LI-FI (UPCOMING BOON FOR DATA TRANSMISSION)

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Abstract: Li-Fi is short form for Light Fidelity. Internet is playing a dominant role in our life and has become one of the basic needs in this technology age. There are different ways through which we access internet. Li-Fi is one of the technology which uses light for transmission of data. Li-fi has extended the capabilities of light not just for illumination but also for data transmission. In our research we have uncovered how Li-Fi is better than our existing technology and how it will be helpful in different sectors. We are also going to state what are the challenges faced for using Li-Fi.

Index Terms- **Li-fi, Light Sensor, Optical wireless technology, Visible Light Communication, Wireless Fidelity.**

I. INTRODUCTION

Harald Hass is father of Li-Fi technology. Li-Fi was first introduced in year 2011 by Harald Hass at TEDGlobal talk in Edinburgh. He was working in this field since 2004 and finally in year 2011 he showed demo of Li-fi by sending a video using LED light lamp at speed of 10 Mb/s [5]. Speed of light is much more than the speed of other wireless medium, Li-fi uses the same technology for transmitting data between two devices using light. This technology is also called as Optical Wireless Technology (OWC) or Visible Light Communication (VLC). Li-fi uses technology that can transfer data through illumination of LED bulbs that veers in intensity faster than the human eye can take after. Data is encoded in the light by varying the rate at which the LEDs flicker on and off to give different strings of 0s and 1s. The LED intensity is modulated so fast that human eye cannot notice, so the output appears constant. In the age of crowded data communication, Li-Fi is a new wireless technology that transmits data wirelessly through LED lights. Li-Fi can be called as light-based Wi-fi. It uses light instead of radio waves to transmit and receive data. Current wireless devices use radio waves for transmission of data. As the number of devices get connected to one network, the availability of the bandwidth becomes very less for devices to enjoy a high-speed internet. This clogging of network goes on increasing as the devices increases. Li-Fi will help to ease this clogging of network by using a method of light communication which uses rapid pulses of light to transmit data wirelessly. Li-fi works based on illumination of light. It uses LED light bulbs or lamps as downlink transmitter [1]. Light has the capacity to transfer vastly more amount of data in less time compared to radio waves. As of now Li-Fi technology seems to be very promising. Researchers at Oxford have achieved speeds of 224 gigabits per second using Li-fi which is many times faster than a google fiber internet connection.

The current scenario is:

- Currently there are 1.5 million radio wave base stations over the globe.
- We have about 5 million various network connections which transmit information more than 600TB.
- Radio Spectrum is congested yet the interest for remote data is constantly increasing each year.

Li-fi can help us to carry this excess demand of transmission of data more efficiently.

II. LITERATURE REVIEW

Professor Harald Haas, from the University of Edinburgh in the UK, is said as the founder of Li-Fi [3]. Harald Hass changed the vision of accessing internet, how we see videos, how we access and receive our e-mail using Li-fi.

This technology was first begun in countries like Japan, Korea and Germany during 1990's. These countries discovered LED's could be used to transmit data. This type of light can come in forms of ultraviolet, infrared and visible light [6]. Research has been done in 2003, mainly in

UK, US, Germany, Korea and Japan. Experiments showed that LED can be adapted to transmit data wirelessly and also provide light. Harald Hass researched how these signals should be modulated that is the information, embedded into light emitting LED's is transmitted by means of changes made to the intensity of light at high rate of 100 million cycles per second (100Mhz) [6].

III. Working of Technology

Li-Fi technology is a wireless communication that uses visible light among the blue (670 THz) and red (480 THz). Contrast to Wi-Fi which utilizes the radio part of the electromagnetic spectrum, Li-Fi utilizes the optical spectrum. The principle of Li-Fi is based on sending data by amplitude modulation of the light sources in a well-defined and standardized way.

