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# Li-Fi Music Systems for Concerts

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## Abstract:

As the wireless communication is growing each day, demand for Light Fidelity abbreviated as Li- Fi has increased that uses visible light, ultraviolet, and infrared spectrums in order to transmit data between devices. It is advantageous over many other communication systems due to its high- speed connectivity that can withstand higher data rates. Furthermore, its environmentally friendly nature and high security offerings make it even better. On the other hand, Li-Fi does not require any licensing from the government for its access, making it cost effective. Starting from the previous generation till the present, elderly as well as youths love to attend concerts. These are even made more harmonious when a good music system is installed. Here comes one of the usability of Li-Fi, where light can be used as a medium to transmit the audio signals from the stage to the amplifier connected speakers placed far away from the stage. This reduces the haphazard wire management making the setup more time and cost efficient. Other technologies like Bluetooth and Wi-Fi only support a range of ten meters where Li-Fi beats them by a huge margin. Additionally lossless and High-Resolution (Hi-Res) audio can be transmitted wirelessly due to its support to higher bandwidth and data rates. In this paper, a study on the Li-Fi technology is done and the same is implemented in an advanced music system for transferring audio data from one place to another using light signal.

**Keywords:** Li-Fi, Lossless audio, Bluetooth, Wi-Fi.

## 1. INTRODUCTION

Professor Harald Haas, of the University of Edinburgh, UK, is the father of Li-Fi technology. The term Visible Radiation Communication (VLC) puts forth the use of visible radiation of electromagnetic spectrum for data transmission [1]. Light Fidelity (Li-Fi), technology is developed by a research team at the University of Edinburgh. It is a current and present-day wireless communication technology that validates negligible transmission of data using electromagnetic waves, preferably light. Li-Fi has the potential to complement Wi-Fi due to the availability of broad bandwidth, non-existence of electromagnetic interference, high security, and high reliability [2,3,4]. Data may be obtained within the area of visible light by means of electronic gadgets with photodiode. In order to provide enhanced coverage, a hybrid Li-Fi and Wi-Fi network, which combines the high-speed data transmission of Li-Fi and the relatively large coverage of Wi-Fi, is envisioned for indoor wireless communications [5]. Wi-Fi plays an effective role in wireless data coverage within buildings, while Li-Fi will provide excellent data coverage in particular locations without any radio interference problems. An alternative to Wi-Fi for limited or short-lived wireless communication technology is Li-Fi communication. As the spectrum of Wi-Fi and Li-Fi is non-overlapping, therefore they would not

interfere with each other, as a result the hybrid network will provide higher system throughput as compared to an independent Li-Fi or Wi-Fi network [6]-[8]. From hybrid network point of view, there are two main problems which are required to be addressed for load balancing, namely, user association or access point (AP) selection and Resource allocation. In case of hybrid network [9],[10], the issue in AP selection is challenging firstly due tocoverage area of Li-Fi and Wi-Fi network overlaps each other and secondly Wi-Fi covers larger area but have lower capacity, thus, is more prone to overload [11]-[15]. In any performance or festival, we can install or approve such wireless technology systems like Li-Fi for better throughput to avoid the desultory and erratic wire arrangement. This reduces havoc and costs and increases maintainability. This paper is based on installing Li-Fi technology in any concerts for better sound version and reducing the random wire management. The methodology along with the framework diagram and result is discussed in the following sections of the paper.

## 2. METHODOLOGY

The idea behind our proposed work is to utilize Li-Fi technology in-order to transmit audio signal mostly in big speakers used in concerts placed at a distance more than ten meters from the stage. With the use of this the lights on the stage facing towards the audience can be used to transmit the audio signals from the stage to the speakers placed even more than ten meters away wirelessly. For our proposed work, the hardware components used are LED bulb, Auxiliary (AUX) cable, 270Ω resistor, photodetector (Solar panel), power supply, audio source (microphone or mp3 player) and audio output device (speakers connected to amplifier). The overall overview of the proposed architecture of the model is proposed in Figure 1. A comparison between Li-Fi and Bluetooth is discussed in Table 1.

Table 1: Comparison between Li-Fi and Bluetooth Technology.

| Sl no. | Li-Fi | Bluetooth |
|---|---|---|
| 1. | Uses light wave for data transmission. | Uses radio wave for data transmission. |
| 2. | No specific operating frequency. | Operating frequency is around 2.4 GHz |
| 3. | Data transfer rate are even higher than 1 Gbps. | Data transfer rate is around 800 Kbps. |
| 4. | Due to higher data rate availability, support of Hi-Res lossless audio having bit rates about 24-bit/192kHz or 9216kbps audio streaming is possible. | Due to low data transfer rates, support of lossless audio streaming is not possible. |
| 5. | No licensing is required for using this technology. | Licensing is required for using this technology. |
| 6. | Highly secured. | Security is not up to Li-Fi's standard. |
| 7. | Requires no software to operate it. | Requires software for its operation. |
| 8. | Range is more than 10 m and can be even made better by improving the directivity and intensity of light. | The most common type class 2 Bluetooth can operate upto 10 m range. |

## 3. Algorithm

The operating procedure of Li-Fi is easier than it sounds. The flickering of light that causes the light to switch ON and OFF thousands of times in a second causes production of digital signal. The ON state transmits a digital signal 1 whereas OFF state transmits 0. A light emitting diode (LED) placed in the transmitter end acts as the transmitter and a photo detector (light sensing diode preferably solar panel) is placed at the receiver end that acts as a receiver. It is the photo detector, here

solar panel that senses binary 1 and 0 by the flickering of LED and delivers the data to the destination. With the use of this technology each and every LED source can be served as a data transmission hub. The framework diagram of our proposed model is depicted in Figure 3 along with its experimental setup shown in Figure 2.

