International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-5, January 2020

Design and Implementation of MPVLC Li-Fi Model for End-To-End Wireless Data Transmission

A. Gayathri, S. Mohanapriya

Abstract*: *Li-Fi system is a recent and brilliant technology which is utilized visible light as a medium for multimedia data transmission. In Li-Fi communication system, transfers data in the form of light signals as an alternative of Wi-Fi. The Li-Fi technology supports transmission of multimedia data in the way of light particles by sending the multimedia data via LED bulbs that make changes in faster transmission. The Li-Fi with hardware and software model creation with many parameters that must be considered while implementing a Li-Fi based transmission system prototype which is high data rate, distance and the LOS. These parameters are taken for major component when modelling a Light Fidelity system. The main problems in the implementation of an improved data rate at low network coverage and powerless location multi point VLC system and solar component are the range and cost effective model. The VLC source component and destination component must be compatible for high data rate. The conventional lighting technique in communication feels from intrusion and maximum delay possibilities. Solution for the above light based transmission problems in implementation; VLC is a preferred communication model because of its maximum throughput and secure transmission from light particles. The proposed Multi Point Visible Light Communication Li-Fi model provides high-speed communication to achieve better capacity, efficiency, and availability at low network coverage than existing lighting technology.

Keywords*: *Li-Fi, LED, Solar Panel, Wireless, Multimedia Data, PC, Mobile.

I. INTRODUCTION

The Visible Light Communications is always progress the communication by light source. It sends the data via the LED bulbs is obtained by having the light as a communication medium from the Li-Fi model to represent a logic signal rate respectively [1]. A receiver device either connected with solar panel, photodiodes, camera will detect the data fetching from the transmitter device and will connect the frequency [2]. When the destination identifies the light particles, it is activated as value as "1" and when it knows not activated the light at all from the source part, it is activated as a value "0" [3]. By using the light state as activate and deactivate, the source can pass 0's and 1's.

This is the easiest model that linearly used for wireless transmission. The different levels of light colors between activate and deactivate state open for passing high data rate information. Visible light communication motivated by much advancement including immunity to challenge with earlier communication systems, for huge unregulated bandwidth (THz) [4]. Visible Light model due to its short range communication can be utilized to eliminate data traffic and signal malicious in next generation networks. VLC is a part of wireless communication that can be allowed to solve huge communication problems [5].

Visible Light Communication is pointed as an effective target option for next generation wireless communications network and it is attain the improving focus in the last years [6]. VLC is a modern technology which takes entire advancement of Light Emitting Diodes for the multipurpose of illumination and data communications at very faster. VLC is a good light energy source and green technology with the effective sense to recreate models to solve the problem near future benefits. It is capable to provide solutions for several applications including wireless local area, personal area, and heterogeneous networks, indoor localization and navigation, vehicular networks, providing an amount of data size from a $5x10^2$ Mbps to $10x10^2$ Gbps [7]. Li-Fi is a part of VLC that exhibits high-speed, bidirectional, fully networked communications for fast transmission.

When comparing VLC with RF communication, VLC has number of advantages over RF technologies in term of bandwidth, VLC has 400 THz unlicensed band for communication where RF has limited and regulated bandwidth ≈300 GHz [8]. Another advantage of VLC is the low implementation cost and low power consumption due to the advancement of LED light bulbs that is used for both data communication and illumination where RF requires its own base station which consumes more power. As a result, LEDs incoming light can be detected using different types of receivers such as image sensors which make it possible to detect light-wave carrying data from the transmitter [9].

Manuscript received on January 02, 2020.
Revised Manuscript received on January 15, 2020.
Manuscript published on January 30, 2020.
* Correspondence Author
A. Gayathri*, Department of Computer Science, Vivekanandha College of Arts and Sciences for Women, Tamil Nadu, India.
Email: gayathriragul2005@gmail.com
Dr. S. Mohanapriya, Department of computer science, K.S.R College of Arts and Science for Women, Tiruchengode, Tamil Nadu, India.

II. LITERATURE REVIEW

A. Submission of the paper

The light emitting diode which provides high modulation bandwidth for communication purposes as well as illumination.

