



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 10, October 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

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Li-Fi Data Transfer System

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ABSTRACT: Li-Fi, short for "Light Fidelity," is an emerging technology that utilizes visible light communication to enable high-speed data transfer wirelessly. Unlike traditional radio frequency-based communication systems, Li-Fi employs light-emitting diodes (LEDs) to transmit data through the modulation of light signals. Li-Fi technology harnesses the properties of visible light to transmit data, leveraging the vast available spectrum of visible light waves. By rapidly modulating the intensity of LED lights, data can be encoded and transmitted to a receiver equipped with a light sensor. This optical wireless communication technique offers several advantages, such as increased data transfer speeds, reduced interference, and enhanced security compared to traditional Wi-Fi. The unique features of Li-Fi make it a promising solution for various applications, including indoor wireless communication, Internet of Things (IoT), and next-generation smart lighting systems. The potential use cases range from office environments and hospitals to public spaces and transportation systems.

KEYWORDS: Li-Fi, data transfer, wireless communication, LED, Internet of Things (IOT), Text, Sound.

I. INTRODUCTION

The rapid growth of data-intensive applications and the increasing demand for high-speed wireless communication have driven the exploration of innovative technologies beyond the capabilities of traditional radio frequency-based systems. In this context, Li-Fi has emerged as a promising solution, harnessing the power of visible light to enable wireless data transfer. This paper provides an in-depth analysis and evaluation of the Li-Fi data transfer system, exploring its key principles, advantages, challenges, and potential applications. Li-Fi technology represents a paradigm shift in wireless communication by utilizing light-emitting diodes (LEDs) to transmit data through visible light signals. Unlike Wi-Fi, which operates in the radio frequency spectrum, Li-Fi utilizes the abundant and unlicensed spectrum of visible light waves to achieve unprecedented data transfer speeds, reaching gigabit-per-second rates. By modulating the intensity of LED lights at extremely high speeds, data can be encoded and transmitted to a receiver equipped with a light sensor.

One of the key advantages of Li-Fi lies in its potential for significantly higher data transfer rates compared to conventional wireless technologies. The gigabit-per-second speeds offered by Li-Fi enable rapid file transfers, seamless multimedia streaming, and real-time communication, thereby addressing the growing need for high-bandwidth applications in various domains. In addition to speed, Li-Fi offers enhanced security, making it an attractive choice for applications where data privacy is crucial. Since visible light does not penetrate through walls like radio waves, Li-Fi provides a more confined communication channel, reducing the risk of unauthorized interception. This characteristic makes Li-Fi well-suited for sensitive environments such as healthcare facilities, defense installations, and financial institutions.

II. LITERATURE SURVEY

The most of the people are using Wi-Fi Internet devices, which will be useful for 2.4-5GHz RF to deliver wireless Internet access surrounded our home, offices, schools, and some public places also. We are quite dependent upon these nearly ubiquitous services. While Wi-Fi can cover an entire house, school, the bandwidth is limited to 50-100 megabits per seconds (Mbps). It is a most current Internet services, but insufficient for moving large data files like HDTV movies, music libraries and video.

In reference with [1] transmitter and receiver have been implemented where the flickering in LED is basically used as the signal to be transmitted. The rapid ON (transmits 1) and OFF (transmits 0) of the LED is used to encode a string of data signal. In the receiver the data is converted into digital signals with the help of modulation. The optical concentrator is using to compensate for high spatial attenuation due to the beam divergence from the LEDs to illuminate large area.

In reference with [2] audio transmission using Li-Fi have been implemented. They have implemented Li-Fi transmitter module consisting of amplifiers and power LED whereas the Li-Fi receiver module consists of amplifiers and LDR. They have used a way like Wi-Fi hotspots which are used to transmit the data wirelessly. This reduces the electrical overhead and is ecofriendly and hence the environment will be more radiation free zone.

In reference with [3] 2D Image transmission have been implemented using Li-Fi. They have used light as a data transmission medium to securely transmit data as it overcomes the disadvantage of data leakage and efficiently transmit multimedia data over a medium. It uses Visible light communication technology.

In reference with [4], Wi-Fi may not be the most efficient way to provide new desired capabilities such as precision indoor positioning and gesture recognition. The optical 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 the terms of communication speed, usability and flexibility, reliability. VLC is the possible solution to the global wireless spectrum shortage. LIFI technology is a fast and cheap optical version of Wi-Fi. It is a based on Visible Light Communication. The data is encoded in the light to generate new data stream by varying the flickering rate, to be clearer, by modulating the LED light with the data signals, it illustrates the communication source.

