International Journal of Research and Development in Engineering Science
ISSN: 2582 - 4201(Online) , http://www.ijrdes.com/
Regular Issue, Vol. 6, Issue. 6 (November – December) , 2024 , Pages: 14 - 17
Received **:** 12 May 2024 ; *Accepted***:** 26 October 2024 ; *Published***:** 17 November 2024
https://doi.org/10.63328/IJRDES-V6RI6P4
Original Paper : Applied Research - Experimental Research Paper

Transmission of Audio, Voice and Text using Visible Light Communication

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Abstract: : In recent technology Visible Light Communication (VLC) is utilizes visible light to transmit the data. While it's commonly used for indoor lighting, it can also be harnessed to transmit audio, text, and even voice signals. it's worth noting that VLC faces some challenges compared to traditional wireless communication technologies. For instance, VLC requires a direct line of sight between the transmitter and receiver, making it less suitable for long-range communication or scenarios with obstacles obstructing the light path, because it has few advantages over other standard wireless transmissions. The advantages of VLC are low power consumption, high data rate, more security and can avoid interference occurs. Under various constraints, including light intensity, output quality, and distance, the transmitter and receiver system will combine the audio, text, and speech transmission utilizing Li-Fi and validate its performance. Li-Fi employs standard light for transmissions at 10 Kbit/s or LED for up to 500 Mbit/s of connectivity over short distances. This paper describes a system that can provide data over a range of distances through experimentation. We are also implementing the transmission of Audio, Voice and Text Using Visible Light Communication for indoor location-based services.

Keywords: Audio transfer; Li-Fi, voice transfer, text transfer, visible light communication and Arduino uno

1. Introduction

The University of Edinburgh is credited with coining the name "Li-Fi," The term Li-Fi stands for "**Light Fidelity** however German scientist and physicist Herald Has originally presented this concept. In July 2011, he presented and illustrated it during a TED talk. He thought that lightbulbs might serve as wireless routers for data transfer. In his demonstration, he demonstrated how energy transfer may be achieved by varying the amplitude of a lightbulb operating at high rates. He first showed the audience the high-definition video he had produced using LEDs to transmit it. Later on, he founded a business called pure LiFi. The usage of this wireless technology has grown since then. Li-Fi is a wireless communication technology that primarily uses visible light with frequencies between 400 THz and 800 THz for transmission. Li-Fi relies only on amplitude modulation of the light source to propagate information in a specified and consistent manner. Visible light communication, or VLC, is called as Li-Fi. It detects incoming light signals using a photo detector, also known as a photodiode, and converts the received data into digital format. The quick alternating stream of ON and OFF signals used by the LED light bulb is undetectable to the human eye. Currently, Li-Fi is operational in over 20 nations. The implementation of Li-Fi in several areas, including healthcare, transportation, retail, and commercial applications. Li-Fi is far quicker than regular Wi-Fi, which has a maximum data transfer rate of about 7 Gbps. Li-Fi can handle data transfer speeds of up to 10 Gbps. The unchallenged leader in wireless data transfer is the Wi-Fi. Although manufacturers are clearly interested in Li-Fi, the technology hasn't yet attained any type of critical mass. However, given the various conditional benefits that Li-Fi does provide and the constraints associated with Wi-Fi spectrum availability, it is reasonable to anticipate a significant increase in interest in Li-Fi in the years to come.

2. Literature Survey

In 2011 Harald Haas was the first person to put "Information conveyed through luminous" in front of the world at the global TEDx. The target is based on data ceding through luminosity. Another way it's said as light

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is -based on wireless fidelity (Wi-Fi). Here, a transceiver outfitted with LEDs is employed as a source of lumine and a data transmission device in place of Wi-Fi modems. The world of data connection is largely dependent on wireless communication. Worldwide sales of cell phones were approximately 122.32 million in 2007. In 2013, the amount reaches 969.72 million. Additionally, the population will reach 1.524 billion in 2019 and is projected to rise to 1.582 billion in 2021. From this, it may be inferred how significant wireless communication is.

The researchers have done some study on the use of visible light communication systems. A effective integration of data, video, and audio VLC transceiver system for tablets and smartphones was reported in (Chieh, 2013). Moreover, (Chieh, 2014) have shown how high-quality audio may be transmitted for VLC systems aboard commercial aircraft. Above the passenger seats, LED reading lights have been integrated into the transmitter circuits that transport the audio signal. The headphones have integrated and customized receiver circuits. Since visible light wireless optical communication systems are easily integrated into current aircraft electronics and do not interfere with the aircraft's control system, they have the greatest potential for usage in aviation. Implementation of a Basic Li-Fi Based System by Shilpi Mishra [5]

This study focuses on text, audio, and video data transfer using Li-Fi technology. This procedure necessitates a somewhat more intricate transmitter that uses PCB. This is used to regulate and change the LED's light intensity. Thus, this study turns out to be a more sophisticated version of the project we are working on right now, which just shows how text data can be transmitted. Additionally, RGB LEDs (red, green, and blue) are incorporated to improve the data transfer rate. The efficiency of receiver design is improved by using a phototransistor rather than an LDR, as is the case in most situations.

