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Original Article

Survey of Vehicle to Vehicle Communication using LI-FI Technology

Buvaneswari S[1], Saranraj S[2], Tanishka raghu[3]

[1,2,3] *Computer science and engineering, Easwari engineering college Chennai, India*

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Abstract *- Wireless communication has become a basic utility in our day to day life such that it becomes fundamental to our lives, and this communication uses the radio spectrum for data transfer. There are issues in using the radio spectrum. They are capacity, efficiency, availability and security. The usage of Wi-Fi also causes damage to the ecosystem, such as flora and fauna. The defects of the Wi-Fi technology has given birth to the concept of Li-Fi (Light Fidelity) technology. Li-Fi is an advanced technology. This project is concise to a vehicle to vehicle communication for avoiding road accidents. We use the ultrasonic sensor, gas sensor, vibration sensor, LCD display, Li-Fi transmitter and receiver. In case of an abnormal condition in the front vehicle, the vehicle at the back will be intimated and will stop on the second. For future enhancement, Li-Fi can be implemented in classrooms where data stored in the server is transmitted through LED lights attached in the ceilings of the classroom, and the data can be received through a Li-Fi receiver(dongle) which is present with each student in the classroom.*

Keywords *- Li-Fi, LEDs*

I. INTRODUCTION

There are around 1.4 million cellular mast radio waves base stations set, with over 5 billion mobile phones. Mobile phones transmit over 600TB of data on an average basis every month. Nowadays, wireless communication uses radio waves. But radio waves have a problem of efficiency, availability, security and capacity. Spectrum is a very important requirement for wireless communication. With the advancement in technology and increase in the number of users, the existing radio wave spectrum fails to meet the need and hence, the capacity problem. To resolve all the issues, we have come up with the concept of transmitting data wirelessly through light using LEDs, called as Li-Fi, which is the latest technology that makes use of LED lights which helps in the transmission of data much faster, and flexible because of the durability, efficiency and high lifetime characteristics that make Li-Fi concept a better one. LED lights are nowadays widely used for their high efficiency. Visible light communication (VLC) is a type of wireless communication that uses visible light. Being a highly populated country like India and a lot of traffic problems, there is always a problem of manual traffic control whenever an ambulance arrives in a particular direction which is not effective. Automatic traffic control and uninterrupted traffic for fire extinguishers and an ambulance is highly necessary. The proposed system aims in using Li-Fi for the transmission of data through LED lights between two vehicles which helps in reducing road accidents and promotes safe driving.

II. LITERATURESURVEY

A. Introduction to indoor networking concepts and challenges inLiFi

Harald Haas, Liang Yin, Cheng Chen, Stefan Videv, Damian Parol, Enrique Poves, Hamada Alshaer, AND Mohamed SufyanIslim have told that the present results of a real-world use case where a Li-Fi network was deployed in a classroom in addition to a Wi-Fi network. The network topology consists of eight Li-Fiattocell Aps. The Li-Fiattocell APs coexist with two additional Wi-Fi APs that serve seven classrooms. The Wi-Fi APs are commercially available and based on the IEEE 802.11ac standard. Each Wi-Fi AP can support data rates between 300 and 867 Mbps, depending on the mode of operation and bandwidth. A commercially available Li-Fi system was deployed in a single classroom. Each Li-Fi AP can support a circular coverage area with diameters ranging between 2.8 and 3.5 m. The Li-Fi AP operates in full-duplex mode and supports multiuser access and Internet protocol handover between the deployed APs. Each Li-Fi AP can support a maximum of eight users with a maximum aggregate data rate of 43 Mbps. This corresponds to a total maximum aggregated data rate of 344 Mbps per classroom. We note that the data rate of an access point is significantly lower than the VLC transmission speeds reported in lab experiments.

