

LOW COST AND LOW POWER VIDEO TRANSMISSION USING LIGHT FIDELITY

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in Electronics and Communication Engineering

by

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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

CATEGORY -1 UNIVERSITY BY UGC

**Accredited with Grade "A++" by NAAC | 12B Status by UGC | Approved by AICTE
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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **V. HARISH (40130245)** and **D. RAHUL (40130708)** who carried out the project entitled **"LOW COST AND LOW POWER VIDEO TRANSMISSION USING LIGHT FIDELITY"** under my supervision from November 2023 to April 2024.

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DECLARATION

We V. Harish (40130245) and D. Rahul (40130708) hereby declare that the Project Report entitled "Low Cost and Low Power Video Transmission Using Light Fidelity" done by us under the guidance of Ms. S. Annie Angelino Preethi, M.E., (Ph.D) at Sathyabama Institute of Science and Technology is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

DATE: 18.04.2024

PLACE: Chennai

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ABSTRACT

Light Fidelity is a wireless communication technology, which is used to transfer data in the form of light. In the existing systems, we are using Wi-Fi (wireless fidelity) to transfer the data, whereas transferring data using Wi-Fi is less secure and low accurate compared to Light fidelity (Li-Fi). This paper presents an innovative idea of transferring data or video using light fidelity at low cost and low power utilization.

In the proposed system, we are going to transfer a moving video file from one device to another device using Li-Fi Technology. Firstly, the video file in 3gp format from one device is modulated into binary data packets through Transmitter software, and the binary data packets are transferred using an LED through a space medium. At the receiver end, the photodiode detects and allows the light rays which contain data packets for demodulation through receiver software. The demodulated video file is stored in the receiver device.

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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

These days, everyone wants to work online due to the rise in high-speed internet usage in recent years. People want to watch and get films quickly and with excellent quality. The efficiency of the speed decreases when multiple users use a single internet connection in a space. Several options were looked into to address this issue; one of them was to use the underdeveloped visible light spectrum, leading to the development of the unique Li-Fi idea. It is a short form for Light-Fidelity, which have light based data transfer service. Li-Fi systems use Light Emitting Diodes (LEDs), which have a high modulation bandwidth and sufficient efficiency to give long-term lighting.

Li-Fi's affordability is one of its main advantages over more traditional communication methods. Commercially available LED bulbs can be used to construct Li-Fi systems, which convert the current lighting infrastructure into networks for data transfer. Because of its dual-purpose features, Li-Fi reduces the need for additional infrastructure expenditures, making it an affordable choice for both large-scale deployments with limited resources.

Low power consumption is another benefit of Li-Fi' s usage of light waves for data transfer. Li-Fi linked devices have the ability to send data without the need for specific radio components, compared to wireless communication systems that use radio frequency transmissions. This increases the battery life of connected devices and helps in increasing focus on eco-friendly and low-energy technologies.

1.2 Architecture of Li-Fi

Li-Fi which can be the future of data communication appears to be a fast and cheap optical version of Wi-Fi. Being a Visible Light Communication (VLC). Li-Fi uses visible light of electromagnetic spectrum between 400 THz and 800 THz as optical carrier for data transmission and illumination. It uses fast pulses of light to transmit information in wireless medium. The main components of a basic Li-Fi system may contain the following:

- a) A high brightness white LED which acts as transmission source.
- b) A silicon photodiode with good response to visible light as the receiving element.

Switching the LEDs on and off can make them generate digital strings with different combination of 1s and 0s. To generate a new data stream, data can be encoded in the light by varying the flickering rate of the LED. In this way, the LEDs work as a sender by modulating the light with the data signal. The LED output appears constant to the human because they are made to flicker at a phenomenal speed (millions of times per second) and it's impossible for human eye to detect this frequency. Communication rate more than 100 Mbps can be achieved by using high speed LEDs with the help of various multiplexing techniques. And this VLC data rate can be further increased to as high as 10 Gbps via parallel data transmission using an array of LED lights with each LED transmitting a different data stream.

This Project discusses the implementation of the most basic Li-Fi based system to transmit Sound signal from one device to another through visible light. The purpose is to demonstrate only the working of the simplest model of Li-Fi with no major consideration about the data transfer speed. This model will demonstrate how the notion of one-way communication via visible light works, in which Light emitting diodes (LEDs) are employed as the light sources or Transmitter antennas. The model will transmit digital signal via direct modulation of the light. The emitted light will be

detected by an optical receiver. In addition to the demonstration purpose, the model enables investigation into the features of the visible light and LEDs incorporated in the communication model.

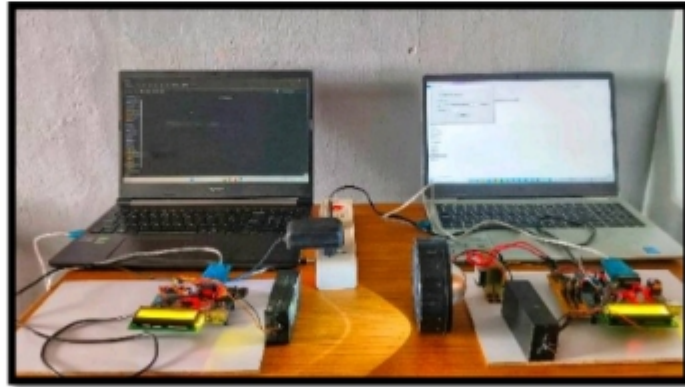


Fig:1.1 : The Architecture of Light Fidelity.

1.3 Working of Li-Fi

Light Fidelity (Li-Fi) technology is a wireless communication system based on the use of visible light between the violet (800 THz) and red (400 THz). Unlike Wi-Fi which uses the radio part of the electromagnetic spectrum, Li-Fi uses the optical spectrum i.e. Visible light part of the electromagnetic spectrum. The principle of Li-Fi is based on sending data by amplitude modulation of the light source in a well-defined and standardized way. LEDs can be switched on and off faster than the human eyes can detect since the operating speed of LEDs is less than 1 microsecond. This invisible on-off activity enables data transmission using binary codes. If the LED is on, a digital '1' is transmitted and if the LED is off, a digital '0' is transmitted. Also, these LEDs can be switched on and off very quickly which gives us a very nice opportunity for transmitting data through LED lights, because there are no interfering light frequencies like that of the radio frequencies in Wi-Fi. Li-Fi is thought to be 80% more efficient, which means it can reach speeds of up to 1 Gbps and even beyond. Li-Fi differs from fibre optic because the Li-Fi protocol layers are suitable for wireless communication

over short distances (up to 10 meters). This puts Li-Fi in a unique position of extremely fast wireless communication over short distances.