Madhuri G, et al. Data, audio, and text signal transmission via Li-fi technology [6]. A thorough illustration of picture transmission is shown. We observe the use of transceivers that are linked to the two PCs that are in communication with each other. Here are some benefits of employing LEDs in the transmitter system: they are environmentally friendly, perform better, have a flexible design, and have a longer lifespan.

3. Experimental Method

(a) Text Transmission

To maintain the content ready for transmission, the text will first be inputted into the source, such as a computer, laptop, or mobile device. Subsequently, the transmitting end will function in line with the required text transfer. The transmitter side's micro controller will receive the text. The circuit shown in fig1 schematic illustrates how an Arduino UNO is interfaced with an LDR sensor on the Li-Fi reception side. Here, an analog voltage output from the LDR sensor is sent to Arduino as an input signal by connecting it in series with a resistor to create a voltage divider circuit. Here, we're employing an LCD-equipped I2C module to decrease the number of connections with Arduino UNO.

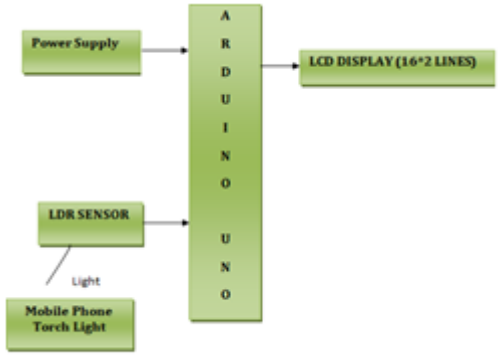

Fig.1 Block diagram of text transmission

To move further with the additional processing, the text will be coded in a form. When the code is prepared, it is sent to the converter, which transforms the coded text into the light form. Once it is inside the light's range, the data are then sent to the receiving side. The coded text is subsequently transmitted to the receiver's output after being decoded. Next, the source that is on the receiving side is used to retrieve the output

(b) Audio Transmission

The Fig.1 represents the block diagram for the text transmission. The transmission of audio signal was done through a Smartphone at the transmitter end, providing the audio signal through the 3.5 mm jack.

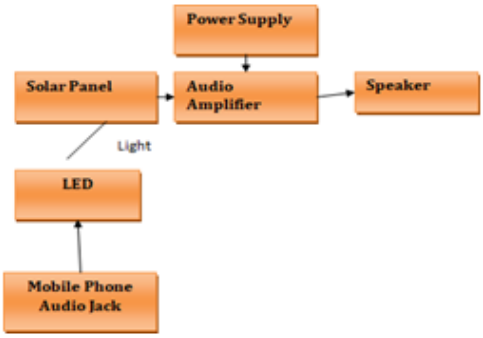

Fig:2 Proposed Block Diagram for Audio transmission

The 3.5mm audio jack and the input audio from the phone is converted from digital to Analog. It is connected to a LED along with a 5V battery to supply the power required and the LED converts the audio signal to light signal. This variation in the intensity of light,

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however, is captured on a solar panel that acts as a photo detector. It captures all the variations and sends the received signal to an amplifier circuit and then the speaker.

The audio amplifier circuit amplifies the analog signal that was sent from the flickering LED to the solar panel, causing the sound waves to be heard from the speaker. We use an amplifier board, speaker, solar panel, LED light, and earbuds to transmit audio. Here, we'll connect an earbud to our system, which is connected to a solar panel. When we play music on our system, the light on the solar panel sends a signal to the amplifier circuit, which amplifies it and sends it to the speaker. We utilize an Arduino board to analyze the data and a Li-Fi transmitter and receiver to facilitate communication between an LCD display and a Li-Fi .

4. Result and Discussion

Li-fi is a completely fresh technology for data transmission. By varying the light's intensity, LIFI data is transmitted and subsequently detected by a photo detector. A light source functions as a transmitter in visible light communication (VLC) technology, while a photo detector functions as a receiver. Electrical signals are transformed into optical signals in the transmitter and sent via LED. A photo detector is included in the receiver. The optical signal is transformed into an electrical signal by the photo detector. Using multiple LEDs at once makes this process more complicated. More information can be transmitted in this manner, enabling faster data transfer. The LCD screen will ask for or display any message sent via the Li-Fi app
The text will be inputted in the text format by utilizing the Li-Fi app. Following the message sent through the Li-Fi app, the mobile flash will activate immediately.

