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# Light Fidelity (Li-Fi) Technology: Breakthrough Technology for the Network and Communication

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## ABSTRACT

In this paper we focus on what is Li-Fi technology? how Li-Fi will help in future? as we currently using communication technology in daily use such as wireless-fidelity (Wi-Fi) and Bluetooth as we basically using the radio waves as basic medium in Communication. In the technology era, it's essential to add enrichment and progress in communication technology. During the pandemic in 2019-20, we all realise there should be wireless high speed internet which will sending data of patients by using different body sensors such as Heart Beat Sensors, Temperature Sensors or Pressure Sensors from Li-Fi which will be safer, secure, greener and radiation-free. Li-Fi not only use in health sector but also in every aspect of life such as in home, school, hospital and various industry. It also helps in key performance in 5<sup>th</sup> generation of cellular system and beyond. It covers all of the key research in Li-Fi network to illustrate that Li-Fi is no more theoretical concept any more, but at the point of the real world deployment. Still there are many challenges in this technology which we have to take into the picture.

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## 1. Introduction to Li-Fi, Challenges in Wi-Fi

**THE TERM "Li-Fi" was first introduced by Harald Haas-**

During 2011 in TEDGlobal talk at Edinburgh the term Li-Fi (also written as LiFi) was first introduced by Harald Haas. Li-Fi is a wireless communication technology which use light to transmit data and position between devices. Due to increasing demand for wireless data communication it is necessary to progress and enrichment in technology.

As we aware of Wi-Fi Technology is currently using all over the world. But in Wi-Fi Technology, there different challenges as this technology operates on Radio Frequency (RF) band. Wireless devices which are used for transferring the medical data are very highly reliable and secure but the devices uses Wi-Fi can interface with one another which results to the loss of connectivity. However, the patients in ward facing some serious Radio Frequency waves which can also harmful for their health. Also, the RF band is just a small portion of the electromagnetic spectrum available for data transfer which is limited in bandwidth. In order to overcome this is best solution for these issues is Li-Fi. Li-Fi is a wireless optical networking technology that uses light between 400 and 800 terahertz (THz) from Light Emitting Diodes (LEDs) rather than Radio frequencies to transmit data. In this work, a simple communication protocol is proposed to bridge energy harvest sensors and Li-Fi. Data transmission through wireless medium has been prominently increasing in the current era due to many emerging technologies like Internet of Things (IoT). Most of the wireless communications happen through the air medium. Li-Fi (Light Fidelity) is a technology which transfers data using optical-like visible light. Data from the Arduino can go through the light and a while later be received on the receiver side using any light-sensitive device like LDR or photodiode.

### Motivation

1. To provide a High-Speed data communication network.
2. To provide wireless secure network.

### 1. Aim and Objective of the work

The project began with four aims:

- 1). To get cost effective solution using Li-Fi as it is thought to be the future generation of the internet, in which data will be transmitted using light as a medium between two devices.
- 2). Li-Fi replaces Wi-Fi for effective and speedy data transfer.

- 3). Due to the existence of LED bulbs that are always available everywhere, LI-FI Holds the potential to be more energy efficient and cheaper.
- 4). It can be used in many hospital applications,with radio frequency equipment.
- 5). The main objective of the Li-Fi is provide an effiecient, low cost, secure communication network.

## 2. A brief Intro to Li-Fi

The operating idea of Li-Fi is very clear and simple. If LED is ON, a digital signal 1 is transmitted, If its OFF then a digital signal 0 is transmitted . A light emitter(LED) is present on the transmitter side and a photo detector ( light sensor)is present on the receiver side. It is this photo detector that records binary 1 and 0 by clicking ON and OFF Lights.With this technology, each and every LED light source will serve as a center for data transmission. Li-Fi technology depends upon two important parts :LED bulbs and photo diode .In amplication and signal Processing equipment , a lamp fiited on LED will beam to the photo detector which will detect visible light.

