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# Audio Streaming Using Li-FI Communication

A. Akbar Ali[1], R. Harish Kumar[2], R. Dheenathalayan[3], N. Prasanth[4], V. Parthasaradi[5], S. Senthilkumar[6*] & T. Senthil Kumar[7]

[1-4]*UG Scholars,* [5-7]*Assistant Professor, Department of Electronics and Communication Engineering, E.G.S. Pillay Engineering College, Nagapattinam, Tamilnadu, India. Corresponding Author (S. Senthilkumar) - senthilkumar.s@egspec.org**

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ABSTRACT

In Wireless communication, Wi-Fi is the most versatile and effective technology which compact with radio frequencies for data transmission. But because of multiple accesses, Wi-Fi is facing many challenges namely capacity, availability, efficiency and security. The Wi-Fi emits radio waves which are very harmful to the patients and the radio waves interpret the medical instruments. This paper focuses on developing a light fidelity (Li-Fi) based system and analyzing its performance. This protocol can be adapted where radio waves are restricted, such as in airplane hospitals, and in some research facilities. Noticeable Light Communication (VLC) has increased extraordinary enthusiasm for the most recent decade because of the quick improvements in Light Emitting Diodes (LEDs) manufacture Li-Fi is a novel technology for high-density wireless data transfer relieving no radio interferences in confined areas so it can be used in biosensors to measure various health parameters. This technology envisions a future where data for laptops, smartphones, and tablets will be transmitted in an economic and eco-friendly medium of light in the room.

**Keywords**: LI-FI; LASER; Audio transmission; Solar panel; VLC.

## 1. Introduction

Over the past few years, there has been rapid growth in the utilization of the RF region of the electromagnetic spectrum. This is because of the huge growth in the number of mobile phone subscriptions in recent times. This has been causing a rapid reduction in the free spectrum for future devices. Hence, an alternative means to wireless communication is necessary to accommodate the exponentially increasing wireless traffic demand. Visible light communication systems provide an alternative to the current standards of wireless transfer of information, using light from LASER as the communication medium.

The term Li-Fi was Invented by a German Professor at the University of Edinburgh, Harald Haas and it refers to light-based communications technology that delivers high-speed, bidirectional networked mobile communication which is similar to Wi-Fi [1], [2]. Light fidelity (Li-Fi) operates in the visible light spectrum of the electromagnetic spectrum .it uses visible light as a medium of transmission rather than traditional radio waves. Figure 1 shows the architecture of the Li-Fi module.

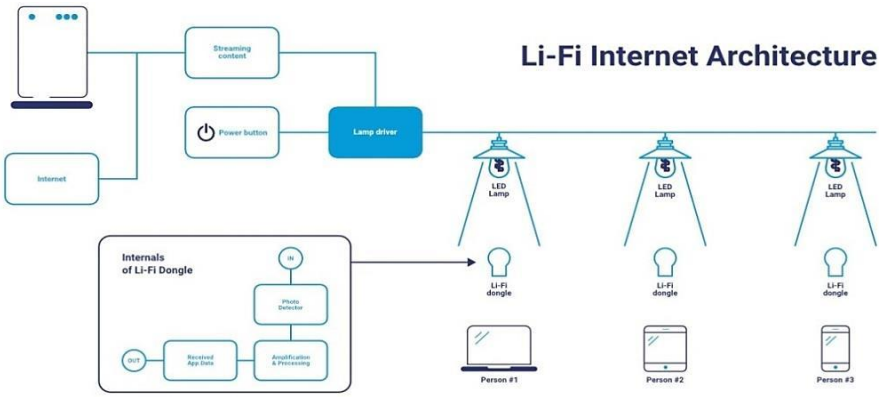


**Figure 1.** Li-FI Architecture

Li-Fi is the transmission of data using visible light. This is done by sending data through an LED light bulb that varies in intensity at a speed much faster than the human eye can follow [3]. If the LED is on, the photodetector registers a binary one; otherwise, it's a binary zero that is registered. This Li-Fi system can be used to produce data rates higher than 1 Giga bits per second which is much faster than our average broadband connection or Wi-Fi. The high speed of Li-Fi can be explained using frequency spectrum of Electromagnetic Radiations [4],[5]. From the electromagnetic spectrum, we can see that the frequency Band of visible light is between 430THz to 770THz and that of the Radio Frequency Band is between 1Hz to 3 THz. Hence the Frequency Bandwidth of visible light is about 400 times greater than the Radio Frequency Bandwidth and so, a number of bits can be transferred through this Bandwidth than in the radio frequency bandwidth. Thus the Data rate will be higher in Li-Fi and a higher speed can be achieved. In this work, the audio signal is modulated and transmitted to the LASER light source. This signal is captured by the photodetector and demodulated to give the output. Figure 2 shows the prototype of the Li-Fi model.