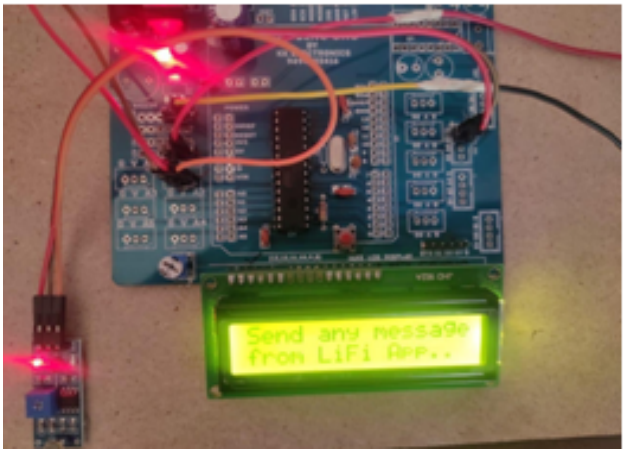

Fig.3 Li-Fi Model

A Li-Fi model typically includes the necessary hardware components to set up a Li-Fi network. This may include LED light bulbs or fixtures equipped with Li-Fi technology, The receivers or dongles to decode the transmitted data, and software to enable communication between devices.

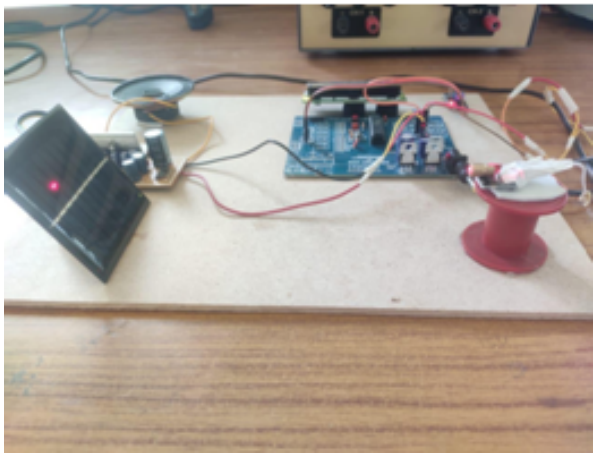

Fig.4 Laser light on solar panel

In transmitter side, when we connect 3.5mm jack to audio source LED 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, LED's intensity is changing faster than the human eye can follow.

The LED on the transmitter side illuminates when the 3.5mm jack is connected to an audio source; nevertheless, the light's intensity remains constant when the audio source is turned off. As soon as the soundtrack starts playing, you'll notice that the light's intensity is constantly changing. The intensity of the LED changes more quickly than the human eye then the loudness of the speaker is increased. Because solar panels are so sensitive, even slight changes in intensity can cause a commensurate shift in the voltage at the panel's output. Thus, voltages will vary based on the intensity of light when LED light strikes the panel. The solar panel's voltages are then routed into an amplifier, which is connected to a speaker, amplifying the signal and producing an audio output that is heard through the speaker.

5. Conclusion and Future Work

In conclusion, Li-Fi technology stands at the forefront of wireless communication innovation, offering compelling advantages in terms of speed and security. Despite current challenges related to coverage and standardization, ongoing research and industry efforts hold promise for broader adoption and integration into diverse applications.

As Li-Fi evolves and matures, it is poised to play a significant role in the future of wireless connectivity, complementing and potentially surpassing traditional wireless technologies in specific use cases and

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environments. Continued investment and collaboration across academia, industry, and standards bodies will be key to unlocking the full potential of LiFi technology in the years to come.

With the aid of the laser light source located on the transmitter side, we have successfully transferred the audio signal to the receiving side. The speaker produces a clear audible sound. With the Arduino and Li-Fi Software. we have successfully transmitted the text signal, and the output is precisely shown. This technology has a highly promising future. Here is an example of how the difficulty of integrating visible light with a communication system was solved. Without requiring any modifications, this system can be utilized with the current infrastructure. In the realm of wireless communications, visible light communication is a rapidly developing technology. Although this sector has numerous hurdles, there are just as many, as benefits.

Although there is still much to be done to bring this technology to the market, it holds significant promise for the development of wireless internet. This idea is presently being developed by a large number of academics and businesses, and it holds the potential to address the issues of limited radio spectrum, space, and slow internet connections. By implementing this technology, we can switch to communication networks that are safer, cleaner, and greener. Li-Fi's basic idea promises to address problems like radio frequency shortages

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