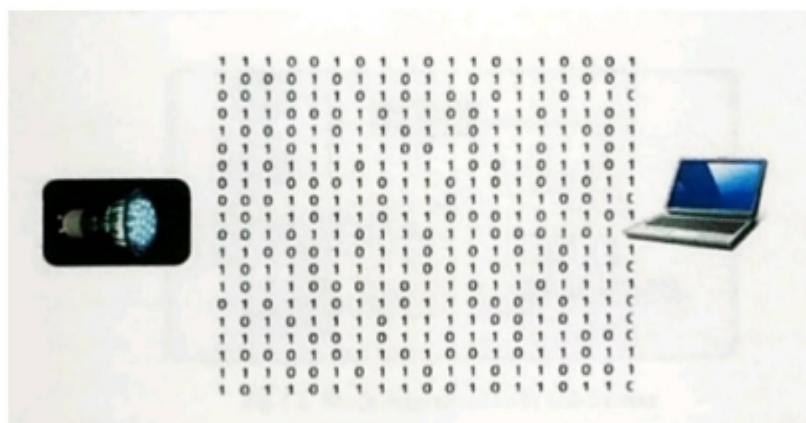


Fig:1.2 : Li-Fi Transmission in Binary Form

1.4 HOW IT WORKS?

The working of Li-Fi is very simple. There is a light emitter on one end i.e. an LED transmitter, and a photo detector (light sensor) on the other. The data input to the LED transmitter is encoded in to the light (technically referred to as Visible Light Communication) by varying the flickering rate at which the LEDs flicker 'on and 'off to generate different strings of 1s and 0s. The on/off activity of the LED transmitter which seems to be invisible. The LED intensity is modulated so rapidly that human eye cannot notice, so the light of the LED appears constant to humans enables data transmission in light form in accordance with the incoming binary codes switching ON a LED is a logical '1' switching it OFF is a logical 0. By varying, the rate at which the LEDs flicker on and off, information can be encoded in the light to different combinations of 1s and 0s. In a typical setup, the transmitter (LED) is connected to the data network internet through the modem and the receiver (photo detector/light sensor) on the receiving end receives the data as light signal and decodes the information, which is then displayed on the device connected to the receiver. The receiver (photo detector) registers a binary '1' when the transmitter (LED) is ON and a binary 0 when the

transmitter (LED) is OFF. Thus, flashing the LED numerous times or using an array of LEDs (perhaps of a few different colours) will eventually provide data rates in the range of hundreds of Mbps. The Li-Fi working is explained in a block diagram.

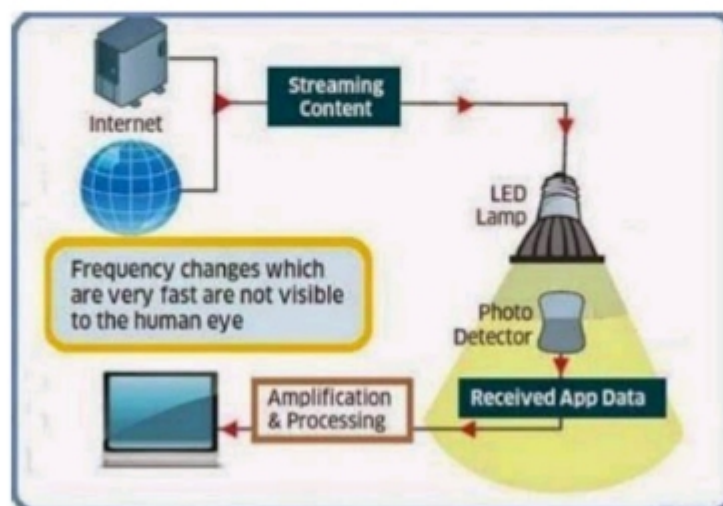


Fig:1.3 : Block Diagram of Li-Fi Subsystem

Hence all that is required, is some or an array of LEDs and a controller that controls/encodes data into those LEDs. All one has to do is to vary the rate at which the LEDs flicker depending upon the data input to LEDs. Further data rate enhancements can be made in this method, by using array of the LEDs for parallel data transmission, or using mixtures of red, green and blue LEDs to alter the light's frequency, with each frequency encoding a different data channel. Figure 1.4 shows working/deployment of a Li-Fi system connecting the devices in a room.



Fig:1.4 : Li-Fi Connection in a room

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

[1] Arun Prakash K, Prashant Kumar and K P Sharma, “Challenges and Applications of Li-Fi in D2D Communication” June 2023.

In this paper, advantages of using Li-Fi is done by comparing one of the leading Device to Device communication facility available which is Wi-Fi. Wi-Fi is in for a long time now since it is providing a much more efficient compared to other technologies in terms of data rate, range and the ability to accommodate more devices in a single access point but that advantages come with some limitations which can be overcome by the help of Li-Fi, the features of Wi-Fi and Li-Fi are compared in depth.

[2] R. Badeel, S. K. Subramaniam, Z. M. Hanapi, A. Muhammed, A. Shkurinov, and C. Li, “A Review on Li-Fi Network Research: Open Issues, Applications and Future Directions,” 2022.

In this paper, we have extensively reviewed the Li-Fi technology from various aspects of the literature. The survey was extensively conducted on some of the major databases, and all eligibility criteria were applied to achieve the intended outcome of this review. The papers surveyed all the topics concerning Li-Fi technology. Based on this work, it has been distinctly identified that Li-Fi is an emerging field that fully warrants further investigation. This paper presented detailed information to be furnished for future researchers. These have been summarized by analyzing and classifying the literature as a comprehensive review and by reviewing Li-Fi technology based on its essential aspects.

[3] Saqlaim Razzaq , Nimra Mubeen, and Farhan Qamar, “ Design and Analysis of Light Fidelity Network for Indoor Wireless Connectivity” October 2021.

This paper proposes an optimized and smooth wireless connectivity model is put forward, based on improved Q-factors at different distances (2m to 10m) between the

source of connectivity and the user, for ameliorated indoor network connections. We propounded firm connectivity model to achieve new targets successfully. The model brought forth is studied in detail, and we tested myriad ambient sources on different levels to make sure the model is duly optimized and efficiently analysed.

[4] **S. M. Praveena, T. G. Sree, and W. Rajendran, "Li-Fi Based Indoor Navigation System for the Visually Impaired People," International Journal of Engineering Applied Sciences and Technology, vol. 4, pp. 372–376, 2020, Accessed: May 13, 2021.**

This paper proposes is to help visually impaired users to navigate conveniently when they move around and to able to transmit and receive directions correctly and well function for users to use. In order to make this paper work smoothly, it needs to deal with changing weather conditions such as sunblazing. Moreover, light waves can easily be blocked and cannot penetrate thick walls like radio waves can.

[5] **C. Jenila and R. K. Jeyachitra, "Green indoor optical wireless communication systems: Pathway towards pervasive deployment," Digit. Commun. Networks, vol. 7, no. 3, pp. 410–444, 2021.**

The objective of this work is to make a roadmap of OWC systems toward the establishment of reliable, energy-efficient, high-speed, and spectral-efficient OWC links in indoor environments. A safe and secure OWC and its ubiquitous deployment are vital for the sustainable development of ICT. As this communication technology has its innate nature of safety in terms of harmless EM rays and security in terms of spatial limitation, the optimization of OWC systems and transmission techniques will lead to dependable, future-generation, high-speed communication. Being an energy-efficient communication technology, OWC can also reduce other sectors, such as aviation, transportation, and manufacturing. More efficient energy use can bolster energy security also. The positive consequences of an environmentally conscious, safe, and secure OWC are explored in this paper.