LEDs have been used in different applications, such as traffic lights, street lighting, automotive headlamps and many others. In addition, legislations on the sustainable and efficient use of energy has increased the usage of LED lamps and is expected to reduce their price to much less than the current price of fluorescent light bulbs [10]. This will create a suitable place to change the inefficient light bulbs with LEDs, which in turn will create an excellent environment to implement VLC everywhere. The combination of lighting and communication infrastructure can be cost efficient and consume less energy compared to the conventional lighting, where communication and lighting are used separately [11].

The VLC shows the basic usage of LED as a transmitter and CAMERA as a receiver. In this model, they fixed a camera before the front end of the car. The camera is used as the information receiver from traffic signal lights. The advantage of using the camera is that multiple data can be transmitted by the LEDs and received by High-speed cameras [12]. Although a lot of various development over Li-Fi technology but still some limitation are presence. In term of security, VLC cannot penetrate a wall which makes it impossible for eavesdroppers to pick up the signal from outside the room where RF is known to provide connection through components.

III. PROPOSED MPVLC LI-FI MODEL

In proposed Li-Fi model, the data rate is increased by incorporated with tri-color LED such as Red, Green, and Blue to enhance the light frequency range at the low network location. However, in our implementation model the successful transmission for outdoor can only concatenated on the last node of the system. The audio data is passed faster and the accessed process is able to convert the accessed signal send back into accurate form due to light source in the ADC's of the microcontroller. Sampling errors accumulated to the point until it can filtered by the down sampling error rectifying method, resulting in throughput with minute error rate.

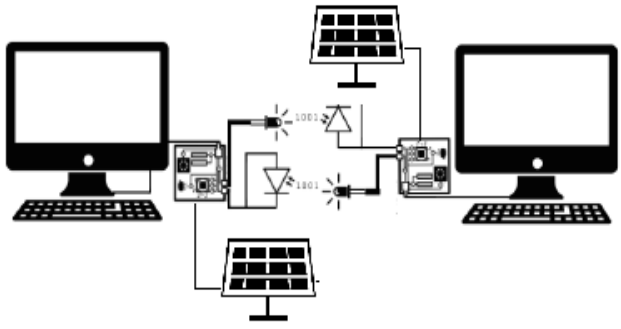

Fig. 1. System Design of MPVLC Li-Fi Model

The major components of proposed Li-Fi Model transmitter and receiver side as follows:

- PC / Mobile
- Auxiliary Cable
- LED Array / Photo Diode
- Resistor
- Battery
- PCB Board
- Solar Panel
- Socket Cable

In this, the motivated goal of the color LEDs in the MPVLC model is to generate light to be used to pass multimedia data. LEDs progresses the passing accurate data by turning on frequency with logic activate and turning off which represents logic deactivate. The successful score obtaining through our approaches, here needed to make sure that the Multi-color LEDs have selected the bright and may twist to a high bandwidth. Without LEDs capable of those scopes, the transmitting distance and data rate taken for long range.

Any of the features must have the importance of relationship for its next features. The most involved feature is the response time. The photodiode in MPVLC model was capable of detecting the light of the LEDs fast enough, and then it would be capable of meeting our design requirements. The photodiode device is active as faster to each data block is transferred. This means to a response time is lower than 10 Nano seconds is considered as very feasible response time. By this feasible response time, the device can obtain greater frequency rates. The communication speed is 1 MHz, the end point is must to monitor and stored for each bit. The transistor can connect as an external power terminal to the variety color LEDs progressively having the board controller route the LEDs directly.

In this model, the battery is used for generate extra power to the communication device. The source end point used a various capable batteries, that is too often supplying 15-20V to the N LEDs. The need of maximum required power is used for the both communication end points to confirm the LED bulbs fetched the required power to pass accurately. A best effect of using batteries is to allow the maximum power to pass the signal to flow around without relying on a continuous power supply unit.

Designing and creating a MPVLC System, a number of rules and steps are constrained. Using previous design as a sample, this MPVLC model with some additional components for this proposed design. The progress of component selection can be repeated as needed for every additional component that wants to be added. Once the initial resources are participated, the hardware board for both the source end and destination end are modeled and tested in appropriated simulations by the MATLAB tool. After the testing phase, the researcher can order the resources, then made the model, and test the hardware boards. The hardware boards are connect to function linearly at the time of receiving frequency, the proper component connected to their responsive board controller, which offers connections to the PC or other devices, and the digital light particles of this model is to addressed. Finally, the resource for the proposed design cost is very feasible financial solution.

