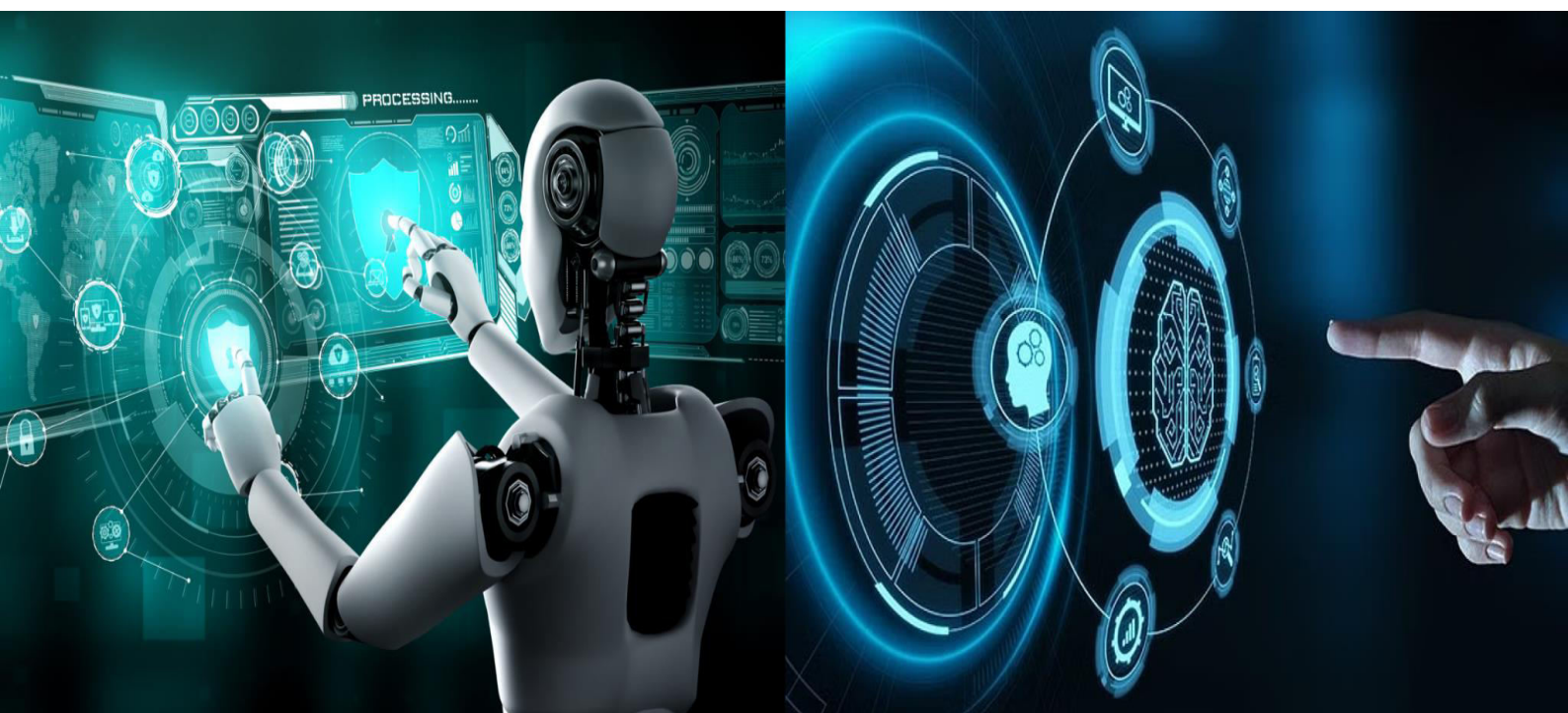# International Journal of Innovative Research in Computer and Communication Engineering

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Transmission of Text, Audio and Image Using Li-Fi Technology

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ABSTRACT: The paper explores the use of **Li-Fi (Light Fidelity)** technology for wireless communication of **text, audio, and image** data. Unlike Wi-Fi, Li-Fi uses **visible light** from LEDs to transmit data, offering advantages like **high speed, energy efficiency, security, and no RF interference**.