[6] P. LOENZ and L. HAMADA, “Li-Fi Towards 5G: Concepts, Challenges, Applications in Telemedecine,” Aug 2020.

In this paper, The main future use of Li-Fi seems to be the relief of different networks namely: 3G, 4G, Wi-Fi. In this perspective, there is a technology currently under study: 5G This technology will use these 4 kinds of networks so as not to clutter them. For example, if someone picks up Wi-Fi or Li-Fi at home, goes out and travels to their place of work, the most powerful and appropriate network will take over. In this case, surely that once outside it will capture 3G or 4G.

[7] Mohamed Sufyan Islim and Harald Hass “Modulation Techniques for Li-Fi” in Research gate April 2016.

In this paper, the techniques satisfy the illumination and communication requirements. Single carrier modulation techniques offer a simple solution for frequency flat Li-Fi channels. Low to medium data rates can be achieved using single carrier modulation techniques. Multicarrier modulation techniques offer high data rate solutions that can adapt the system performance to the channel frequency response.

2.2 SUMMARY

Explaining the concept of Li-Fi as a wireless communication technology that uses light waves instead of radio frequencies to transmit data. Highlighting its potential to complement existing technologies like Wi-Fi and its advantages such as high data transfer rates and security. Discussing the potential applications of Li-Fi in various sectors such as indoor positioning, internet access in areas with electromagnetic interference, healthcare, aviation, and underwater communication. Summarizing the key findings of the literature survey and providing insights into the current state of research on Li-Fi. Identifying areas for future research and development to address remaining challenges and further enhance the capabilities of Li-Fi technology.

CHAPTER 3

REQUIREMENT ANALYSIS

3.1 EXISTING SYSTEM

The data file is only transmitted in the existing system and also it takes more time to transfer with costly equipment.

The existing system uses RF based communication, so the interference of signals and noise of the signal is high. Power consumption of existing system is high compared to proposed system. Installation cost and environmental hazards are high in this system because radio frequencies are used for communication. In existing system, users are using RF technology for transmission of data and are transmitted only to a short range. More data loss occurs because of the phenomenon called interference. Power loss is much higher as the system got heated up while communicating via radio waves. So, the chance of getting the destruction of the system is high due to prolonged use. We transmit wireless data through radio waves which are limited.

Radio waves are scarce and expensive and we only have a certain range of it. With the advent of the generation technology as of like of 2.5G, 3G, 4G and so on we are running out of spectrum. There are 1.4 million cellular radio base stations which consume massive amount of energy. Most of this energy is not used for transmission but for cooling down the base stations. Efficiency of such a base station is only 5% and that raise a very big problem. Availability of radio waves or RF signals causes another concern as we have to switch off our mobiles in aeroplanes, it is not advisable to use mobiles at places like petrochemical plants, hospitals, defense areas and petrol pumps. Radio wave penetrates through walls and they can be intercepted. If someone has a knowledge and bad intentions than they may misuse it.

3.1.1 Limitations

1. High power usage.
2. Costly Equipment.
3. More time taking process.

TABLE: 3.1 : Data of Existing Model

Existing Model	
File size	Time (seconds)
104 KB	114
120 KB	223
189 KB	342

3.2 PROPOSED SYSTEM

Our proposed work focuses on the use of LED for layout the data communication like video by Li-Fi technology. Transmission is executed by switching LED light ON and OFF. In this setup the transmission distance between receiver and transmitter is 1m at the 31 bytes/s. For video transmission we used Tx-Rx Software.

The step involved in the above process is the device is switched ON, the video from PC is transmitted to UART through the USB cable. For direct and fast connection, RS232 level serial UART interface to USB is done by using the USB to RS232 cable. The length of the cable is 0.8m which is wire shielded. The UART (Universal Asynchronous Receiver and Transmitter) board is an asynchronous serial transmission hardware equipment. UART transmit the individual bits by taking bytes of data in a sequential manner. Input and output shift register, read/write logic control, clock generator, transmitter/receiver control are elements of UART. For the transmission of data from UART, we are using Arduino UNO controller in this project. It has the

capability of interrupt upon 14 sources. It is a high rate and low power CMOSFLASH/EEPROM technology. Its voltage range is from 2V to 5.5V. When the PIC16F877A receives the UART data, it converts the data into TTL [Transmitter Transistor Logic]. TTL is from the bipolar junction transistor logic family. The transistor implements both the operation of logic and amplification. The Transistor-Transistor Logic works on the constant current flow from the positive rails between the resistor and into the multiple emitter transistor. From the base emitter junction, the current is passed to the output transistor. The performance and pulling of the output voltage are allowed in TTL. From UART the data is transmitted to a LED driver. The main application of LED driver is to retrieve high voltage direct current, alternative current to low voltage. The voltage or current fluctuation in a LED is preserved by LED driver. In this paper the LED driver converts the video into light with the same frequency which it receives. Li-Fi Transmitter receives the light from the LED Driver.

In the proposed system to overcome the drawbacks of the existing system, Here, both the audio and video file of 3GP format is transmitted with low-cost equipment in less time.

3.2.1 Advantages:

1. High Speeds: Li-Fi can achieve data transfer speeds that are significantly faster than Wi-Fi. This is because light waves have a higher frequency and can carry more data compared to radio waves.
2. Increased Bandwidth: The available spectrum for visible light communication is much larger than that of radio frequencies, offering potential for greater bandwidth and higher data capacity
3. Security: Li-Fi offers improved security compared to Wi-Fi because light signals cannot pass through walls, making it more difficult for unauthorized users to intercept data. This can enhance the privacy and integrity of sensitive information.
4. Less Interference: Li-Fi operates in the visible light spectrum, which is less congested compared to the crowded radio frequency bands used by Wi-Fi and

other wireless technologies. This reduces the likelihood of interference from other devices and networks.

TABLE: 3.2 : Data of Proposed System

Proposed Model	
File size	Time (seconds)
104 KB	58
120 KB	98
189 KB	186

In this project, we proposed to transfer a moving data file with audio feature in the 3GP video format from one device to another device instead of transferring in the MP4 video format.

The 3GP format helps users to watch videos without downloading the entire file because of its streaming features. Because 3GP files use audio and video files that lower file size and quality, they can be used on devices with low storage capacity.



Fig:3.1 : 3GP Video Format

We also proposed for low power usage because of implementation of step down transformer. They are very efficient and gives the output with an efficiency of upto 99 percentage. We can get the output voltage easily without loss of much power usage. They are reliable and less expensive.

