicate Vehicle-toInfrastructure for smart city.

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