Li-Fi (Light Fidelity) is a cutting-edge wireless communication technology that uses the **visible light spectrum** instead of radio frequencies to transmit data. It operates using LEDs that flicker at speeds imperceptible to the human eye. This flickering encodes data which can be decoded by a photo detector on the receiving end.

I. INTRODUCTION

Li-Fi is a type of wireless technology that communicates via visible light. Li-Fi has been a huge success in every industry of communication because it uses visible light, which has a fast speed, more security, and less interference, allowing for high-capacity wireless data transmission. The goal of this study is to use light as a carrier to communicate text and audio data. To convey text data and audio, a high-flickering LED can be used as a source. Data is sent using LEDs in Li-Fi technology. It is a variation of optical wireless communication technology that uses light from LEDs to transmit data at fast speeds. The human eye cannot detect visible light communication because the LEDs are turned on and off at a very fast rate.

Li-Fi is an emerging optical wireless communication (OWC) technology that leverages the visible light spectrum for data transfer. Unlike Wi-Fi, Li-Fi uses light from LEDs to transmit information, offering benefits such as higher data rates, security, and immunity to electromagnetic interference. This paper aims to design a Li-Fi-based communication system to transmit text, audio, and image data.

II. LITERATURE SURVEY

To develop an efficient and reliable Li-Fi system, it is crucial to understand existing approaches and technologies. This literature review summarizes prior work that has influenced the design and implementation of our Li-Fi-based transmission system.

P. Sonawane et al. (2022) the experimental results are detailed and discussed in depth, and the gadget design is thorough. With the addition of a focusing sensor between the transmitter and the receiver, it has been shown that high-quality video/audio and image transmission is possible across 12 feet. Even yet, there are still limitations when comparing photos taken before and after transmission.

For more studies this research project consisted of a data transmission implementation through Li-Fi with light signal propagation circuits and Arduino Uno kits. The circuit is composed of two Arduinos, a LED, a photodiode and a software developed with Arduino Ide and C#. Data communication was implemented through an Arduino board for data encoding and decoding.

Further exploring real time transmission Mali et al. implemented real-time text and audio transmission using LED and solar panels explained and demonstrated a real-time text and audio broadcast prototype by using LED and solar panel and examine the transmission of both text and audio signals using visible light communication.

Along with this Murthy et al. developed a bidirectional system for audio and text communication using Li-Fi. The system utilized visible light modulation techniques and low-cost hardware components such as LEDs and photodiodes. Their implementation demonstrated effective communication over short distances and highlighted the potential of Li-Fi in secure and interference-free environments such as hospitals and industrial settings.

Collectively, these studies highlight the growing interest and progress in the field of Li-Fi technology. They demonstrate that visible light communication can effectively support the transmission of various data types such as text, audio, and images under controlled conditions. Furthermore, they reveal opportunities for Li-Fi in environments where traditional RF communication is limited or undesirable, thereby reinforcing the motivation for continued research and development in this domain.

III. SYSTEM BLOCK DIAGRAM

This study's technique was centered on assessing how well Li-Fi technology could transmit audio data. To show that this may work with Li-Fi technology, a simple circuit was built.
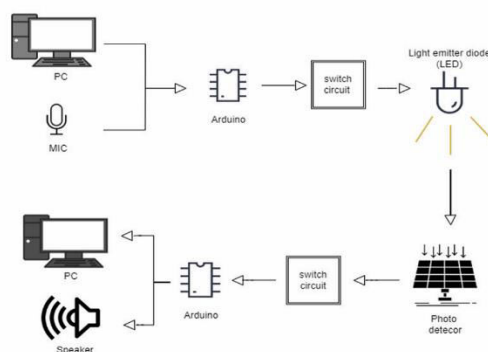

Figure 1: Block diagram of Li-Fi transmission and reception.

Transmitter Module The transmitter consists of an ESP32/ESP32-CAM for data handling and a high-power LED modulated via a MOSFET driver. A DIP switch selects between audio and data modes. Text and image transmission is initiated through push buttons.