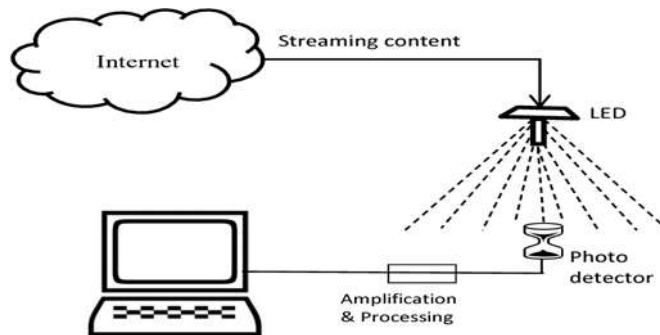


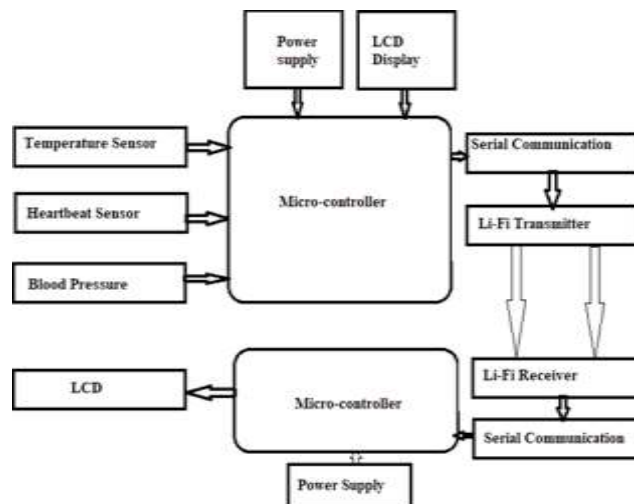
Fig. 1. Architecture of Li-Fi

## METHODOLOGY:

The Li-Fi System divided mainly divided into two parts:1) transmitter section 2)receiver Section

The working of Li-Fi is very simple. There is a light emitter on one end transmitter and the reciver .LED light is used as signal source between two end systems. Data is carried by the controlled light from the LED. The functioning of new Li-Fi technology.Although, Wi-Fi uses radio waves while Li-Fi runs on visible light. The Li-Fi technology is implemented using white LED light bulbs used for illumination by applying a perpetual current.

However, by fast variations of the current, the light output can be made to vary at very high speeds. We essential at all for sending data are some LEDs and a controller that cods data into those LEDs and for receiving data, we essential an Image Sensor, Photodiode which is used as a detector. The binary data are seizing by few light receptors are required, and are installed on all types of connected devices, from computers to tablets, to phones, televisions or appliances shows in Figure The matter specialist makes clear that the light pulses are imperceptible to the human eye, without causing harm or discomfort of any kind. Therewith, any lamp or flashlight can become a hotspot. How Li- Fi works are quite simple because you have a light on one end (an LED), and a photodetector (light sensor) on the other. If the LED is ON, the photo detector registers a binary one; else it's a binary zero. Flash the LED sufficient times and you build up a message. Using an array of LEDs , and probably a few different colors, and very shortly you are dealing with data rates in the range of hundreds or megabits per second, this is endowed by the flickering of LED light bulbs to create binary code (on = 1, off = 0), and is done at surpassing rates than the human eye can detect. The excess LEDs in your lamp, the excess data it can process.



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## 2. Methodology of Li-Fi

### 2. Benefits and Advantages

There are many advantages and benefits of Li-Fi technology as follows:

- 1) **HIGH DATA SPEED:** Li-Fi has high data transfer rate as compared to Wi-Fi as light spectrum is about 10,000 times wider than the spectrum covered by radio waves. It has data transmission rate 100 times faster than Wi-Fi. As it has data rate 224GB per second.
- 2) **HIGH SECURITY:** Li-Fi covers low region as it not pass through in solid object such as wall that will avoid unwanted access to unknown persons that will secure your data and important files.
- 3) **HARMLESS TO HUMAN BEING:** as we know Wi-Fi used radiofrequency waves which are harmful to human health which impact on hormonal changes , DNA damage and oxidative stress. But Li-Fi transfer the data using LED that are not harmful to human being it does not causes any emission of waves which avoid the danger to human health.
- 4) **Electricity Saving:** as Li-Fi works on LED so there will no addition of electricity require for like Wi-Fi. Great amount of energy reduction will be there in industries which save environmental loss.
- 5) **Low Latency:** In Li-Fi latency rate has three times less than Wi-Fi due to that it works powerful than Wi-Fi which encourage to different sector works powerfully and fully forcefully.
- 6) **Interference Free Network:** Li-Fi is seen as the field of lighting meaning that interference is easier to prevent or avoid completely which will include hospital, industrial are