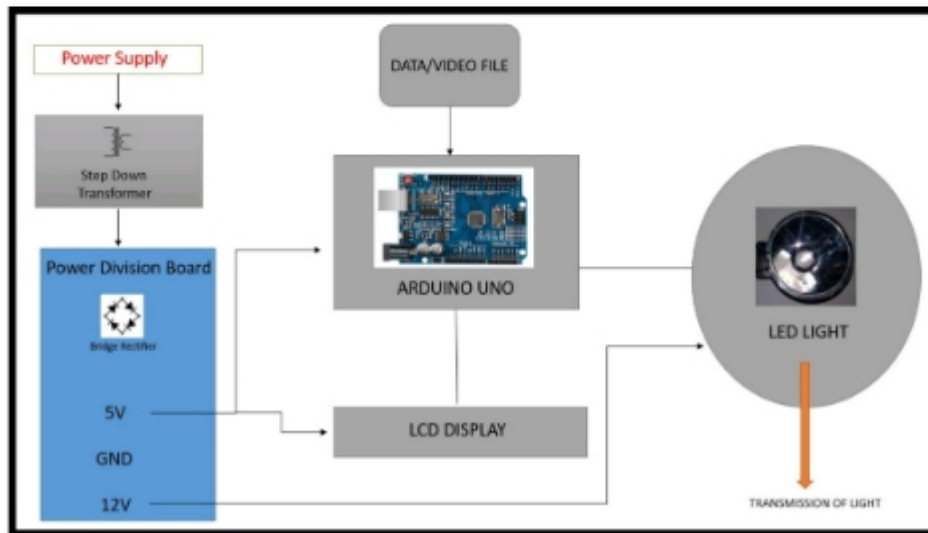


Fig:3.2 : Block diagram of Li-Fi Transmitter

In the Li-Fi setup, the first half is the Transmitter in which the power supply is given to the step-down transformer which converts the 230V AC to the 12V AC. After that the 12V AC is converted into 12V DC with the help of a Bridge Rectifier and the power is divided into 5V DC.

The input video file from the transmitter side computer is modulated by using Transmitter-Tx software modulation technique and transmitted through the LED to the receiver.

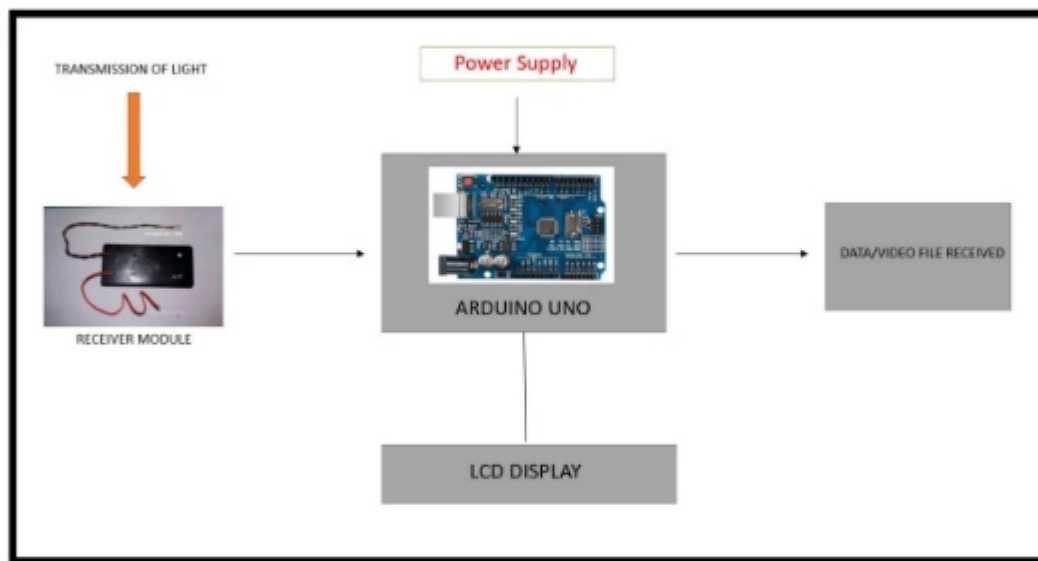


Fig:3.3 : Block diagram of Li-Fi Receiver

In the Li-Fi setup, the second half is the Receiver which detects the light waves through the photodetector.

The light waves are demodulated into the original video file by using Receiver-Rx software demodulation technique in the receiver's computer.

Once the light waves are captured and converted into electrical signals, the next step involves demodulating these signals into the original video file. This demodulation process is facilitated by specialized software known as Receiver-Rx, which operates within the receiver's computer system. Through advanced demodulation techniques, Receiver-Rx deciphers the encoded data carried by the light waves, reconstructing the original video file for playback or further processing. This intricate interplay between hardware and software components within the Receiver ensures efficient and reliable data transmission in Li-Fi systems.

3.3 CIRCUIT VIEW

A Li-Fi transmitter is a device responsible for converting data into optical signals and transmitting them using light waves. Here are some key aspects and components typically found in a Li-Fi transmitter Overall, a Li-Fi transmitter plays a crucial role in enabling high-speed and secure wireless communication by harnessing visible light as the medium for data transmission. As Li-Fi technology continues to evolve, advancements in transmitter design and functionality are expected to further enhance its performance and usability in various applications.

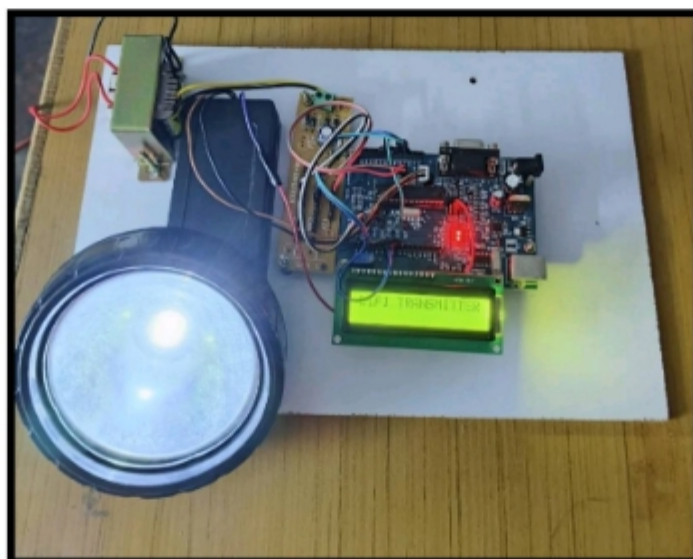


Fig:3.4 : Circuit of Li-Fi Transmitter

A Li-Fi receiver is a device responsible for detecting and decoding optical signals transmitted via light waves and converting them back into digital data. Here are some key aspects and components typically found in a Li-Fi receiver. Overall, a Li-Fi receiver plays a crucial role in enabling high-speed and secure wireless communication by converting modulated light signals into digital data. As Li-Fi technology continues to evolve, advancements in receiver design and functionality are expected to further enhance its performance and usability in various applications.

