Integrated Light Fidelity (LiFi) for Smart Communication

C. Subashini*, K. Yamini** and R. Mahendran***

ABSTRACT

"Light Fidelity"(LiFi) is the impending technology which has greater impact in future. LiFi is a transmission of data through illumination, in which data can be sent through a LED light bulb that varies in intensity faster than human eye can follow. This sort of communication is called as Visible light communication (VLC).visible light technology (VLC) is being researched. So it can be used eventually used for common communication systems. LEDs' ability to transfer information signals over light (light which varies in frequency between 400THz to 800THz and whose wavelength is between 400nm to 700nm) providing a very good communication medium. Using this technique, the user can transmit the data through light from one device to another. The light which we are using in our daily life is not only used for providing light but also for communication by illumination. Transmission of image through LiFi technology is done. Using visible light for data transmission including many advantages and eliminates the disadvantages of transmission of data through electromagnetic waves.

Keywords: LIFI, VLC, LED, DMT, RS232, PLC

1. INTRODUCTION

"Light Fidelity"(LiFi) is the progressive mode of communication where data can be transmitted over light so that it can reach the receiver. The idea of using visible light for data transmission is not adequately new. Several thousand years back smoke signals are used to transfer messages goes and was used by many different cultures, e.g. Native Americans. Light houses are enumerated to help ships maneuver through dangerous coastal areas by sending out visible beams of light in intermittent intervals. The Pharos of Alexandria was arguably the first tower which was served as lighthouse and was one of the Seven Wonders of the World. Its construction dates back to 300 BC. Scottish scientist identified visible light for transmitting data. Inventor Alexander Graham Bell who is credited for his invention of other devices like photo phone. The photo phone was a device that is used to transmit data on sunlight rays and it was built fully in the year of February 1880 by Bell and his assistant Charles Tainter.

Visible light used for data transmission includes many advantages and eliminates the disadvantages of transmission of data through electromagnetic waves. For instance, few known visible light causes health hazards today, exposure of this light to a saturated limited extend provides safer health. It uses same 802.11 protocols for communication. It can be used in aircraft basins, nuclear power plants. It has no limitations on capacity and it is ten times cheaper than WiFi. On combining the penetration of HB-LED's in our daily life style, and IR wireless communications.VLC presents itself acts a beneficial technology for the future wireless communications. It is a ubiquitous technology, generating no interference and secured communication to human life and it seems to be the future technology.

In this paper, Image transmission between two devices is done by using the medium of visible light in electromagnetic spectrum. It is always a efficient technology providing greater speeds for communication.

*   Associate Professor, Dept. of EEE, S.A. Engineering College, Email: subashini200235617@yahoo.co.in.

**   Assistant Professor, Dept. of EEE, S.A. Engineering College, Email: yaminik@saec.ac.in.

***   Post Graduate, Dept. of EEE, S.A. Engineering College, Email: mahendranr93@gmail.com.

In LiFi transmission of image works based on a simple technology. When LED light is ON digital data bit stream of 1is transmitted. When LED light turns off, digital bit stream of 0 is transmitted. Based on this simple technique image transmission was done through visible light communication.

The inconvenience in existing method is that, existing system provides,

- High radiated radio waves is used for data communication between two devices.
- Unsecured data transmission is available here, even though, wps key encryption can be provided, it can also be hacked in many ways.
- It also provides damage to your health as its radio wave transmission.
- Interference of signals
- Use of external cables is strictly avoided
- High cost and time consuming.

The proposed system will overcome these disadvantages,

- No interference on radio frequency signals as this communication totally depends on light.
- It is based on a simple technique of illumination cum communication.
- When compared to other medium of communication, data speed of this LIFI is extremely fast.
- Since the communication is based on visible light which is the most used part in electromagnetic spectrum for communication.
- As, data transmitted through light so health problems will takes place.