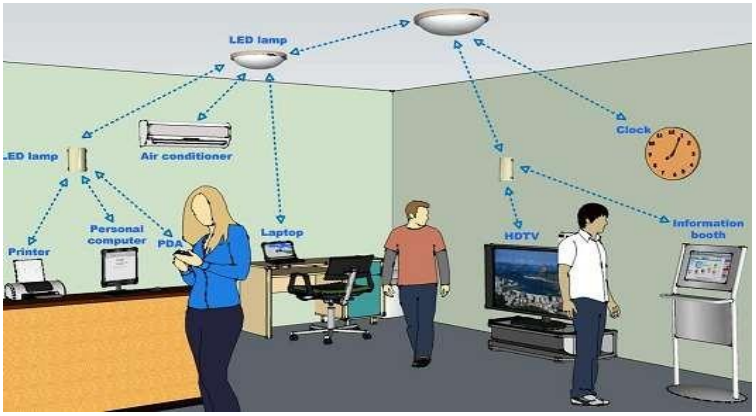


**Figure 2.** Li-Fi Model Prototypes

## 2. Literature Survey

In broad area of Wi-Fi Internet devices, most of the people are using 2.4-5GHz RF to deliver wireless Internet access surrounding our offices, schools, home, and some public places also. We become quite dependentupon these nearly ubiquitous services [6]. While Wi-Fi covers an entire house, school, the bandwidth is limited to 50-100 megabits per seconds (Mbps). It is a mostly current Internet services, but insufficient for moving large data files such as HDTV movies, music libraries and video games. Most of the dependent upon the cloud or our own media services to store all of our files, including audio and video devices, movies, photos, games, the more and more bandwidth and speed should be needed to access this data. Hence RF-based technologies Wi-Fi are not the optimal way. In addition, Wi-Fi may not be the most efficient way to provide new desired capabilities such as gesture recognition and precision indoor positioning [7]. The optical [8] wireless technologies, sometimes called visible light communication (VLC) and more recently referred to as Li-Fi. On the other hand, offer an entirely new paradigm in wireless technologies in communication speed, usability and flexibility, reliability. VLC is the possible solution to global wireless spectrum storage. LI-FI technology is a fast and cheap optical version of Wi-Fi [9]. It is a based on Visible Light communication medium using Light between 4000 THZ to 375 THZ as optical carrier for data illumination. The data is encoded into light to generate data stream by varying the flickering rate, to be clearer, by modulating the LED and LASER light with the data signals, it illustrates the communication source. This is a

whole new spectrum of possibilities as compared to the radio waves spectrum and is 1000 times more in size radio waves spectrum. And is 1000 times more in size. Visible light is not injurious to vision and is a mandatory part of the infrastructure.

### 2.1. Advantages of LI-FI

The main advantage which runs in favor of LI-FI-based communication is its ability to make available high data rates. Carrying out the system usage in the visible light frequency range translates into higher frequency; which creates room for potentially broader bandwidth and as a consequence a higher data rate. According to studies, visible light frequency band is expected to be ten thousand times more accommodating than conventional radio band. Expectations are already there to attain gigahertz range. As anticipated, the user requirement for data has risen exponentially and hence demand higher and higher bandwidth has become more vital. Spectrum scarcity is an issue that needs to be addressed. Significant amount of available radio frequency range has been fully utilized and it is becoming stringent to make space to accommodate more range. Another problem is the situation of licensing to operate an RF range-based communication system. Good news is that visible light bands can be locally used and such problem is notencountered with this spectrum. Making use of this frequency band can effectively address this problem. The legacy radio communication systems get heated rapidly due to high energy consumption and hence require even more energy to maintain a cooling system to cool the base stations or the access points. However, LASER consumes less energy and does not require any such cooling system unlike any legacy system. Also, it delivers illumination. Traditional systems face glitches created due to multi-path propagation. The transmitted signal concerningthe reflected signal can sometimes be at anti-phase which would nullify the summation and could decline thesignal. The light signals do not cancel each other; they complement and enhance each other.

## 3. Existing Technology

The existing Wireless communication makes use of electromagnetic waves for communication systems. For instance, the deployment of Wi-Fi obviously brings several important benefits. Because it is very convenient that numbers of equipment connect to each other using wireless networks. Home-based Wi-Fi-enabled device helps you to connect PC, game console or laptop. There are no boundaries if you are using Wi-Fi, you can move from one room to another or even away from home you have the liberty to access internet within the range of radial distance. The Wi-Fi hotspots concept is getting popularity among business communities and mobile workers. For this reason, ISPs are consolidating Wi-Fi switches to numerous spots for scope of wide range. The transmitted signal from the LEDs has to be detected, demodulated and acknowledged. So, in order to detect the message signal from the blinking LED light, we use a photocell or a Solar Cell (which comprises large no of photocells connected in series) [10-13]. The solar cell only the variation of the light, since the blinking can be easily detected and the output of the solar cell will be the message signal in the analog form. So using solar we could detect and demodulate the data signal transmitted.