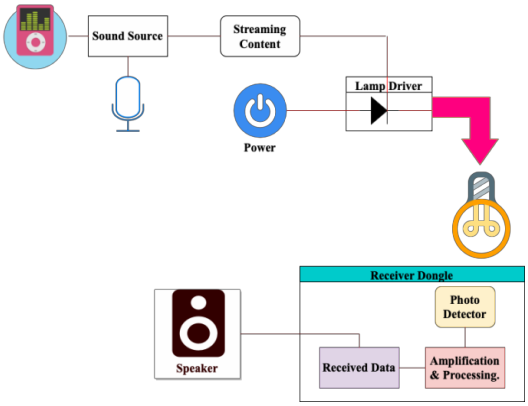


Figure 1: An overview of Li-Fi' architecture.

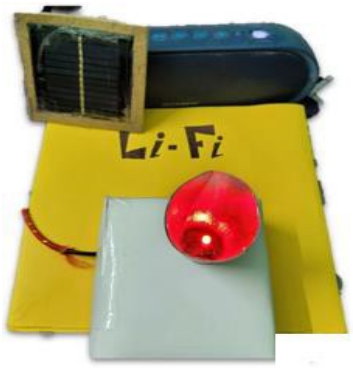


Figure 2: Experimental setup.

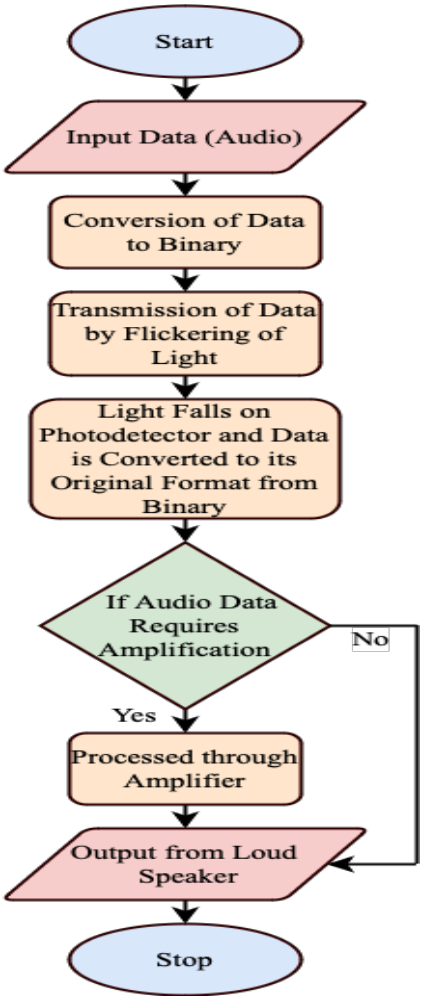


Figure 3: Framework diagram of our proposed model.

## 4. RESULTS

A Li-Fi based audio transmitting model was successful in transmitting audio signals without any loss from the audio source to the amplifier connected speaker wirelessly. The source (audio source) was kept at about ten meters far from the destination (speakers) and we observed that the latency was about 0.03 milliseconds for the signal to reach the destination which is far better than Bluetooth technology that takes about 34 milliseconds to 300 milliseconds to reach the destination. Furthermore, using this technology, we can transmit Hi-Res lossless audio having bit rates about 24-bit/192kHz or 9216kbps wirelessly, that was impossible using Bluetooth. The experimental setup is shown below in Figure 3.

Table 2: Study of effect of distance on latency for Li-Fi based system.

| Distance between source and destination | Latency |
|---|---|
| 10 m | 0.0000333 ms |
| 7 m | 0.0000234 ms |
| 5 m | 0.0000167 ms |
| 3 m | 0.00001 ms |

## 5. CONCLUSION

Li-fi is an apparently prominent technology that focuses on wide usage of wireless applications. It helps in greater area of coverage unlike a single Wi-Fi router. This technology provides high speed communication at gigabytes per second. One of the usability of Li-Fi is, any light source for example the halogen lights in any theatre or auditorium can be used as Li-fi epicenters or hubs where the light can be used as a means to transmit the audio signals from a podium or a stage to the amplifier connecting the speakers placed far away from the podium or the stage. This reduces the irregular or disorganized wire management, making the setup more time-efficient and cost-effective. Use of light will not intermeddle with any electronic wiring and hence this technology is very much secured and unthreatening to the human lives.

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