Li-Fi: The Future Technology

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Abstract— *Li-Fi is a wireless technology which provides the connectivity within large area network. The main objective of this technology is we can transmit the data using light illumination using light emitting diodes and radio frequency is used in Wi-Fi and LED bulb light intensity is faster than human eye that cannot follow. One germen phycist-Prof Harald Haas an expert in optical wireless communications at the University of Edinburgh, he demonstrated how an LED bulb equipped with signal processing technology could stream a high-definition video to a computer. By using this technology a 1 watt LED light bulb would be enough to provide net connectivity to more than one computers. This technology termed as "light fidelity". This technology provides transfer data more securely with higher data rates and high speed and high intensity. This technology is still under research and further exploitation could lead to wide applications.*

Keywords— Wireless, Li-Fi, Wi-Fi, LED, VLC.

I. AIM AND OBJECTIVE

The main objective of this paper is to present VLC concept through Li-Fi.

This paper also present the concept of connectivity of the network using Li-Fi through which we can communicate with other user which is based on LED blub.

II. INTRODUCTION

Now a days Wi-Fi is more used in all the areas such as offices, homes, school, hotels, colleges. Due to this radio frequency is getting blocked gradually; simultaneously usage of wireless data is increasing exponentially every year. Each person is wanted to use wireless data but the capacity is going down. Wireless radio frequencies are increasing day by day, complexities are rising and RF interferences keep on growing also day by day. In turn to overcome this difficulty in future, light fidelity (Li-Fi) technology came into existence since year 2011. This technology is a wireless communication technology in which light is used as a carrier signal in place of RF. Li-Fi is a technology that uses light emitting diodes to transmit data to a sender . Visible light communication (VLC) uses rapid pulses of light to transmit data wirelessly that cannot be detected by human eye. This paper will focus on principle, working of Li-Fi technology and advantages over Wi-Fi technology. Li-Fi can transfer data at rates faster than 15 megabits per second which is more than your average broadband connection.

III. LITEARTURE SURVEY

LiFi is transmission of information through light illumination by taking the fibre out of fibre optics by sending information through a LED light bulb that varies in intensity faster than the human eye that can not follow. Li-Fi is the term some have used to label the fast and cheap wireless-communication technology, which is the optical version of Wi-Fi technology. The term was first used by Herald Haas in his TED Global talk on Visible Light Communication (VLC). "At the heart of this technology is a new generation of high brightness light-emitting diodes", says Herald Haas from the University of Edinburgh, UK, Very simply, if the LED is on, then you transmit a digital 1, if it is off, then you transmit a 0, Herald Haas says, They can be switched on and off very quickly, which gives nice opportunities for transmitted information. It is possible to encode information in the light by changing the rate at which the LEDs flicker on and off to give different values of 1s and 0s[1].The LED intensity is modulated so rapidly that human eye cannot detect , so the output appears constant. More sophisticated techniques could dramatically increase Visible Light Communication data rate. Terms at the University of Oxford and the University of Edinburgh are focusing on parallel data transmission using a group of LEDs, where each LED transmits a different information stream. Other group are using mixtures of green, red and blue LEDs to alter the light frequency encoding a different information channel. Li-Fi, as it has been dubbed, has already achieved blisteringly high data speed in the lab[2]. The technology was demonstrated at the 2012 Consumer Electronics Show in Las Vegas using a pair of Casio smart phones to exchange information using light of varying intensity given off from their screens, detectable at a distance of up to 15 metres. In October 2011 a number of companies and industry groups formed the Li-Fi Consortium, to promote high-speed optical wireless systems and to overcome the limited amount of radio based wireless spectrum available by exploiting a completely different part of the electromagnetic spectrum. The consortium believes it is possible to achieve more than 15 Gbps, theoretically allowing high definition film to be downloaded in 35 seconds.