2. LITERATURE REVIEW

In this communication, visible light is used as the medium for data transmission. Here, LED bulbs behaves as a source and medium for communication is light and photo detector at the receiver behaves as a receiving component. Visible light communication can provide data rate of 100mbps. One of the greatest advantage is that it doesn't cause any harm to RF based devices as it has no interference. Light emitting diodes(LED) flashes light at speed. Visible light communication uses white coloured led for communication. Data transmission on visible light incurs many advantages and eliminates more drawbacks when compared to data communication through radio waves. This visible light communication is used in hospitals, electromagnetic interference sensible locations and space stations.vlc presents itself as a promising technology for future indoor and outdoor lighting scenarios. finally VLC seems to be an alternative for radio frequency signals[1].

The reliable data transmission takes place through light emitting diodes whose size seems to be comparatively small. The confinement of wifi is only for small distance and more devices will be connecting day by day which leads to heavy traffic as signals are being clogged up. Such that, LiFi technology came into existence with greater benefit in military, navy and research organisations. The main important role of LiFi is to provide security as wifi password can be hacked and it can be accessed easily and this is not possible in case of LiFi as data transmission is through light, only the persons inside room can access internet and others cant gain access through internet due to opacity of walls. this secured data transmission seems to be a main important property[2].

For data to be transmitted, determining the characteristics of the communication channel over any medium is necessary. For low-rate, control purpose communication. Power line channel has been considered as a medium and also for data communication in high speed, such as networking in home and Internet

access. In order to implement advanced communication technologies, the complete knowledge of the broadband power line channel is required. As its generally much larger interference and noise at high levels. By knowing complete characteristics of broadband PLC channel is important when implementing advanced communication systems can be done properly by using discrete multi-tone modulation (DMT) for channel capacity maximization[3].

White LED's are used for indoor wireless networks for communication. These equipments should have capacity of wireless optical communication. The medium of communication is visible light. The communication throughout the whole room is provided by high power lighting equipment. This is often easy to install and low in terms of cost. However, arrangement of lighting device is fixed over the white ceiling. So, it is difficult to install new communication cable between pc and LED or among LED lightings. On the other hands, power line communication make it possible to use electricity for this medium of communication in Power line channel each terminal connected to power line can communicate[4].

LED lights are selected as a perfect choice, because they can flicker instantaneously which is enough to transmit a meaningful amount of data and for illumination purposes it is widely used [5].

3. SYSTEM MODEL

The block diagram for LiFi communication includes personal computer (PC), RS232 level shifter, data modulation unit which consists of microcontroller to modulate data, LED array, photo diode and demodulation unit.
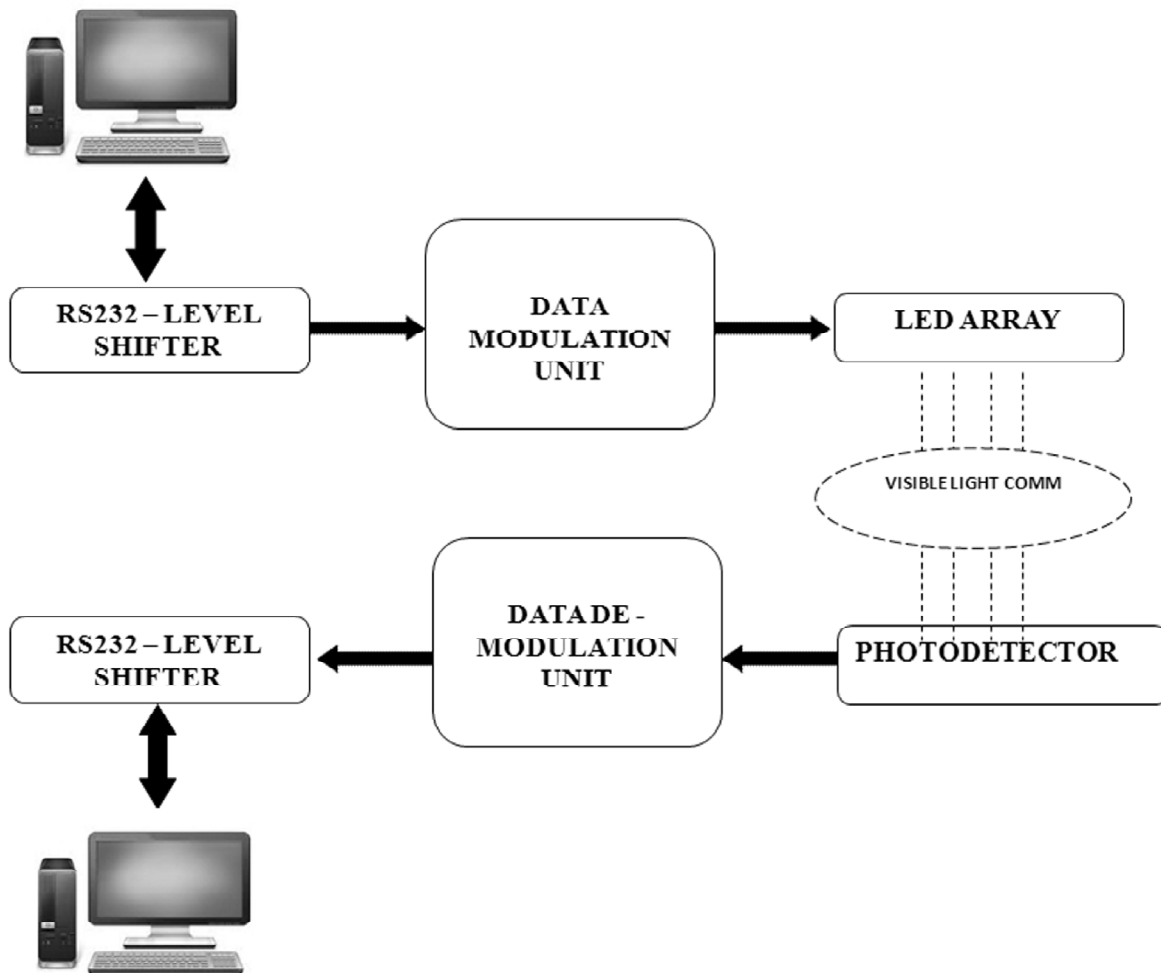