The principle is simple: the LED turns on and off at high speed and is not visible to humans. This ribbon of on and off signals is interpreted to create binary streams of 0 and 1 [4]. Since there are no engaging light frequencies like that of the radio frequencies in Wi-Fi, Li-Fi is believed to be 80% more efficient. For implementation of Li-Fi, LED light is used as downlink transmitter [2]. These devices are only used to supply current by illumination. However, by fast and unpretentious differences of the current, the optical output can be made to fluctuate at enormously high speeds. Lamp Driver is connected to internet through which content is streamed. A switch associated with lamp driver and LED Lamp are also connected to this lamp driver through fiber optics cable. Photo detector is used for receiving signal and processing, this device is linked with PC or Laptop's LAN port. Through internet all data will be streamed to a lamp driver when the LED is switched on the microchip converts the digital data in form of light. The light sensing device i.e. photon detector receives the signal, amplifies and processes the data and converts it back into original data. This technique of utilizing rapid pulses of light to transmit information remotely is technically stated as Visible Light Communication.
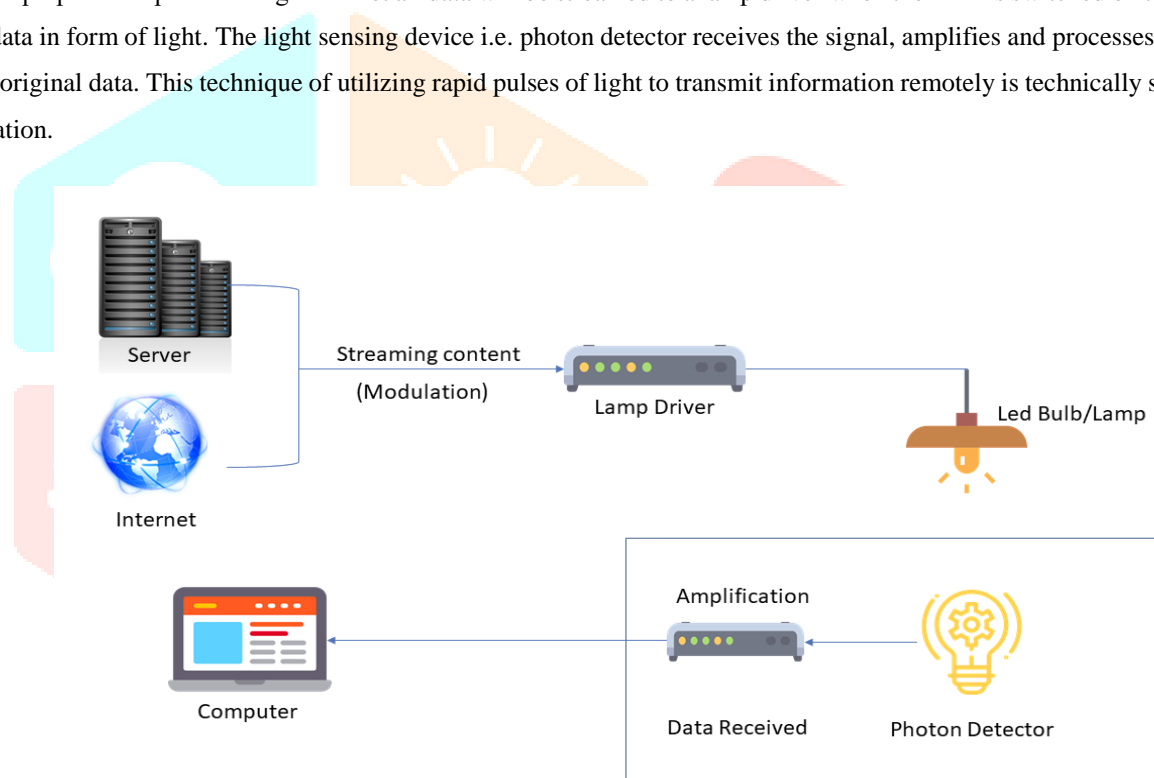

Figure 1: Working of Li-Fi

IV. MODULATION TECHNIQUES

Li-fi uses light for sending and receiving data. In order to transmit this data, it uses some of the modulation techniques and they are as follows

Orthogonal Frequency-Division Multiplexing (OFDM): OFDM is used for encoding the digital data on various frequencies. It uses same technique of frequency division multiplexing for digital multi-carrier modulation. Various orthogonal sub-carrier signals have responsibility to carry data on different channel.