IV. DATA TRANSMISSION THROUGH LI-FI

The functioning of Li-Fi technology is very simple. You will have a light source at one end that is LED (Input Device) and a photo detector on the other end (Output Device). As soon as, LED starts glowing, photo detector on other end will detect light of LED and get a binary 1 value otherwise binary 0 value. VLC is a information communication medium, which uses visible light between 400 THz (780 nm) and 800 THz (375 nm) as optical carrier for data transmission and illumination. It uses fast pulses of LED light to transmit data wirelessly. The main components of this communication system are 1) a high brightness LED, which acts as a communication source and 2) a silicon photodiode which gives good response to visible wavelength region serving as the receiving element. Li-Fi is typically implemented using brightness white LED light bulbs at the downlink transmitter. These devices are normally used for illumination only by applying a constant current rate.. However, by fast and subtle variations of the current rate, the optical output can be made to vary at extremely high speeds. This very property of optical current is used in Li-Fi setup. The operational procedure is very simple in Li-Fi: if the LED is on, then you transmit a digital 1, if it is off you transmit a digital 0. The LEDs can be switched on and off very quickly, which gives nice opportunities for transmitting information. So what you require at all are some LEDs and a controller that code data into those LEDs. We have to just vary the rate at which the LED's flicker depending upon the information we want to encode. Further enhancements can be made in this method, like using a group of LEDs for parallel data transmission, or using mixtures of green, red and blue LEDs to alter the light's frequency with each frequency encoding a different data channel. Such advancements promise a theoretical speed of 15 Gbps- meaning you can download a full high-definition movie in just 35 seconds.

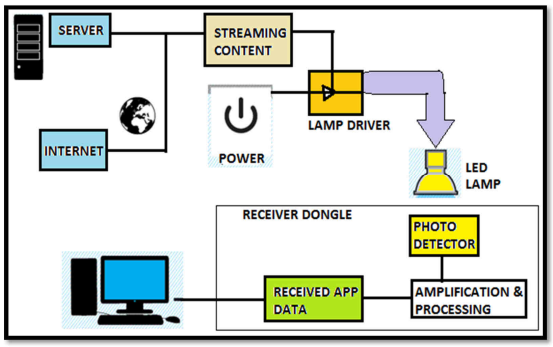

Fig. 1: Working of Li-Fi

If the LED is on, digital 1 is transmitted , if the LED is off digital 0 is transmitted[2]. The LEDs can be switched on and off very quickly, which gives nice opportunities for transmitting information. So what we require are some LEDs and a controller that code data into those LEDs. We have to just vary the rate at which the LED's flicker depending upon the data we want to encode successfully. It is possible to encode data in the light by varying the rate at which the LEDs flicker on and off to give different stream of 1s and 0s.The LED intensity is modulated so rapidly that human eye cannot detect, so the output appears constant[5].Figure 2 shows the block diagram of transmitter section, which consists of a Java application, microcontroller, MOSFET and LED. The data to be transmitted is sent to PIC16F877A microcontroller through a USB to serial connector. The microcontroller will encode the information to be transmitted using Manchester Algorithm. Then encoded information will be sent to the MOSFET switching device. MOSFET is a switching device, so according to the getting signal applied, it will turn ON and OFF. So the LED lamp will blink according to the on and off. The information to be transmitted is encoded as 0's and 1's. The LED will turn ON when '1' is to be transmitted to the receiver and LED will turn OFF when '0' is to be transmitted to the receiver. Since MOSFET and LED are semiconductor devices, it can be switched ON and OFF quickly. So very high information rates can be achieved. Also since this blinking rate is very high, human eye cannot detect it and it appears to stationarychanging customer requirements.[3]