IV. EXPERIMENT RESULTS

The transmission process consists two way of computing codes needed to implement the model. One way is shell script to communicate via the hardware system of MPVLC Li-Fi model. Another way is used to send and receive the multimedia data as a 0's and 1's bit of information.

The shell script method is implemented for the MCU system using so that it take the responsibility of transmission progress between source and destination port line. The Matlab tool is used develop the code to read in information from the MCU device by using receiver end port point, and then perform related frequency analysis process, the data encrypted data is converted into an original information at the receiver end point.

Table-I: Comparison of Existing Li-Fi Model and Proposed MPVLC Li-Fi Model

Parameters	Existing Li-Fi Model	Proposed MPVLC Li-Fi Model
Capacity	White Light only	Multi-Color Visible Light Possible
Efficiency	One LED or LED Array	One LED or LED Array or Multi-color LED Array
Availability	Indoor	Indoor and Outdoor
Topology	Point - to - point	Point - to - Multi Point
Communication	VLC	MPVLC
Power Consumption	less	Less
Network Coverage	High Network	Low Network
Action in Power State	ON	OFF
Range	100Gbps	>100Gbps

The data block is send to 24 character information into an encrypted form as 0s and 1s for outdoor validating with testing small size of lighting particles completely.

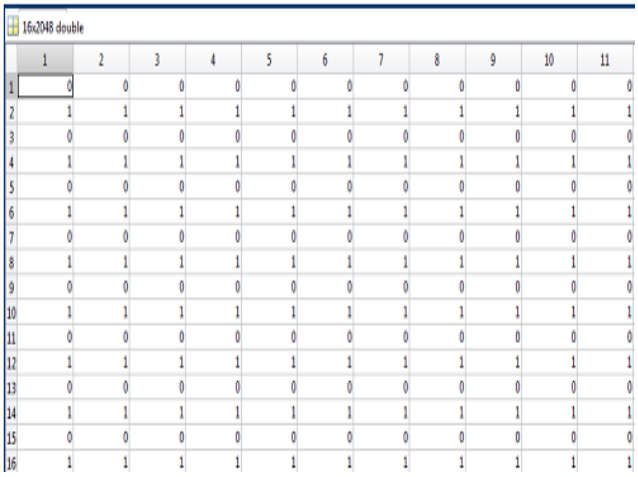

Fig. 2. Encrypted Transmitted Data

The distance point between S-Node and D-Node must comprises with minimum limit as 10 m from one node to another intermediate node while processing data rate from 200 Giga bits per second. The data is transmitted to a computer and the computer is used to encode as a file and then decoded by using MATLAB tool for safe transmission.

Table- II: Speed and Distance Measurement

Transmission Distance	10 meter
Transmission Frequency	10GHz
Transmission Data rate	100Gbps
Transmission	Text / Audio File / Image

The A large number of different types of data are used to obtain the required target of the MATLAB tool. In the transmitter end, the serial port connection is required to implemented by configure the hardware system to the MATLAB and same process can be carried out for receiver end. The configuration of the serial port connection of the transmitter end is same as the receiver end, the Input Memory Space parameter is developed to confirm the storage space to store the multivariate data that is planning for what data next to be transferred to the device from the control unit other choice of the Output Memory Space variable. The shell script is waiting for a small size of initial data sequence known as preamble. The data sequence pattern of zeros and ones is picked up for the validation of mismatch of its presents in varies of data format. The visible particle is received perfectly with less or no errors to prove and finally it is achieved successful transmission.

V. CONCLUSION

Li-Fi can be termed as the solution to low radio bandwidths. Li-Fi can be the replacement of next generation wireless communication networks and can be used as the primary benefit of data transfer in all the existing as well as the upcoming technological development.

In recent years, faster indoor networks using LEDs have been identified with advantages in low power consumption, high adjustable frequency, and data safety. The research is still hold some development issues for future indoor and outdoor networks, for this reason visible light communications are attractive. In this research work, by using MPVLC Li-Fi model, The speed and range of transmission were both achieved with high computation power, when the communication of a multimedia data with low network coverage, long distance point and low power.