The main reason is that this proof-of-concept system uses off-the-shelf unmodified LED luminaires whose electrical bandwidth is in the region of 2 MHz. The main purpose of this proof-of-concept demonstration in a real-world environment is to showcase the simultaneous functions of lighting and wireless networking using the same system. Future upgrades will include the integration of bespoke optical components within the luminaires leading to aggregate data performances of 1 and 10 Gbps. The latter will require bespoke luminaires, which are capable of wavelength division multiplexing. The Advantage of this system is its speed of communication.

B. What Is Li-Fi?

Harald Haas, Liang Yin, Yunlu Wang, Cheng Chen have explained in detail how to set up the LIFI system. Due to the increasing demand for wireless data communication, the available radio spectrum below 10 GHz (cm wave communication) has become insufficient. The wireless communication industry has responded to this challenge by considering the radio spectrum above 10 GHz (mm-wave communication). However, the higher frequencies, f, mean that the path loss, L, increases according to the Friis free space equation (L?f2).In addition, blockages and shadowing in terrestrial communication are more difficult to overcome at higher frequencies. Light-Fidelity (Li-Fi) is a continuation of the trend to move to higher frequencies in the electromagnetic spectrum. Specifically, Li-Fi could be classified as nm wave communication. Li-Fi uses light-emitting diodes (LEDs) for high-speed wireless communication, and speeds of over 3 Gb/s from a single micro-LED have been demonstrated using optimised direct current optical orthogonal frequency division multiplex in(DCO-OFDM) modulation. Li-Fi attocells are an additional network layer within the existing heterogeneous wireless networks, and they have zero interference from and add zero interference to the radio frequency (RF) counterparts such as femtocell networks. A Li-Fi attocell network uses the lighting system to provide fully networked (multiuser access and handover) wireless access. This paper provides some initial results of the downlink performance of a DCO-OFDM-based Li-Fiattocell network and compares its performance to the state-of-the-art RFfemtocell networks. Morethan15yearsof research in physical layer techniques for LED-based VLC has provided the fundamental solutions to develop Li-Fiattocell networks that are capable of achieving magnitudes of higher data rates per unit area compared with state-of-the-art RF small cell solutions. As an advantage, the performance has been increased.

C. A new approach to wireless data transmission using visiblelight

DeepaliJavale, Chinmay Atul Sashittal, Sujata Wakchaure, Ameya Milind Phadnis, Sahil Santosh Patil, Rohan Sanjay Shahane, This system consist of Arduino, photodiode, led, 16x2 LCD display. The system proposed in this paper has the potential to exploit the existing light sources available in the environment to form a robust network of communicating devices. This system demonstrates that it is possible to have a network setup based solely upon light. If the system is fully implemented, then every light source can be used as an access point to have the data communication facility. The system was tested under different scenarios to evaluate its performance of the system. The Advantage of this system is that it ensures efficient wireless communication.

D. Understanding Li-Fi Effect on LED light Quality

Evangelos Pikasisand Wasiuo. Popoola, The impact of Li-Fi on LED can be studied by implementing different Li-Fi modulation techniques and monitoring the resulting variations in the light quality metrics as reported in our earlier work. To achieve this, different Li-Fi modulation techniques have to be implemented first. This is process could belong costly and time-consuming. It is therefore desirable to develop a simple model/tool from which the impact of Li-Fi on the LED light Quality can be estimated. Such a model will provide a direct relationship between emitted light quality metrics and the LED's driving current. Since in Li-Fi, the LED's driving current is directly modulated, such a model will thus make it possible to accurately estimate: (1) the variations in emitted light Quality at any driving current, with any Li-Fi modulation technique and any modulating signal amplitude (i.e. modulation index).