Block Diagram of The System

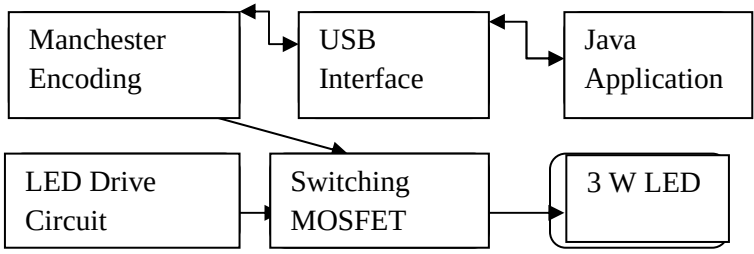

Fig.2 Block Diagram- Transmitter section

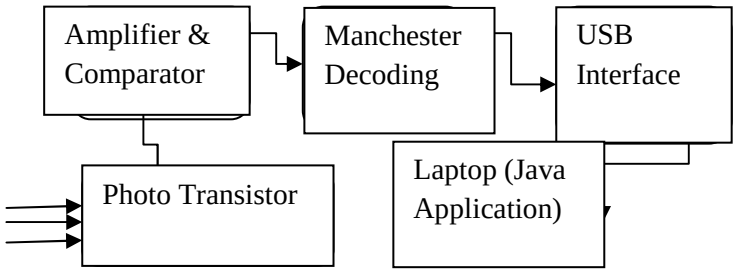

Fig.3: Block Diagram- Receiver section

Figure 3 shows the block diagram of receiver section which consist of a Amplifier, Laptop, Photo Transistor where, the data transmitted serially is detected by the photodiode. When a LED light falls on it a positive voltage will be generated and output will be high. When logical zero or no signal is received, photodiode output will be low. The Op Amp circuit will compare signal received to the reference voltage which convert it to logical zero or one. Since the data rate is high, the diode

output also very fast and good. So an Op Amp circuit is provided to compare very data that received. The output of comparator is sent to microcontroller which will decode this signal to regenerate the data sent. This regenerated information is sent to the laptop via serial to USB connector.**FDD** is a client-centric, architecture-centric, and pragmatic software process [3, 4]. There are five main activities in FDD that are performed iteratively.

V. DIFFERENCE BETWEEN Li-Fi & Wi-Fi

Li-Fi	Wi-Fi
1). The speed is faster 2). Data Density is high 3).Security is high because it can't be penetrate through walls. 4).Power availability is high 5).Obstacles interference is low.	1). The Speed is slower 2).Data density is low. 3). Security is low because it can be penetrate through walls. 4). Power availability is low. 5).Obstacles interference is high.

VI. ADVANTAGES OF LI-FI

A. Li-Fi can solve problems related to the shortage of RF bandwidth because this technology uses Visible light spectrum that has still not been greatly utilized.

B. High data transmission rates of up to 15 Gbps can be achieved.

C. Since light cannot passes through walls, it provides privacy and security but Wi-Fi can't provides.

D. Li-Fi has low implementation and repairing expenditure. Longevity of LED bulb: saves money

E. It is safe for humans as light, not like radio frequencies, cannot penetrate human body. Hence, concerns of cell transformation are mitigated.

F. LED lighting is already efficient and the data transmission requires negligible additional power.

VII. LIMITATIONS OF LI-FI

A. The main problem is that light can't go through objects, so if the receiver is by mistake blocked in any way any time, then the signal will instantly cut out.

B. Reliability and network coverage are the major issues to be considered by the companies while providing VLC services. Interference from outside light sources such as sunlight, normal bulbs; and opaque materials in the path of transmission will cause interruption in the communication.

VIII. CONCLUSION

Li-Fi is the enhanced technology in the field of wireless information technology. It is a alternative technology to conventional methods of wireless communications that in place of traditional radio frequency as in Wi-Fi use light as a data carrier. This concept promises to solve issues such as the shortage of radio-frequency bandwidth and overcome the limitation of Wi-Fi. Li-Fi allow internet where traditional radio based wireless isn't allowed such as hospitals, atomic power plants etc. If this technology is put into practical use, every LED can be used as a Wi-Fi hotspot to transmit data.

IX. FUTURE WORK

According to this paper, in future may work or study about the implementation we can implement more speed data transfer rate by using other combination of LED blub**.** We also increase the range of data transfer.

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