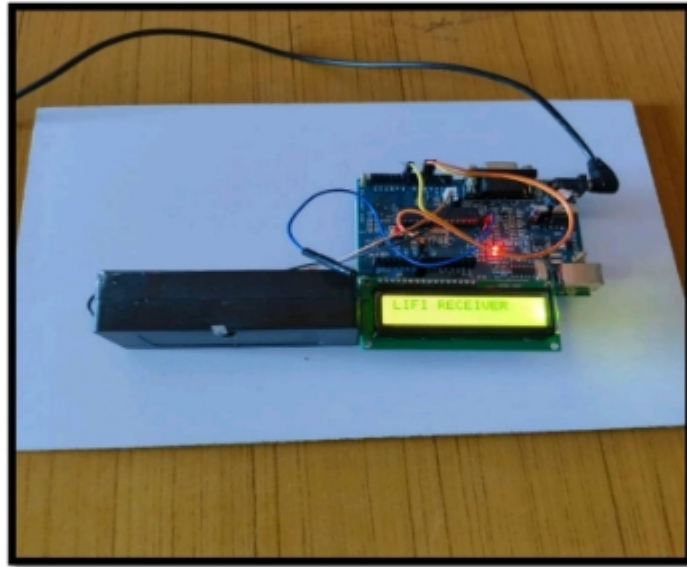


Fig:3.5 : Circuit of Li-Fi Receiver

3.4 Standards

IEEE Standards for Communications: IEEE (Institute of Electrical and Electronics Engineers) has several standards related to wireless communication technologies, including Li-Fi. Referencing relevant IEEE standards would provide credibility to the proposed system.

ISO Standards for Data Transfer: ISO (International Organization for Standardization) standards related to data transfer and communication protocols to ensure compatibility and reliability of the proposed system.

Li-Fi Consortium Guidelines: The Li-Fi Consortium may have established guidelines or specifications for implementing Li-Fi technology. Adhering to these guidelines could ensure interoperability and performance of the system.

Data Transmission Standards: Standards such as TCP/IP (Transmission Control Protocol/Internet Protocol) for data transmission over networks to demonstrate compatibility and efficiency in data transfer.

Video File Formats: Standards for video file formats, such as MPEG (Moving Picture Experts Group), to ensure that the proposed system supports common video formats and encoding standards.

LED Communication Standards: Standards related to LED (Light-Emitting Diode) communication to ensure proper modulation and transmission of data through light.

Photodiode Specifications: Specifications and standards for photodiodes and optical receivers to ensure accurate detection and demodulation of data at the receiver end.

Power Efficiency Standards: Standards related to power consumption and energy efficiency to demonstrate the benefits of using Li-Fi technology in terms of low power utilization.

3.5 Constraints

Line-of-Sight Requirement: Li-Fi communication typically requires a direct line of sight between the transmitter (LED) and the receiver (photodiode). Any obstruction in the path of light could hinder data transmission. **Limited Range:** Li-Fi communication range is generally limited compared to Wi-Fi, especially in outdoor environments or areas with high ambient light. The effective range of the proposed system may be constrained by factors such as LED intensity and sensitivity of the photodiode. **Interference from Ambient Light:** Ambient light sources, such as sunlight or indoor lighting, could interfere with the transmission of data through Li-Fi. This interference may affect the reliability and accuracy of data transfer.

Data Rate: While Li-Fi offers high-speed data transmission, the achievable data rate may be limited by factors such as LED modulation capabilities, photodiode sensitivity, and environmental conditions. **Hardware Limitations:** The practical implementation of Li-Fi technology may be constrained by the availability and cost of specialized hardware components, such as high-intensity LEDs and sensitive photodiodes. **Security Concerns:** Although Li-Fi offers potential security advantages over Wi-Fi due to its localized nature, the proposed system must address security vulnerabilities such as interception of light signals and unauthorized access to data.

Compatibility with Existing Infrastructure: Integration of Li-Fi technology into existing communication networks and devices may pose compatibility challenges. Ensuring seamless interoperability with other wireless technologies could be a constraint.

Power Consumption: While the abstract mentions low power utilization as a benefit, the actual power consumption of the Li-Fi system, including LED operation and signal processing, as a constraint, especially in battery-powered devices.

3.6 Trade-offs

Speed vs Range: Li-Fi can offer high-speed data transmission, but this may come at the cost of reduced range compared to Wi-Fi. Users may need to prioritize between faster data transfer rates and the distance over which data can be reliably transmitted.

Line-of-Sight vs Mobility: While Li-Fi typically requires a direct line of sight between the transmitter and receiver, mobility may be limited. Users may need to trade off the convenience of mobility with the need for a clear line of sight for effective communication.

Security vs Interference: Li-Fi offers potential security benefits due to its localized nature, but it may be more susceptible to interference from ambient light sources. Users may need to weigh the security advantages against the risk of interference in their specific environment.

Cost vs Performance: The proposed system aims to provide data and video transmission using Li-Fi at low cost. However, achieving low cost may involve tradeoffs in terms of performance, such as data transfer speed or range. Users may need to assess the tradeoff between cost-effectiveness and system performance.

Compatibility vs. Standardization: Integrating Li-Fi technology into existing devices and infrastructure may require adherence to standards and protocols. Users may need to balance the benefits of compatibility with the need to innovate and differentiate their system from existing standards.

Power Consumption vs Efficiency: The abstract mentions low power utilization as a benefit of using Li-Fi. However, achieving low power consumption may require tradeoffs in terms of signal strength, data rate, or range. Users may need to optimize power consumption while ensuring efficient data transmission.

Reliability vs. Environmental Factors: Li-Fi communication may be affected by environmental factors such as ambient light levels, physical obstructions, and atmospheric conditions. Users may need to consider tradeoffs in reliability and performance based on the specific environmental conditions in which the system will be deployed.

Moreover, physical obstructions such as walls or objects in the transmission path can attenuate the light signals, reducing their strength and impacting the overall communication quality. Additionally, atmospheric conditions like fog or rain can scatter light signals, further complicating their transmission and reception.

Given these environmental challenges, users must carefully weigh the tradeoffs between reliability and performance when deploying Li-Fi systems. They may need to adapt their deployment strategies or utilize additional technologies to mitigate the effects of environmental factors. By understanding and addressing these challenges, users can optimize the reliability and performance of Li-Fi communication in various real-world scenarios.

CHAPTER 4

SOFTWARE AND HARDWARE REQUIREMENT

4.1 PROTEOUS SOFTWARE

Proteus is used to simulate, design, and drawing of electronic circuits. It was invented by Lab center Electronics. By using proteus you can make two-dimensional circuit designs as well. With the use of this engineering software, you can construct and simulate different electrical and electronic circuits on your personal computers or laptops. There are numerous benefits to simulating circuits on proteus before making them practically. Designing of circuits on the proteus takes less time than practical construction of the circuit. The possibility of error is less in software simulation such as loose connection that takes a lot of time to find out connections problems in a practical circuit. Circuit simulations provide the main feature that some components of circuits are not practical then you can construct your circuit on proteus. There is zero possibility of burning and damaging of any electronic component in Proteus. Electronic tools that are very expensive can easily get in proteus such as an oscilloscope. Using proteus you can find different parents of circuits such as current, the voltage value of any component, and resistance at any instant which is very difficult in a practical circuit.

Features of proteus

- There are 2 main parts of proteus first is used to design and draw different circuits and the second is for designing of PCB layout.
- First is ISIS used to design and simulate circuits. And second is ARES used for designing a printed circuit board.
- It also provides features related to the three-dimensional view of design in PCB.