REFERENCES

1. Cisco, "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2013 – 2018", Whitepaper, Feb 2014.
2. D. Tsoney, Hyunchae Chun, and S. Raibhandari, "A3-Gb/s Single LED OFDM-Based Wireless VLC Link using a Gallium Nitrideu LED", Photonics Technology Letters, IEEE, Vol.26, No.7, PP.637-640, Apr 2014.
3. A. Aldalbahi, M. Rahaim, and A. Khreishah, "Visible Light Communication Module: An Open Source Extension to the NS3 Network Simulator with real System Validation", IEEE Access, Vol.5, 2017.
4. Y. Chen, C. W. Ho, and W. S. Wong, "Ber Analysis for Interfering Visible Light Communication Systems", International Symposium on Communication Systems, Networks and Digital Signal Processing, IEEE, PP.1-6, 2016.
5. Ghassemlooy, L. N. Alves, and Zvanovec, "Visible Light Communications: Theory and Applications", CRC Press, 2017.
6. M. Rahaim and T. D. Little, "Optical Interference Analysis in Visible Light Communication Networks", International Conference on Communication Workshop, IEEE, PP. 1410-1415, 2015.
7. M. Rahaim and T. D. Little, "Interference in Optical Wireless Communication Networks", Journal of Optical Communication and Networking, IEEE, Vol.9, PP.D51-D63, 2017.
8. C. V.N, "Global Mobile Data Traffic Forecast Update, 2015-2020", Whitepaper, 2016.
9. M. Ayyash, H. Elgala, and A. Khreishah, "Coexistence of Wi-Fi and Li-Fi toward 5G: Concepts, Opportunities and Challenges", IEEECommunications Magazine, Vol.54, N0.2, PP.64-71, 2016.
10. P. Lou, H. Zhang, and X. Zhang, "Fundamental Analysis for Indoor Visible Light, Positioning System", International Conference on Communications in China Workshops, Beijing, IEEE, PP.59-63, 2012.
11. Yingjie He, Liwei Ding, and Yuxian Gong, "Real Time Audio and Video Transmission System based on Visible Light Communication", Journal of Optics and Photonics, Vol.3, N0.2B, PP.153-157, June 2013.
12. F. Mousa et al, "Investigation of Data Encryption Impact on Broadcasting Visible Light Communications", International Symposium on Communication Systems, Networks and Digital Sign, Manchester, PP.390-394, July 2014.
13. Y. H. Kim, W. A. Cahyadi and Y. H. Chung, "Experimental Demonstration of LED based Vehicle to Vehicle Communication under Atmospheric Turbulence", International Conference on Information and Communication Technology Convergence, Jeju, PP.1143-1145, 2015.
14. M. Beshr, C. Michie and I. Andonoyic, "Evaluation of Visible Light Communication System Performance in the Presence of Sunlight Irradiance", International Conference on Transparent Optical Networks, Budapest, PP.1-4, July 2015.
15. Y. Liu et al, "Light Encryption Scheme using Light Emitting Diode and Camera Image Sensor", Journal of IEEE Photonics, Vol.8, No.1, PP.1-7, Feb 2016.

AUTHORS PROFILE

Mrs. A. Gayathri received Master Degree in M.Sc. Computer Science, in 2001 & 2005 respectively under Periyar University, Salem and Bachelor degree in B.Sc Computer Science in 2009 Madras University. Currently she is pursuing part time Ph.D in the department of computer science under Periyar University. She is also working as the Assistant Professor in the computer science department in Vivekanandha College of Arts and Sciences for Women, Elayampalayam. Her area of interest is mobile computing and networks.

Dr. S. Mohanapriya, MCA, M.Phil., Ph.D., SET, Associate Professor, Department of B.Sc. Computer Science, K.S.R. College of Arts and Science for Women, Tiruchengode, her area of interest is mobile computing and computer networks. Her experience is more than 17 years. Various awards from various organizing bodies are National Level "Young Women Scientist" Award by Dr. Kalam Educational Trust for Tribal, Chennai on 15.10.2019, "Certificate of Appreciation" – Teacher Innovation Award by Sri Aurobindo Society, and "Perasiriyar Kalaimani Award" on the title "The Contribution of Teacher in Social Development" in National Competion conducted by Kaviyarasar Kalai TamilSangam, velur, Namakkal (D.T) on 20.10.2019. Books are published DBMS book under Charulatha publications, December 2018. Organized various National Level Conferences, Technical Symposium, Workshops and Seminars. She is the reviewer in more than 3 journals. She got fund for Organized ICMR Sponsored National Level Seminar on Big Data Analytics with Apache SPARK 2017 on 8th September 2017. She published 17 International Journals, 2 National Journals.