Pulse-Width Modulation (PWM): This technique is used to change our message into a signal. This method can also be used for encoding the information but its main work is to control the power supply for the electrical devices commonly such as motors. Through this technique many bits of data can be delivered within a single pulse.

On-Off Keying (OOK): It is the simplest form of amplitude shift keying modulation. It denotes binary one when carrier is present for a specific duration and binary zero when it is absent. It is basically used for transmitting text in series of pulse light.

Pulse-Position Modulation (PPM): It is in the form of signal modulation. In this technique M message bit are encoded by transmitting a single pulse in one of possible required time-shifts. It is used for optical communication where there is no multi-path interference.

Sub-Carrier Index Modulation (SIM-OFDM): It is a technique which adds Amplitude Shift Keying and Quadrature Amplitude Modulation. Sub Carrier Index is used to deliver the information to the receiver. SIM-OFDM splits a serial bit stream into two-bit sub-streams of equal length.

V. LIGHTNING SCOPE OF LI-FI IN DIFFERENT SECTORS

After doing a detailed study of the Li-Fi technology we have come to point how we can make an optimum use of technology. Following are the points which can help us to:

Reducing Traffic On Roads: Traffic on roads can be reduced using Li-fi for communication i.e. vehicles use led bulbs in headlights and taillights which can be used as communication with other vehicles. Traffic signals and street lamp also contain led lights. With the help of these LED lights vehicle-to-vehicle and vehicle-to-signal communication will become easy. This will help in road management and safety.

High Speed Internet in Airplanes: Generally, in flights it is suggested to keep our mobile phones on flight mode. However, airplane contains many LED lights which can be used as a source of data transmission.

College/Office Campuses: Li-fi can be good option for colleges and offices. As these campuses contain multiple LED light it will be a fast source of data transmission and internet access point.

Railways: When we travel through trains we often suffer weak network or no network when we pass through tunnels. Li-Fi can be good source for data transmission and internet access as train contains multiple led lights.

A Benefit to Medical Sector: Wi-fi is generally prohibited in hospitals due to over radiation. Also signals from medical and other monitoring devices can cause failure in the working of Wi-fi. Li-Fi can help to solve this problem. As Li-Fi just works on Led lights and hospitals are flooded with led lights it will be a rich source of data transmission. It doesn't transmit any electromagnetic waves so it won't interfere with any other medical instrument.

Safe Data Transmissions at Hazardous Environments: Wi-fi is not allowed in the sensitive areas like powerplants or hazardous factories. Though there is requirement of fast data communication and system monitoring. Li-fi can help to overcome these problems. Li-fi doesn't emit any radio waves which will interfere with the machines of factories. It will be a clean source of data transmission and internet.

Building Smart Cities: There are various sources through which we can get light in a city. Converting this light into a Li-fi technology can help us to provide a fast source of data transmission and internet access. This will help people to connect internet anywhere and everywhere in a city.

VI. CHALLENGES TO OVERCOME

There are lot of advantages of Li-Fi technology though there are some trials which we want to look over. Photon Detector which is used as led light receiver always needs to be in a line of sight of led bulb or lamp. Light cannot penetrate through walls unlike radio waves and light can be easily blocked. If the setup of a LED light is done inside a room then it will be difficult to shift the receiver. As light plays a prominent role in this technology, anything goes wrong with the light source then we may not be able to access internet. If this technology is set outside then it needs to deal with the changing weather conditions.

VII. CONCLUSION

Li-fi is a rich and clean and source of data transmission and internet access medium. There are still innovation and research going on in this technology. Many researchers are still thriving to make innovation in this field. We can also have hotspot like Wi-fi in near future where led

bulb will be used as hotspots. As our current air network is heavily clogged, Li-Fi will help to overcome this problem by reducing the pressure on air network.

VIII. REFERENCES

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