## 4. Proposed Work

In this work, we have been demonstrating simple audio transmission using Li-Fi communication technology. We are using the LASER module as a source of optical light at the transmitter section and Solar Panel as a photodiode at the receiver section. We have made this work as simple as a successful method for better understanding for

others. Cost wise also it is one of the best setups for implementation. Our work has a big scope to do. Existing ways to detect the human being under the earthquake rubble and collapsed buildings are utilization of the dogs, optical devices and acoustic life detectors and the rescue robot. But dogs can detect dead persons and this occupies precious time which can be utilized to detect live victims. Also, optical devices have a limited number of degree of freedom, require expert operators and cannot be used in an inaccessible areas. Acoustical detectors such as geophones are simple to use but they require quiet working environments, a condition difficult to reach especially in critical situations.

Information about the location of the buried person would be of great value for five rescue personnel since it would help to reduce the time of operation and thus, help to save more lives. There is a need to construct a life detection system that can detect buried victims under earthquake or building debris most efficiently and as possible in a short time. Such kinds of problems have been efficiently solved by considering continuous wave or ultra-wideband radars which offer good localization and spatial accuracy. In rescue missions and also in some surveillance operations there is not only the need to detect life signals but also the identification of people in a given area, to facilitate rescue team operations in case of emergencies. Thistask can be complied with through wall surveillance techniques.

## 5. Results and Discussion

On the transmitter side, when we connect 3.5 mm jack to audio source LASER will glow but there is no fluctuation in the intensity of light when the audio source is OFF. As soon as you play the audio, you will see that there is frequent change in intensity of light. When you increase the volume, LASER intensity is changing faster than the human eye can follow. Solar panel is so sensitive that they can catch small intensity change and correspondingly there is a change inthe voltages at the output of the solar panel. So, when the light of the LASER falls on the panel, voltages will vary according to the intensity of light. Then voltages of the solar panel are fed into the amplifier Speaker which amplifies the signal and gives the audio output through the speaker connected to the amplifier. The output will come as long as the solar panel is in contact with LASER. You can put the LASER at max. 10-20 m distance from the solar panel to get a clear audio output. You can further increase the range by increasing the area of solar panel and higher wattage Power LASER.

### 5.1. Transmitter Circuit

On the transmitter side, we have white Bright LASER and a battery which is connected to 3.5 mm jack and the jack will be connected to the audio source. Here we are using battery to power up the LASER because there is less power coming from the audio source which is not enough to power the LASER. Connections are shown below in the circuit diagram. Table 1 summarizes the components used on the transmitter side. Figure 3 represents the transmitter side of the proposed system.

**Table 1.** Components on the transmitter side

| S.No. | Components | Quantity |
|---|---|---|
| 01 | Laser | 01 |
| 02 | Battery | 01 |
| 03 | 3.5 mm Jack | 01 |

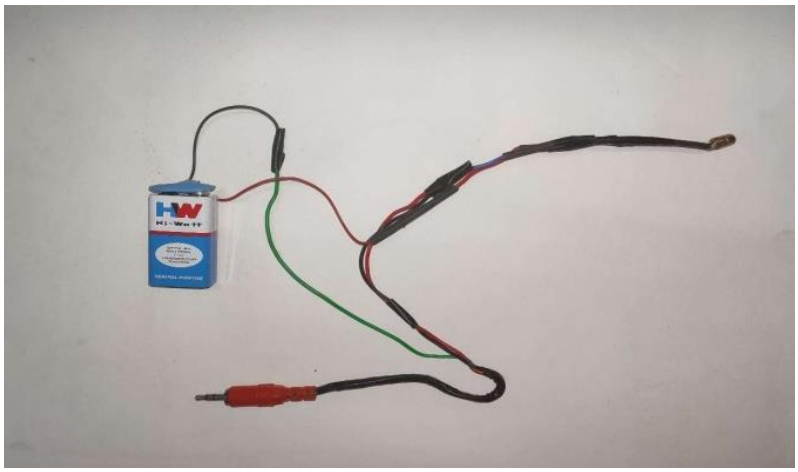

**Figure 3.** Transmitter side

### 5.2. Receiver Circuit

On the receiver side, we are using Solar panel and a speaker which is connected by an Aux cable for receiving one. Table 2 shows the components available on receiver side. Figure 4 shows the receiver side of the proposed system.