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## 3. Applications of Li-Fi

There are different application of Li-Fi technology as follows:

- 1) **HEALTH SECTOR** – In hospital Li-Fi is used to track and record patient condition in real time without using harmful Radiofrequency Waves. It also enable better and secure network for medical instrument to record the data. Hospitals are a specific case of an environment where both EMI sensitivity and security of data are issues which can be resolved by Li-Fi.
- 2) **SMART HOME-** Li-Fi will be used to build a smart home that will allow to enhance the quality of human life and bring more comfort ,saving, convenience to human life. As we use LED light in our home that will provide transmission of data through illumination which cause low energy consumption and more convenience.
- 3) **EDUCATION SECTOR** - Li-Fi is the perfect wireless network to innovate in Education Sector opportunities by linking learners and teachers to smart technology that allows content on every mobile device .It can also provide smooth network access and security from the classroom to university dorms across the whole campus which will bring revolution in education.
- 4) **PHARMACEUTICAL INDUSTRY:-** Li-Fi can be used for real-time tracking of prescribed aseptic drugs like cytotoxic drugs, Parenteral drugs and centralized intravenous additive services (CIVAS) in the unit and nurses and other healthcare professionals from the ward can check the status without the need of calling or going directly to the aseptic unit.
- 5) **LI-FI IN UNDERWATER** - As radio waves do not move underwater easily, Li-Fi can be used to improve submarine communication networks in the Navy The best choice is to use Li-Fi unless Wi-Fi interferes with onboard electronics in petrochemical plants or aeroplanes . Li-Fi infrastructure allows safe high data rate connections for appliances, vehicles and submarines .
- 6) **LI-FI AND INDUSTRY4.0-** Industry 4.0 is often referred to as the “Fourth Industrial Revolution,” Factories are increasingly automated, and self-monitoring as the machines within are given the ability to analyse and communicate with each other and their human co-workers, granting companies much smoother processes that free up workers for different tasks.
- 7) **DISASTER MANAGEMENT:** Li-Fi can be used as a powerful means of communication in times of disaster such as earthquake or hurricanes. The average people may not know the protocols during such disasters. Subway stations and tunnels, common dead zones for most emergency communications, pose no obstruction for Li-Fi.
- 8) **SMART CITY-** The main goal of a smart city is the optimisation of city functions and the promotion of economic growth while also improving the quality of life for citizens by using smart technologies and data analysis. The value lies in how this technology is used rather than simply how much technology is available.

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### 3. Challenges

Although there are advantages and benefits of Li-Fi but it has also many challenges of Li-Fi which lagging the technology to take over Wi-Fi on large scale

1) **Cost of Ecosystem** Li-Fi needs special LED bulbs for transmission and photo-detector for reception. The need for special LED bulbs has made it very hard to put into use Li-Fi on a large scale as these bulbs are not yet mass produced. This will require large amount of money for setting up ecosystem for Li-Fi as compared to Wi-Fi.

2) **Challenge for market place**- As we all know that Li-Fi is prominent technology but due low cost Wi-Fi still in market trend as Wi-Fi 6 also coming will more advance which cause difficult to find market place for Li-Fi .

3) **Light Intensity**- Since Li-Fi uses light to transmit data, we must take into account the regular lighting in a common household which could interfere with the connection. What I mean is, if the Li-Fi bulb has a strength which is not easily able separated from other sources of light such as regular bulbs or sunlight, it would cause the whole system to fail.

4) **Li-Fi VS Wi-Fi**: Wi-Fi is used everywhere for wireless communication. For Li-Fi to replace Wi-Fi, it needs to convince consumers that it is indeed much better than Wi-Fi. But it has failed to do so due to the numerous shortcomings when compared to Wi-Fi.

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### Conclusion:

Li-Fi is an emerging technology and it has vast application. On implementing this technology it is possible to use every bulb as a hotspot to transmit wireless data. In this project it is clearly seen that data can be transmitted via through light. Instead of using this hazardous radio waves, we can coordinate using light.