Figure 1: Block Diagram for LiFi data transmission between two devices

3.1. Transmitter

As image can be transmitted between two devices a serial port cable should be there for serial communication. Recommended Standard 232(RS232) is used for this type of communication where data can be transmitted bit by bit over long distances. This was widely used communication for data transmission. A system with mat lab software was interfaced with data modulation unit through RS 232 level shifter. Level shifter shifts from one voltage to the other. As LED Lights should OFF and ON to transmit data which is not visible to our human eye. So fast switching should be required for efficient transmission of 0s and 1s this was made by pulse width modulation technique. According to the data provided microcontroller will modulate signals using PWM technique and convert it to digital form to serve as a input value for LED array, which is the sequence of led lights. This current is known as biased current which led into led array unit. The microcontroller which used here is ARM microcontroller. This microcontroller had inbuilt capture, compare, Pulse width modulation and Analog to digital convertor which makes it easy to use. Such that image get modulated in the form of 0s and 1s through pulse width modulation technique. A pulse waveform $f(t)$ with period T, low value y_{min} a high value y_{max} and a duty cycle D.

$$\bar{y} = \frac{1}{T}\int_{o}^{T} f(t)dt.$$

3.2. Li Fi communication

The Digital data of 1s and 0s were passed by alternative switching of LED bulb lights through visible light communication.LED light flickers because of this alternate input of 0s and 1s anyway it cannot be visible to human eye. This light from series of LED lights can be used as main source and data for communication which was in the form of light. This light acted as a light in visible light of electromagnetic spectrum which in turn acted as a medium for communication.

3.3. Receiver

Data from led light array was transmitted through visible light and captured by photo detector and this diode converts light signals into electrical signals and then demodulated by data demodulation unit and is filtered to get required appropriate output on the receiver side of personal computer(PC).The final voltage signal should correspond to the received light pulses which are then decoded in the final decoder block, thus extracting the digital data.

4.   RESULT AND DISCUSSION

4.1. Mat lab Simulation

In this simulation, separate transmitter and receiver program for image transmission is programmed using mat lab. This includes executing the transmitter program at the sender side and choosing an image and transmit it to receiver side .a notification dialog box will be seen indicating image is transmitted and on receiver side dialog box will appear on receiving pc indicating image is received. In this transmission and reception of images can be done in high speed .In this way, more images can be sent one by one continuously.