**Table 2.** Components available on the receiver side

| S.No. | Components | Quantity |
|---|---|---|
| 01 | Solar Panel | 01 |
| 02 | Speaker | 01 |

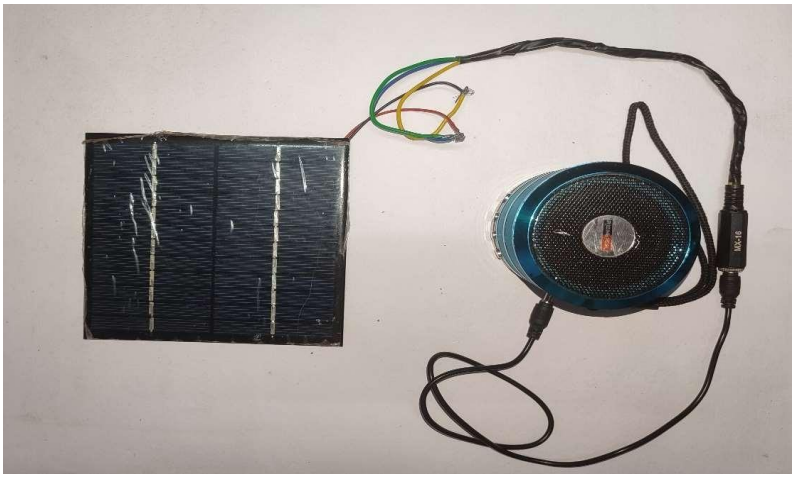

**Figure 4.** Receiver side

In this research work, we designed and implemented a wireless communication device that transmits audio wirelessly known as light fidelity (LI-FI). This work contains two sides 1. transmitter side and 2. receiver side. The transmitter section modulates the incoming message audio signal and transmits it towards the receiver in the visible light using LASER. The receiver section interprets the incoming light which is detected using a solar panel and converts it to an audible sound signal with the help of signal. Figure 5 represents the proposed audio streaming system.

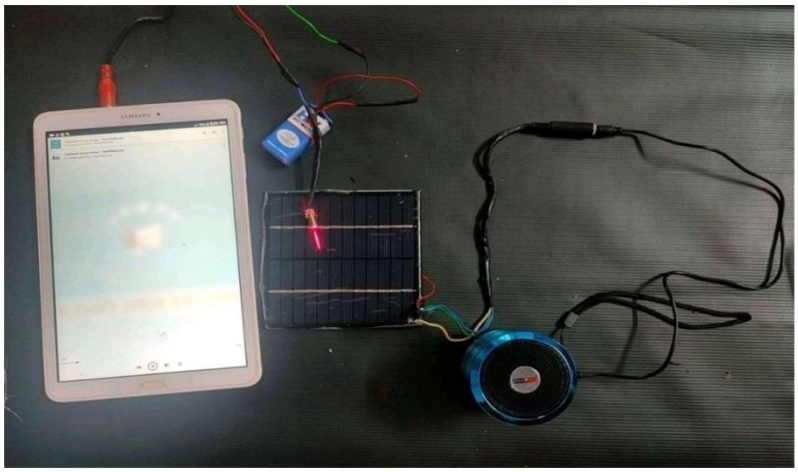

**Figure 5.** Audio streaming systems

## 6. Conclusion and Future Scope

The possibilities are numerous and can be explored further. If his technology can be put into practical use, every bulb can be used as something like a Wi-Fi hotspot to transmit wireless data and we will proceed toward a cleaner, greener, safer and brighter future. The concept of Li-Fi is currently attracting a great deal of interest, not least because it may offer a genuine and very efficient alternative to radio-based wireless. As a growing numberof people and their many devices access wireless internet, the airwaves are becoming increasingly clogged, making it more and more difficult to get a reliable, high-speed signal. This may solve issues such as the shortage of radio-frequency bandwidth and also allow internet where traditional radio-based wireless isn't allowed such asaircraft or hospitals.

Li-Fi can be used in diverse fields. Data transmission is done through LEDs and thus all screens which illuminate light can be served as a platform for data communication.

The Screen of mobiles, televisions and tube lights itself acts as a transmission device. On the other hand, the photodetector can be replaced by a camera in mobile phones for scanning and retrieving data. Transparent screen mobile phones, televisions, desktops, smartcards and smart guides are some of the future scope areas where Li-Fi can be used. Li-FI can also be implemented in schools, colleges, museums, hotels, hospitals, etc. In places like hospitals where electromagnetic rays are very harmful, Li-Fi can be used. It can also be used in a dangerous environment like a thermal power plant and nuclear power plant without causing electromagnetic interference. Hence Wi-Fi can be replaced by Li-Fi.

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**Competing Interests Statement**

The authors declare no competing financial, professional, or personal interests.

**Consent for publication**

The authors declare that they consented to the publication of this research work.

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