Proteus Layout

- Friends, now we discuss the layout of proteus and will discuss sections and their functionality in proteus.
- When you will click on the Icone of installed Proteus in your computer then you will see this window from a new file option.

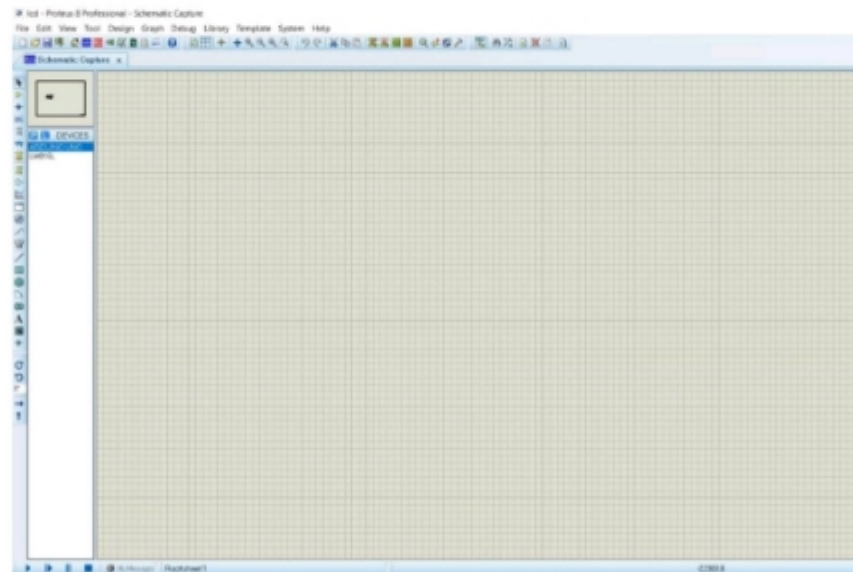


Fig:4.1 : Proteus Layout

Editing Window

- In the above figure, you can see that the dotted portion is called an editing window. This is a drawing portion of proteus where you simulate your engineering circuits and projects.

Overview Window

- In the overview window, you see the complete view of your complete design.

Object Selector

- This section has 2 buttons P and E. P is used to select different components and shown in this box. The E button is for editing something for example you want to vary any value of components then you can use this edit button.

Zoom Option

- By using this option you can easily zoom in and zoom out your layout and can observe the complete simulation very clearly.

Tool Option

- By using this option you can select different devices like voltmeter, ammeter, oscilloscope, etc.

Run Buttons

- At the left bottom, there are 4 buttons Run, stop, pause, and stop. These buttons are like the remote control and are on and off your circuit.

How to make circuit in Proteus**Step 1:**

First click on Proteus icon in your computer and click on a new file option as shown in the below figure.

Step 2:

After that, you will see the drawing sheet as shown in the below figure. Save it according to your project.

Step 3:

After a move to the component option as shown in the below figure and select the elements for your projects.

Step 4:

After clicking on components mode you will see two buttons P and L. If you move to P button you will see Pic from Libraries.

It is used to select different components for circuit construction.

Step 5:

When you will click on the P button you will see box shown in the below figure. Type your component for a circuit.

As I type button and you can see a button in right figure that different buttons are shown you can select according to your use.

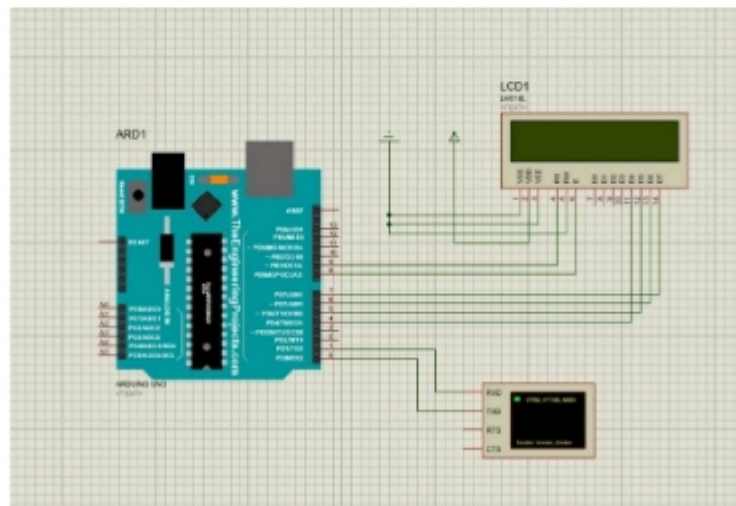


Fig:4.2 : Proteus Circuit connection

Step 6:

When you will select components for your project you will see them in a box shown in the below figure.

I have also selected some components for designing of a simple circuit

After the selection of components make the circuit layout of your project and connect all these components with the wires.

For connection of one component to another clicks the left of the first terminal of the component and drag it to other components.

If you want to remove any component or remove its connection just double-click on the respective of component of the wire.

If you want to change the values of any component such as resistance, or capacitor, then click right on that component and select the desired value and click OK button.

As in the below figure, I vary the value of battery voltages.

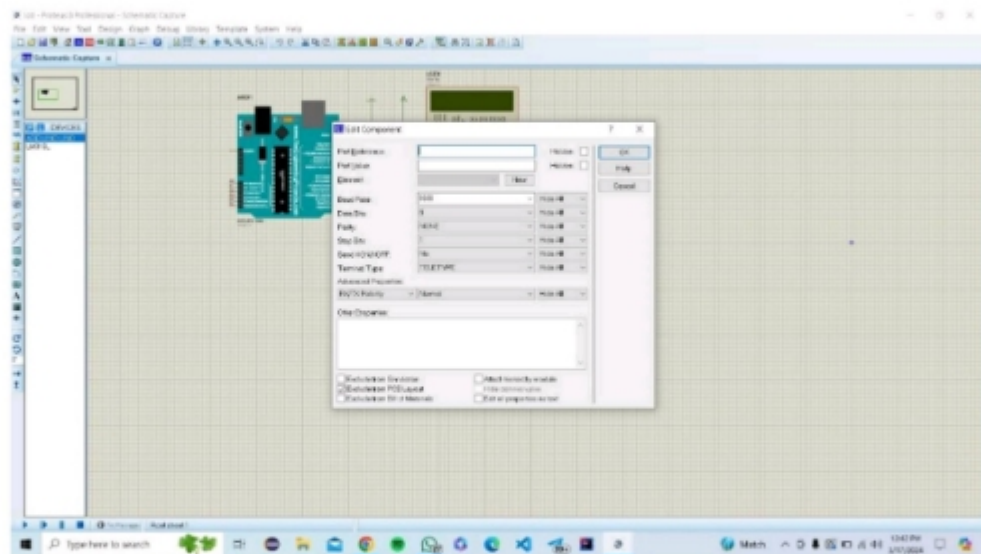


Fig:4.3 : Proteus Component Description

Step 7:

When you connect all components in the circuit like run button in the left bottom see the practical working of your circuit

Step 8:

When you will observe the simulation of your circuit than click on stop button on the left bottom to stop the working of the circuit.