4.2. Transmitter part simulation.

In transmitter part the image is said to be transmitter with a dialog box "image is transmitted".

4.3. Receiver part simulation

At the receiver side, Image is said to be received with a dialog box "image is received".

The goal of receiving part is to receive the image that is transmitted from the transmitted successfully.
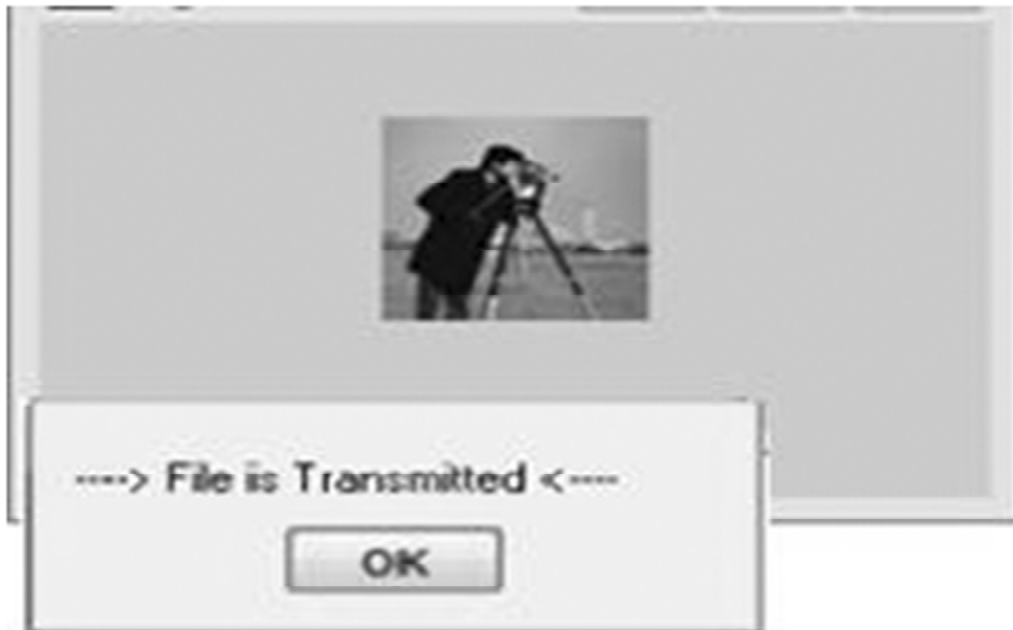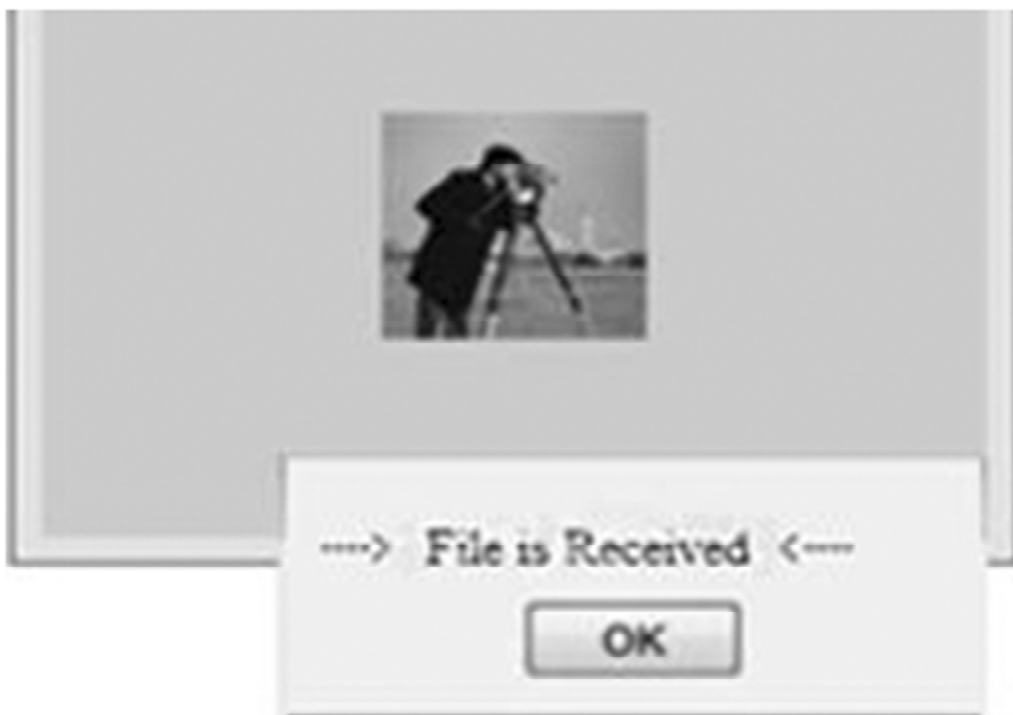
Figure 2: Image is transmitted.