(2) The maximum possible variation in the light quality metrics over the entire dynamic range of the LED. The changes in light Quality due to Li-Fi can then be compared with the industry standard to check if the resulting variations fall within the permissible range or not. This is vitally important in Understanding the impact of Li-Fi on LED light Quality and, by extension, the wellbeing of the users. To illustrate this framework, three different white LEDs (two samples each, making six altogether) will be considered. These illumination LEDs are: i) OSTAR –warm white LED from Osram, ii) OSW 430 I-cool white LED and iii)MoonstoneASMT-MY22-NMPOOwarm white LED. To improve reliability and prevent premature failure, adequate thermal management is implemented with an appropriate heat sink as recommended by the LED manufacturers. To obtain a current-light quality model, the CRI, CCT and chromaticity of each LED are measured with an optical spectrometer at different driving currents. For each measurement, at least 2000samples are recorded, and the mean of these samples is used as a data point in the transfer function plots.

E. An Indoor Wireless Visual Sensor Network basing on Light-Fidelity Communication

Afaf Mosaif Said Rakrak proposed an indoor WVSN system that uses Li-Fi technology for communication, then the process of this communication. They have proposed an indoor wireless communication that uses Li-Fi to transmit and receive image/video data collected from the node source (camera) to the Sink (Final user). As the disadvantage of Li-Fi is that it could be blocked by any obstacle in front of the source node, we suggest using camera nodes that could be hung in a ceiling. Each camera is equipped with a Li-Fi transceiver that allows communication with other nodes of the network. The Paper had proposed to use a double ceiling to allow the light passage without any obstacle and to use Optique fibres to transmit data across the walls. The double ceiling could be transparent if we need light for illumination, or it could be opaque to avoid disturbing the user by the light during the night, for example. By using visible light waves, the camera nodes can power themselves; they are equipped with transceivers that allow charging their batteries and transmit/receive Li-Fi data, such as the Wysips Connect receivers that transform any screen into a solar panel that can generate its own electric energy and send and/or receive data using light. Since this research focuses on the transmission of image/video information in WVSNs where the amount of visual data collected by sensors is huge. Sensors have to use compression to reduce the amount of data in order to effectively save storage memory spare energy and to fit the data on the available network bandwidth. For that, many video compressionstandardssuchasMPEG1,MPEG2,H.261, H.263, H.264/MPEG4, HEVC has been developed. H.264 is one of the lossy video compression methods for removing spatial and temporal redundancy. It provides a modest file size for longer recording, typically consists of the intra- and inter-mode, and is less complex than HEVC. Thus, H.264 has been chosen in this article as a video coding standard to compress the visual data collected by the nodes. The Advantage of this system is that it does not cause harm to human beings.

F. Navigation System using LightFidelity

Niharika Mishra, Monika Rai, RiyaMandal, HarjeetKaur have told that in the cities or towns of India, the average distance between any two street lights is approximately 30 to 50 m. The proposed system requires both the transmitter and the receiver to be in a line of sight for the data to transmit properly. The Car with the receiver will be under the street light for 1 or less than 1 second. And it will reach the next streetlight after 2 or 3 seconds. Hence, the image of the map will be displayed with better accuracy when the receiver is just under the streetlight. To keep the map displayed for a longer time, a delay of 2 s is introduced until the vehicle reaches the next street light. The LED street lights are not in use during the day; hence this system will be helpful during the nighttime. There might be other light sources from the nearby building which might interfere with the main source of data from the street light. The use of high intensity LED light sources is essential to get the correct map display. The maximum distance between the LED light source and receiver at which a proper map is received using the proposed system is 5.5 m when transmitted during the nighttime. The minimum distance between the street light and the various vehicles is estimated from table 1 to be in the range of 1 to 7.73 m. The maximum distance between the different vehicles and street lights is 3.5 to 10.1 m. the Advantage of this system is faster data communication.