Receiver Module The receiver uses four BPW34 [3]photodiodes connected to a transimpedance amplifier. The signal is then filtered and amplified using an LM358 op-amp. Text is displayed on an LCD, audio is played through a speaker, and images are served on a local web server.

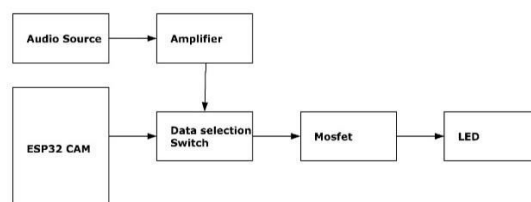### IV. IMPLEMENTION WORKING PROCEDURE

Transmitter Module :

Figure 2: Block diagram of Transmitter module.

[1]The transmitter section of the Li-Fi communication system is designed to support audio, text, and image transmission using visible light. The selection between audio and data (text or image) transmission is controlled using a DIP switch. In the audio mode, an external audio source is connected directly to the circuit. The analog audio signal is used to modulate the intensity of a high-power white LED via a MOSFET driver[2], enabling the transmission of sound through variations in light intensity.

The text and image data are modulated using On-Off Keying (OOK) and encoded with Orthogonal Frequency Division Multiplexing (OFDM) for better transmission efficiency. Each data type is tagged with a unique header— 0xAB 0xCD for text and 0xAA 0x55 for image—to aid in proper identification and decoding at the receiver.
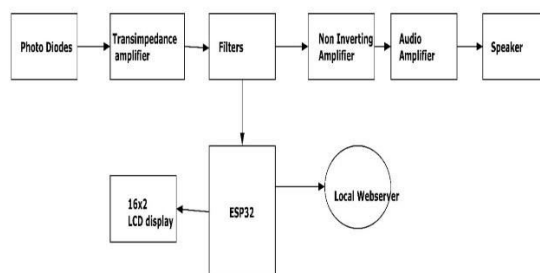
Receiver Module:

Figure 3: Block diagram of Receiver module.

The receiver section consists of a photodiode array comprising four BPW34 photodiodes[4], which detect the modulated light signals transmitted by the LED. These photodiodes are configured to feed their combined output into a transimpedance amplifier circuit, which converts the photocurrent into a voltage signal. This signal is then passed through a low-pass filter to remove high-frequency noise, followed by a non-inverting amplifier stage using an LM358 operational amplifier to increase the signal amplitude.

The amplified output is directed in two ways: one path goes to an audio amplifier capable of delivering up to 5 watts of power to a 3-watt speaker, allowing the reception of real-time audio; the second path is fed directly to the RX pin of another ESP32 module via UART for digital data processing. The ESP32 receives the text and image data, demodulates it, and identifies the type of content using the designated headers. Text data is displayed on a 16x2 LCD screen, while received image data is hosted and viewed through a local web server created by the ESP32, accessible via any device on the same network. Like the transmitter, the receiver is also powered using a 12V adapter, with voltage regulation down to 5V to ensure safe and stable operation of all components.

V. RESULTS

The implemented Li-Fi system was successfully tested for the transmission of **text, audio, and image data** under various indoor conditions. The results validate the functionality and reliability of the prototype.

1. **Text Transmission**
- The transmission of pre-stored text using the ESP32-CAM and LED modulation achieved **100% successfully.**
- Text was successfully decoded and displayed on a 16x2 LCD connected to the receiver-side ESP32 module.
- **OOK (On-Off Keying)** modulation provided sufficient robustness for binary text data transfer.
- The use of **start-stop bits** and **header identification (0xAB 0xCD)** helped in accurate data segmentation and error-free decoding.
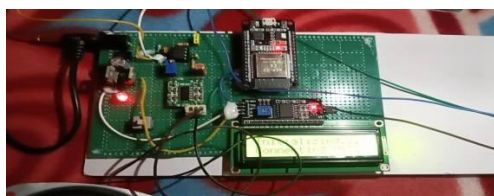

Figure 4: Transmission of text.