4.2 SIMULATION

4.2.1 Transmitter Side

The steps involved in the Transmitter side:

- Open the Li-Fi transmitter software and click the Li-Fi transmitter setup.
- Click Setup.EXE shown in the Fig 4.2.

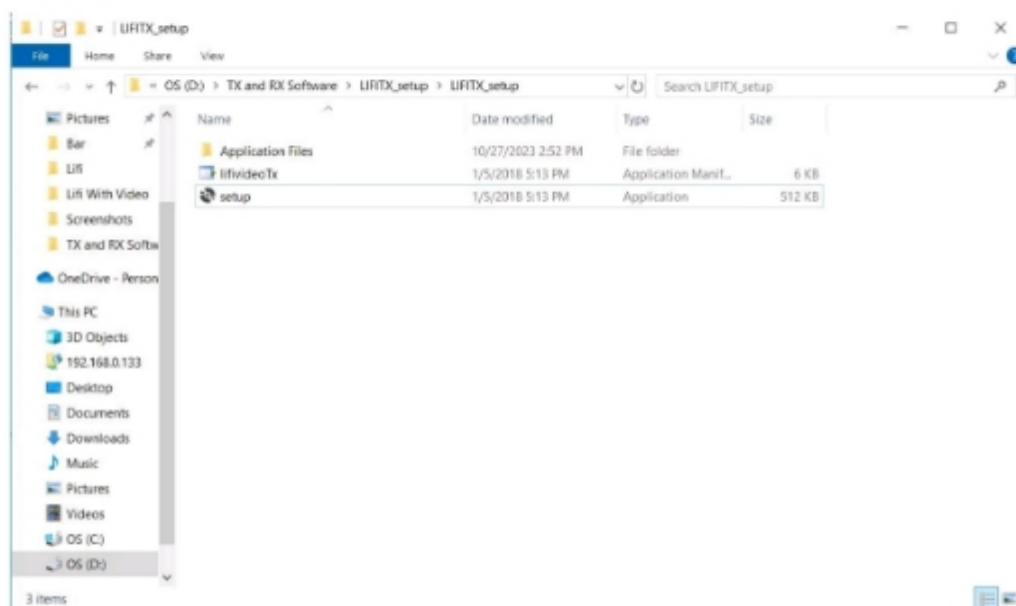


Fig:4.4 : Transmitter TX Setup

- Transmitter page will appear, choose the port which is connected to transmitted kit.
- Click the open file and select the video file which we have to transmit.
- Click send button. Shown in Fig 4.3.

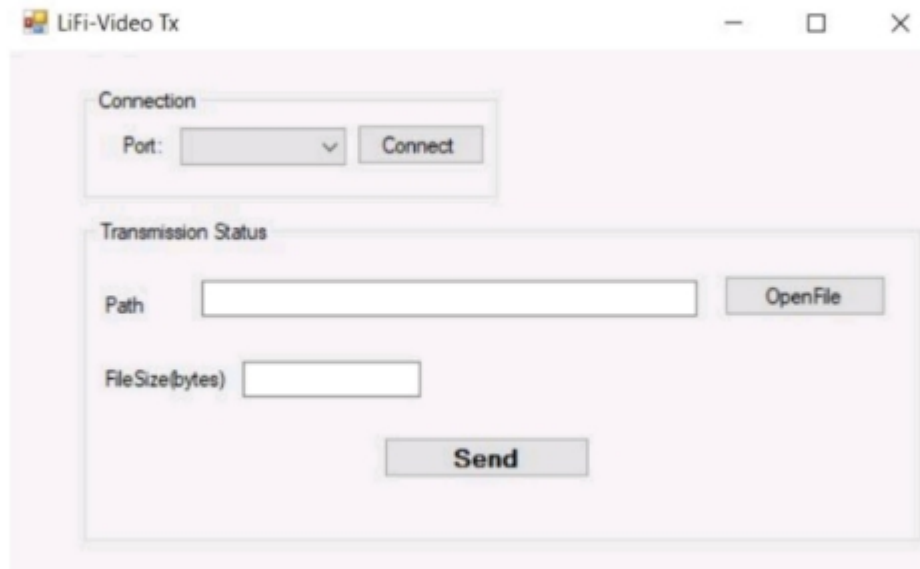


Fig:4.5 : Video Transmitter.

4.2.2 Receiver Side

The steps involved in the Receiver side:

- Create a new folder named as video in Local Disc C.
- Open Li-Fi software in that open Li-Fi receiver setup. Shown in Fig 4.4.

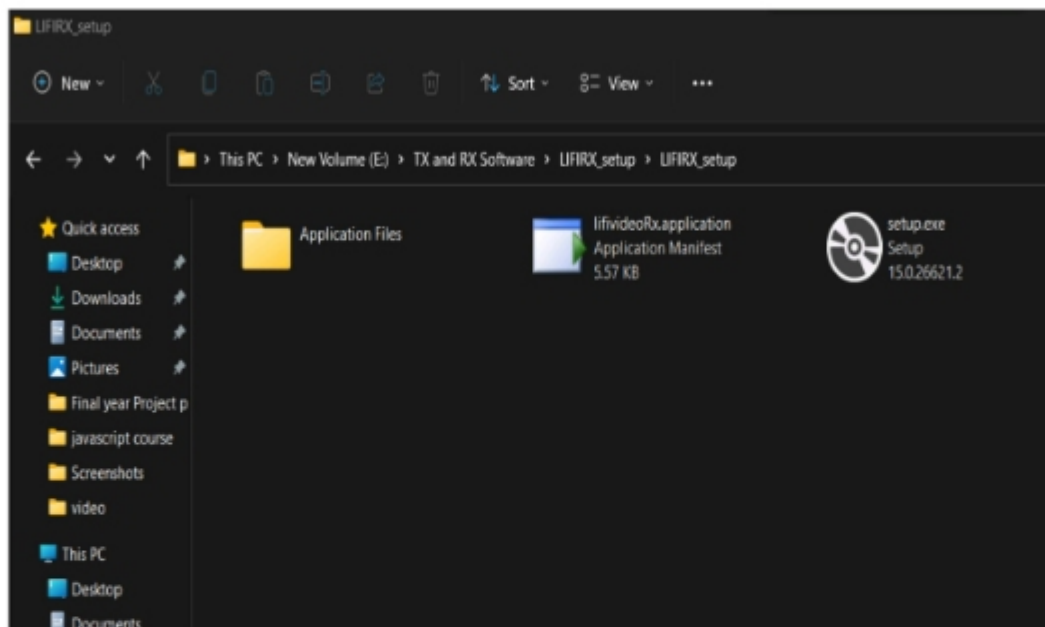


Fig:4.6 : Receiver RX Setup

- Click Setup.EXE, receiver page will appear.
- Choose the port which connect to receiver kit and click the connect button to make a connection.
- The receiving video will be store in the video which we created. Shown in Fig 4.5