G. The Lattice-An intelligent grid for connected car Industry

Kumar Ranjan says that The Lattice is a network of various communication nodes and sectors and a central server. The Lattice divides any region (city/state/country) into various sectors. These sectors are localized regions that are identified using the communication nodes around them. With our research, a sector can be formed by 4 such communication nodes. The important thing to note here is that the Lattice lies underneath the Internet. What this means is that the Lattice never connects to the Internet directly. Imagine it to be a big LAN network. This Ensures that it is safe from the threats of the Internet like hacking. Only the main server connects the Internet to share/communicate data on the Internet. Communication Nodes are local servers that act as intermediate data centres. All the units of a sector communicate to the node in its vicinity. These nodes then communicate to each other to transfer the data to the main server and communicate the decision to the node. These nodes communicate via the local IP given by the sever. Communication Vectors are the unique IP channels through which the data transfer occurs. They are direction-dependent. Out of the n sectors, we have chosen one sector and explained the dynamics of the sector. The outer blue box represents a sector, and each sector connects by a combination of communication nodes. To connect to the Lattice, any unit (vehicles, hospitals, traffic signals, tolls, etc.) must register on the grid with a device that will connect the unit in real-time to the grid. (this is how we begin to retrieve BIG DATA), The device can be procured by the RTO office, company, service stations or showrooms. The device comes as a DIY kit. Once it is plugged plugin, the AI monitors the Car and communicates with the grid depending on the situation. The AI (if the example of a traffic system is taken) will use cognitive traffic signals and signs to manage the traffic. This will also help the AI to learn different traffic scenarios which are unpredictable. The AI will communicate to the traffic police team based on the prediction of traffic jams and other conditions for assistance. The Lattice will

give live updates and feedback on everything happening to the connected vehicles and the units.

H. Smart Lighting: Intelligent and Weather Adaptive Lighting in Street Lights using IOT

Asis Kumar Tripathy, Alekha Kumar Mishra Tapan, Kumar Das Brilliant proposed that Street lights work on an arrangement of sensors that transmit information based upon the light level. The Master gadget (passage) handles all road lights in its encompassing region through correspondence. It passes the message to screen the status of all the slave gadgets, for example, exchanging ON/OFF at the opportune time. Singular Street light works in view of auto force control, i.e. when it identifies any protest or movement in that specific range, it naturally changes to 100% power. Else it works at a low force level. Every road light screens its usefulness and reports its blame, for example, light disappointment, control supply disappointment with important area data. It helps in fast recuperation. The innovation behind the smart ro a dlight idea can get so propelledthat the gained information can even be utilized to decide contamination in encompassing range, prelight life suggestion, well being issues around the street with cameras. The Advantage of this system is that it does not harm flora and fauna.

I. Audio multicast by visible light communication for location information for the visually impaired

E. B. Adoptante, Jr, K. D. Cadag, and V.Lualhati has proposed a smart device system where the recorded audio information is stored in Secured Data/Multimedia Memory Card(SD/MMC) and accessed by the microcontroller through the Serial Peripheral Interface (SPI)using SD/MMC shield. The 16 bits of code that the central device transmits will be checked at the end devices whether the code has its corresponding audio information in the look-up table. The corresponding bitstream per LED of different wavelengths will be measured based on the voltage levels. The ambient light will be measured to determine its voltage level to adjust the threshold value. The voltage levels that the external battery, the LED driver, and the photodiode driver are yielding will be measured to determine the specifications of the modem. The data is received and transmitted will be checked whether the Android application is yielding the same values as the serial monitor and whether the end device is responding to the command being sent. The group will conduct continuous transmissions for certain periods of time and will get the percentage error to determine the accuracy of the system. To test multicast communication, there will be continuous data transfers between the central and end devices, whether they will be able to receivedata simultaneously. To test efficiency, time will be measured when the two end devices were able to receive the information. Stop and Wait for protocol's acknowledgement used together with the group's own transmission protocol will be employed to test the synchronization. The response time of the receiver after the command was sent by the smart device will be observed to test the functionality of the Android application. The Accuracy and Reliability of the VLC system. The VLC system will undergo evaluation of 30 samples of different audio information duration at different scenarios, scenarios that will affect the VLC System. Distance of the Smart device from the LED. Number of Devices able to communicate with the VLC system Advances in Visible Light Communication. The application of VLC for this system is a one-to-many ratio of communication. Visible Light Communication. This system is a point-to-point communication with a smart device using modems. Design, Development And Performance Analysis of DSSS-based Transceiver for VLC. The transceiver used an FPGA and implemented DSSS instead of using the plain modem in this study.