Figure 3: Image is received

5. CONCLUSION

This technology is still under research and surely it will be a breakthrough in communication .It assures data speed of 100gbps which is entirely greater than radio waves. As I transmitted an image through this LiFi technology. The scope of this LiFi technology is marvelous. The main goal of this paper is LiFi provides secured, low cost, easy data transmission and provides reliable communication. It can also be used in industrial, medical, military applications. LiFi technology is still in its starting stages, but improvements in technology are made faster and very shortly this technology will be able to be used in our daily lives. It is intended that this research is providing the further steps for communication study. VLC will become one of the most promising technologies for the future generation in optical wireless communication

REFFERENCES

[1] Krishna Prasad Pujapanda," LiFi Integrated to Power-lines for Smart Illumination cum Communication" IEEE Communications and network technologies, 2013.

[2] "Li-Fi (Light fidelity)-LED Based Alternative International Journal of Scientific & Engineering Research", Volume 4, Issue 5, May-2013.

[3] Ji-Hun Yun, Geun-Bin Hong, and Yong-kab Kim, "A Study on Realization of Visible Light Communication System for Power Line Communication" Using 8-bit Microcontroller Received July 27, 2010; Revised August 18, 2010; Accepted September 15, 2010.

[4] Sivao shavo "An indoor hybrid wifi-vlc internet access system" IEEE transactions on mobile adhoc and sensor systems pp. 569-574, 28-30 Oct. 2014.

[5] T. Hara, S. Iwasaki, T. Yendo, T. Fujji, and M. Tanimoto, "A New Receiving System of Visible Light Communication for ITS", in Proc. IEEE IVS'07, June 2007, Istanbul Turkey. pp. 474-479.

[6] F.J. Lopez Hernandez, "Low-Cost Diffuse Wireless Optical Communication System based on White LED", in Proc.IEEE ISCE'06, Sept. 2006, St. Peterburg, Russia, pp. 1-4.

[7] Muhammad Saadi, Paramin Sangwongngam, "Global Efforts in Realizing Visible Light Communication Systems and its comparison with other Short Range Wireless Communication Networks", et al. NTBC end year conference 2011, December 15-16-2011.

[8] Kwonhyung Lee, John Barry, "Indoor Channel Characteristics for Visible Light Communication", IEEE Communications Letters, 2011.

[9] Y. Yang, X. Chen, L. Zhu, B. Liu, and H. Chen, "Design of Indoor Wireless Communication System Using LEDs", in Proc. IEEE ACP'09, Nov. 2009, Shanghai, China, pp. 1-2.

[10] D. Giustiniano, N. Tippenhaur, and S. Mangold, "Low-complexity Visible Light Networking with LED-to-LED Communication", IFIP Wireless Days 2012, Nov. 2012.

[11] D.C.O' Brien, "Indoor optical wireless communications: recent developments and future challenges," in Free-space Laser Communication IX, San Diego, CA, USA, 2009, pp. 74640b-12.

[12] Y. Tanaka et al., "Indoor Visible Light Data Transmission System Utilizing White LED Lights" IEICE Trans. Commun., vol. E86-B, no. 8, Aug. 2003, pp. 2440-54.

[13] D.C.O', Brien et "Visible light communications: challenges and possibilities" al in Proc, IEEE PIMRC 2008, pp. 1-5, 2008.

[14] Suresh A., "ASN gateway relocation for fast handoff in mobile Wimax networks", International journal of applied engineering research, Vol. 10, no. 17(2015), pp. 12984-12987.