2. **Audio Transmission**
- Real-time analog audio signals were transmitted using LED intensity variation and received by BPW34 photodiodes.
- The audio signal was amplified using PAM8403 and played through a 3W speaker.

- Noise levels increased slightly in high ambient light settings but were mitigated using low-pass filters and shielding techniques.
- No noticeable lag was detected, confirming real-time signal transmission viability.

3. Image Transmission

- The ESP32-CAM captured low-resolution images (160x120 pixels) which were encoded and transmitted using LED pulses.
- The receiving ESP32 module correctly identified the image header (**0xAA 0x55**), decoded the binary stream, and hosted the image on a **local web server**.
- Transmission time per image was around **4 seconds**, due to limited baud rate and image encoding delays.

VI. CONCLUSION

The project "Transmission of Text, Audio and Image Using Li-Fi" successfully demonstrates the feasibility and effectiveness of visible light communication (VLC) as a medium for wireless data transmission. By utilizing low-cost and readily available components such as high-power LEDs, photodiodes, ESP32 microcontrollers, and ESP32-CAM, a reliable and energy-efficient system was developed and tested.

Through practical implementation, the system achieved real-time transmission of audio, accurate delivery of text, and successful image transfer via a web server. The experimental results validate that Li-Fi can offer a secure, interference-free, and high-bandwidth alternative to traditional RF-based communication systems—particularly in environments where radio waves are restricted or undesirable, such as hospitals, aircraft, and underwater applications.

This work lays the foundation for future improvements in Li-Fi-based data transmission systems, including enhanced range, support for higher-resolution media, bidirectional communication, and integration with smart IoT networks. With continued research and refinement, Li-Fi holds great promise as a cornerstone technology in the next generation of wireless communication.

VII. ACKNOWLEDGMENT

REFERENCES

[1]. P. Sonawane, J. S. Pradhan, V. P. Waghmare, S. Kesari, "Complete Data Transmission using Li-Fi Technology with Visible Light Communication," 2022 International Conference on Futuristic Technologies (INCOFT), Belgaum, India, 2022, pp. 1-5, doi:10.1109/INCOFT55651.2022.10094453.

[2]. R. Hassan, M. S. Flayyih, A. S. Sadeq and D. F. Murad, "Visibile Light Communication Technology For Data Transmission Using Li-Fi," 2020 2nd International Conference on Computer and Information Sciences (ICCIS), Sakaka, Saudi Arabia, 2020, pp. 1-5, doi: 10.1109/ICCIS49240.2020.9257654.

[3]. S. Mali, A. Agarwal, S. K. Singh and D. D. Pradhan, "Design and Implementation of Text and Audio Signal Transmission using Visible Light Communication," 2020 Fourth International Conference on I-SMAC, Palladam, India, 2020, pp. 303-306, doi: 10.1109/I-SMAC49090.2020.9243416.

[4]. G. K. J. Hussain, M. Shruthe, S. Rithanyaa, S. R. Madasamy and N. S. Velu, "Visible Light Communication using Li-Fi," 2022 6th International Conference on Devices, Circuits and Systems (ICDCS), Coimbatore, India, 2022, pp. 257-262, doi: 10.1109/ICDCS54290.2022.9780735.

[5]. S. V. S. N. Murthy, S. Vallabhareddi, A. V. S. S. Varma, V. Praveena, K. Pavani and A. Vijjapu, "Li-Fi Technology for Visible Light Communication in Text and Audio Transmission," 2024 10th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2024, pp. 627-632, doi: 10.1109/ICACCS60874.2024.10717302

[6]. S. Sirohi, P. Kumari, J. Arya, A. Kumar and P. Kumar, "Li-Fi Data Transmission Using Visible Light Communication Technology," 2023 3rd International Conference on Advancement in Electronics & Communication Engineering (AECE), GHAZIABAD, India, 2023, pp. 43-45, doi: 10.1109/AECE59614.2023.10428674.

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