J. A Performance Analysis of Light Fidelity and Internet of Things & Its Application

Jaina Patel, Pranati Trivedi, Drashti Patel said that As medical equipment connected with controller systems are capable of continuously monitoring a person physical state, in a health monitoring system, the patient will first be sent to the central unit (controller unit), and the data is collected. The data can be anything, a patient's blood pressure, his heart rate and body temperature, diabetic report etc. In the central unit (controller unit), records are maintained in a queue then this data is sent to the doctor with the help of LIFI. A controller receives the data, processes it and then sends it to IOT with the help of the Internet provided by the LIFI module. The IOT contains a Data Mining Unit, a Feedback Unit and a central database. The central database contains the entire patients' profile, continuous health data and a large set of rules for data mining operations. The Data Mining unit processes the data and provides feedback and results to the Feedback Unit. The feedback unit then sends the data to the corresponding controller unit. The access to these patients' records is only with the doctor and the nurse currently operating him; moreover, they can see data only when they have a valid id. This way, a patient's integrity is maintained. The Advantage of this is that the interfaces of the controller with LIFI and IOT are user friendly. People with little or no technical knowledge can use it without any difficulty.

K. Light Fidelity (Li-Fi) as An Alternative Data Transmission Medium in VANET Justice Owusu Agyemang1, Jerry John Kponyo Mouzna Joseph have proposed that the networked vehicle has embedded sensors which are coordinated by the Central Processing Unit(CPU) on the on-board unit of the vehicle. These sensors function to measure various parameters such as speed/acceleration, distance from neighbouring vehicles etc. Ambient

information gathered by the vehicle is transmitted to other nodes through a wireless medium. This creates a spontaneous network known as the Internet of Things (IoT) among the various vehicles communicating in the vehicular environment. With the evolution of the Internet of Things (IoT), in the case of vehicular networks, a fast communication channel will be needed. Such high-speed wireless connectivity can be achieved using Light Fidelity (Li-Fi) technology. Li- Fi technology uses visible light instead of radio waves as the medium of communication. Visible light communication (VLC) is a continuous data medium that uses visible light between 400 and 800THz(780-375nm). VLC is a subset of optical communication that uses fluorescent lamps(ordinary lamps, not special communication devices)to transmit signals at 10kbit/s or LEDs for up to 500Mbit/s. The Li-Fi technology can be adopted in vehicular networks to solve the problem of high data bandwidth needed for information exchange among the various nodes in the vehicular environment and other services such as infotainment. The Advantage of this system is the rate at which information travels Many systems are developed that uses lifi technology for communication.We can understand this from Table 1.

Table 1.

S.NO	Paper	Technique	Result	Issues
1	Introduction to indoor networking concepts and challenges in LiFi	LiFi, function, mobility support, and multiple access capability	This Paper has shown that it is possible to build future cellular systems based on free-spacelight communication.	It could not be used in larger organisations.
2	What Is Li-Fi?	Li-Fi, IOT	This Paper tells us how to set up efficient Li-Fi communication.	Limited Range
3	A new approach to wireless data transmission using visible light	Light-Fidelity (Li-Fi), Internet of things, Computer-communication networks, Local Area Network (LAN)	This system has 2 versions, 1st version using only Arduino and the 2nd version using python on pc interacting with Arduino, 1st version is slower than the 2nd version, and 1st version's range is smaller than 2nd version, so 2nd version is better than1st version.	In both versions, the range is limited, so we cannot communicate with the vehicles which are in the longer range.
4	Understanding LiFi Effect on LED light quality	Light quality, modulation techniques, LiFi, visible light communications, LEDlighting.	The inter-relationship between the driving current and the emitted light quality of an LED is presented. This model offers an opportunity to estimate the expected changes in light Quality due to any kind of LiFi modulation technique.	Limited Range.
5	An Indoor Wireless Visual Sensor Network based on Light-Fidelity Communication.	Wireless Visual Sensor Networks; Visible Light Communication; Light-Fidelity; Wireless communication; Multimedia transmission.	This paper presents an indoor Wireless Visual Sensor Network that uses Li-Fi technology as a cheap, secure, high bit rate and energy-efficient medium of wireless communication, which is not achieved by Radiofrequency technologies such as WiFi.	It is suitable Only for indoor applications