III. BLOCK DIAGRAM / CIRCUIT DIAGRAM

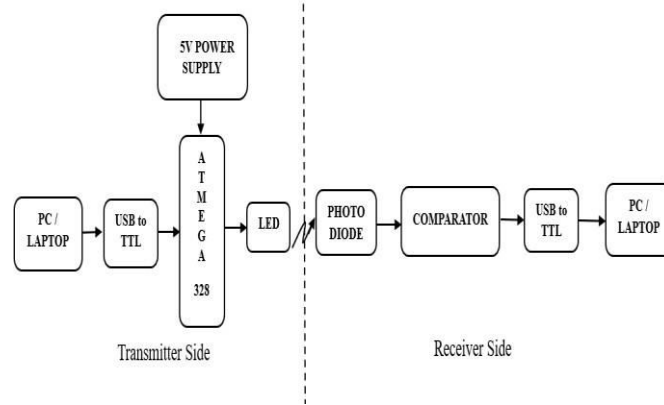


Fig.1. Block Diagram of LiFi Data Transfer System

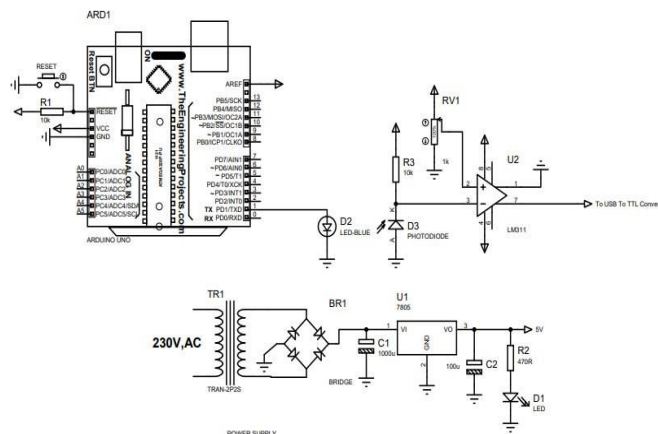


Fig.2. Circuit Diagram of LiFi Data Transfer System

Working:

Li-Fi system mainly includes two parts namely the transmitter and receiver. The input signal at the transmitter section can be modulated with a specific time period then send the data using LED in 0’s and 1’s form. Here, the flashes of LED bulbs are denoted with 0’s and 1’s. At the receiver end, a photo transistor or solar panel is used to receive the LED flashes strengthens the signal & gives the output. The block diagram of Li-Fi system is shown above, and the transmitter section includes the input, Atmega 328, LED. The input of the transmitter can be any kind of data like text, sound etc. The receiver section includes photo transistor or Solar panel. Here, photo transistor receives the LED bulb flashes then changes the flashes into electrical signals. Finally, the amplifier receives the signals from the photo transistor and amplifies to provide the output.

IV. FLOWCHART

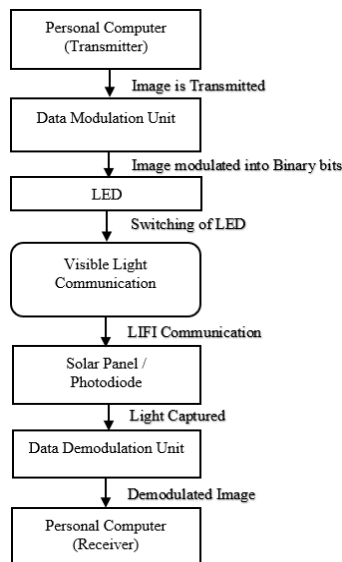


Fig.3. Flowchart of LiFi Data Transfer System

V. RESULTS

Software used – Tetra Term VT

The below output shows the transmitted text and received text, on transmitting PC and Receiving PC respectively.

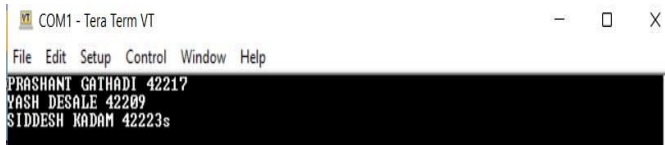
1. Data Transmitted from Transmitter



1. Data Received at Receiver



2. Data Transmitted from Transmitter



2. Data Received at Receiver



VI. ADVANTAGES

- High speed.
- High Data Transfer Rate.
- Highly Secured and Reliable.
- Low Cost.

VII. APPLICATIONS

1. Indoor Wireless Communication: Li-Fi can be employed in various indoor environments such as offices, educational institutions, hospitals, and retail spaces. It offers high-speed wireless connectivity, enabling seamless data transfer for file sharing, video streaming, and internet access.
2. Healthcare Environments: Li-Fi can be beneficial in healthcare facilities where reliable and secure data transfer is critical. It can facilitate high-speed transmission of medical records, imaging data, and real-time monitoring information.
3. Industrial and Manufacturing Environments: It can facilitate real-time monitoring and control of equipment, improve communication between machines, and enable efficient data exchange for inventory management, logistics, and quality control.
4. Underwater Communication: Li-Fi has the potential to enable high-speed wireless communication underwater, where traditional radio-based systems face challenges. By utilizing modulated light signals, Li-Fi can provide reliable and secure data transfer for underwater exploration, marine research, and underwater infrastructure monitoring.

VIII. CONCLUSION

Li-Fi data transfer system represents a transformative technology that utilizes visible light communication to enable high-speed wireless data transmission. Throughout this paper, we have explored the principles, advantages, applications of Li-Fi, shedding light on its potential to revolutionize wireless communication. Li-Fi offers several key advantages over traditional wireless technologies. Its ability to achieve gigabit-per-second data transfer rates provides immense potential for rapid file transfers, seamless multimedia streaming, and real-time communication. Additionally, the enhanced security of Li-Fi, due to the confined communication channel of visible light, makes it an appealing solution for applications where data privacy and security are critical.

IX. FUTURE SCOPE

In future, this work can be enhanced by:

- 1) Adding the high intensity of Array of LEDs or Lasers to increase the range of communication.
- 2) Output disturbance can be reduced by adding the noise termination circuit at the receiver end.

X. ACKNOWLEDGMENTS

The successful completion of this project required a lot of guidance and assistance from many people and we are extremely privileged to have got this all along the completion of our project. All that we have done is only due to such supervision and assistance and we would not forget to thank them.

We respect and thank the HOD of the ENTIC Department of our college **Dr. Mrs. R. S. Kamathe** for providing tous an opportunity to do the project work and give us motivation which made we completethe project duty. We are extremely thankfulto our head of the department, Electronics,for providing support and encouragement for our project work.

We owe our deep gratitude to our project guide, **Dr. Mrs. M. A. Kango** who took keep interest in our project work and guided us all along, till the completion of our project work by providing all the necessary information for developing a good system.

At last, we would like to thank our parents, friends and all those who have helped directly or indirectly towards the completion of our project.

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Impact Factor: 8.423



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