6	Navigation System using Light Fidelity	LED, Light fidelity, wireless communication, photodetector, data transmission	The transmission of the proper image of the map using the proposed system depends highly on the light source intensity and the distance between the transmitter and receiver. Another factor that affects the proper transmission is the type of LED light source used in the system. The transmitter and the channel have been tested, and the results vary as the distance between the streetlights and the vehicle increase and with the presence of any obstacle between the two. The delay needs to be varied according to the distance between any two street lights for proper image display. The implementation of this system would help drivers navigate, especially at night. It can act as a useful resource.	Limited range.
7	The Lattice- An intelligent grid for the connected car Industry	Connected Car, capitalism, sync, governments, Lattice, unanimous network, machine learning, share resources.	This is oriented toward simulating the Lattice and integrating it with the current infrastructure and the GRID.	Limited range
8	Smart Lighting: Intelligent and Weather Adaptive Lighting in Street Lights using IOT	Lighting;Wweather adaptive; IOT; Sensors	With the developing innovation and expanding utilization of the web administrations, potential outcomes are high that utilization of this innovation will be soon practically speaking. Each knob will be supplanted by brilliant globules and may be used as a wifi hotspot for the transmission of information. Utilizing wi-fi innovation will give a cleaner, greener and brighter future and	As light is all over and allowed to make use of conceivable outcome increments, as it were, of the utilization of wi-fi innovation

			Condition. The idea of wi-fi lights is spreading so quick as it is anything but difficult to utilize. It is drawing in the enthusiasm of individuals. The utilization of wi-fi innovation gives an extremely brilliant chance to supplant or to offer a contrasting option to the radio-based remote advances. As light is all over and allowed to make use of conceivable outcome increments, as it were, of the utilization of wi-fi innovation.	
9	Audio multicast by visible light communication for location information for the visually impaired	Light Emitting Diode (LED), Light Fidelity (Lifi), On-Off Keying (OOK), Visible Light Communication (VLC)	The central device is able to transmit using LED as the communication medium to two end devices simultaneously. The end devices can receive the information successful after being placed 1 meter below the central device. The system is also able to function in both dark and bright lighting environments.	Needs an initialization for the process to start
10	A Performance Analysis of Light Fidelity and Internet of Things & Its Application	Performance analysis, light fidelity, diseases , LIFI, IOT, fast connectivity, noninterfering connectivity, cloud computing , data analysis	By using this system, we can easily send the big size of data to doctors about their patients so the doctor can easily monitor the patient's health	-
11	Light Fidelity(LiFi) as An Alternative Data Transmission Medium in VANET	VANET, LiFi, ITS, DSRC, OBU, RSU, IoT	With the help of LIFI, we can communicate with the vehicles which are in the specific location	Needs an initialization for the process to start

III. CONCLUSION AND FUTURE WORK

This system uses Li-Fi technology which includes many sensors such as MQ3, vibration sensor, ultrasonic sensor, PC camera along with an Arduino board, LED light and a solar panel to communicate from one vehicle to another. This system proposes a solution to minimize road accidents, and in the future, it can ensure safety to the drivers along with co-passengers by integrating this system very where.

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