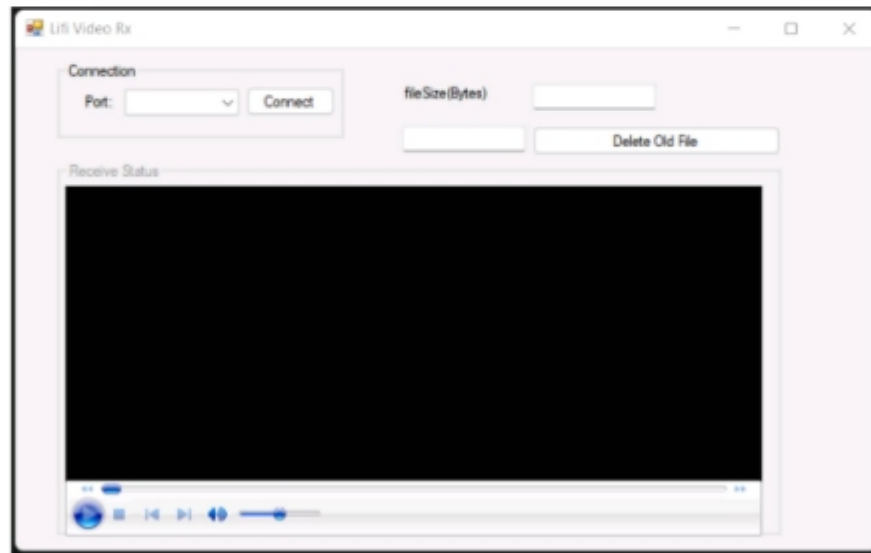


Fig:4.7: Video Receiver

4.3 HARDWARE REQUIREMENT

- AURDINO
- LED LIGHT
- LCD DISPLAY
- LIFI RECEIVER
- UART CABLE
- STEP DOWN TRANSFORMER

➤ AURDINO

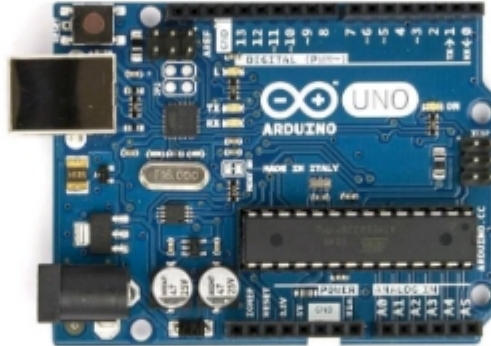


Fig:4.8 : Arduino

The Arduino Uno is a popular microcontroller board based on the ATmega328P chip. It's one of the most widely used boards in the Arduino family due to its versatility, ease of use, and extensive community support.

Here are some key features and aspects of the Arduino Uno:

Microcontroller: The Uno is powered by the ATmega328P microcontroller, which has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button.

Compatibility: It is compatible with a wide range of sensors, actuators, shields, and other electronic components, making it suitable for various projects ranging from simple LED blinking to complex IoT applications.

Programming: The Uno can be programmed using the Arduino Integrated Development Environment (IDE), which is based on the C and C++ programming languages. The IDE provides a simple interface for writing, compiling, and uploading code to the board.

Connectivity: The Uno can communicate with other devices via serial communication (UART), SPI (Serial Peripheral Interface), and I2C (Inter-Integrated Circuit) protocols. It also has a USB port for serial communication with a computer.

Expansion: The Uno is compatible with a wide range of shields, which are add-on boards that extend its capabilities. These shields can add features such as WiFi, Ethernet, Bluetooth, GPS, motor control, and more.

Open Source: Arduino hardware and software are open-source, which means the designs and code are freely available for anyone to use, modify, and distribute.

Community: The Arduino community is large and active, with forums, tutorials, and projects available online. This makes it easy for beginners to get started and for experienced users to find support and inspiration for their projects.

➤ **LED LIGHT**



Fig:4.9 : LED Light

A Li-Fi LED light transmitter is a device that emits modulated light signals to transmit data wirelessly using Li-Fi (Light Fidelity) technology. Here's an overview of how a Li-Fi LED light transmitter works and its key components:

LED Bulb: The transmitter typically consists of an LED (Light Emitting Diode) bulb, which serves as the light source for data transmission. LED bulbs are preferred for Li-Fi applications due to their ability to rapidly modulate light intensity, allowing for high-speed data transmission.

Modulation Circuitry: Inside the transmitter, there is modulation circuitry that controls the intensity of the LED light. This circuitry rapidly varies the brightness of the LED according to the data being transmitted. Different modulation techniques, such as on-off keying (OOK) or pulse amplitude modulation (PAM), can be used to encode digital information into the light signal.

Data Encoding and Transmission: Data is encoded into the light signal by modulating the LED brightness. For example, binary data can be transmitted by turning the LED on or off at specific intervals, or by varying the intensity of the light in accordance with the digital signal. The modulated light signal carries the data and is transmitted into the surrounding environment.

Optical Elements: Some Li-Fi LED light transmitters may include optical elements such as lenses or diffusers to control the direction and spread of the light beam. These elements help optimize the coverage area and ensure reliable communication between the transmitter and receiver.

Power Supply: The transmitter is powered either by mains electricity or by a built-in battery, depending on its intended application. For stationary installations, such as indoor lighting systems, the transmitter may be connected to the mains power supply. In portable or mobile applications, such as Li-Fi-enabled devices or fixtures, a battery-powered transmitter may be used.

Communication Protocol: Li-Fi LED light transmitters typically operate according to a standardized communication protocol, which defines how data is encoded, transmitted, and received. This protocol ensures interoperability between different Li-Fi devices and enables seamless communication in Li-Fi networks.

Li-Fi LED light transmitters are integral components of Li-Fi systems, enabling high-speed, secure, and reliable wireless communication through visible light. They find applications in various sectors, including indoor wireless internet access, smart lighting systems, indoor positioning, and data communication in environments where radio frequency-based technologies may be restricted or pose security concerns.

➤ LCD DISPLAY

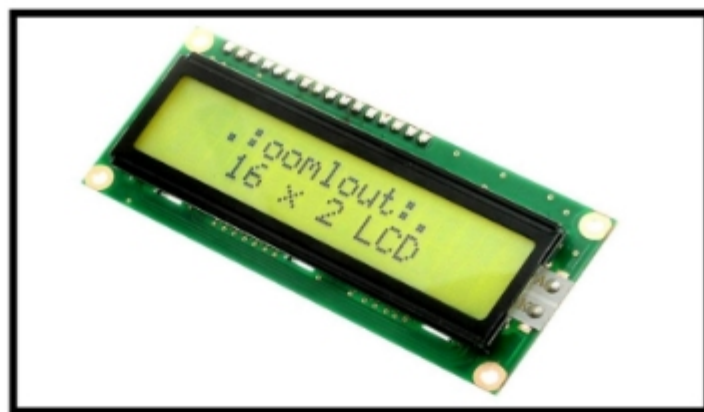


Fig:4.10 : LCD Display

LCD (Liquid Crystal Display) is a type of flat-panel display technology commonly used in televisions, computer monitors, smartphones, tablets, and various other electronic devices. LCDs are popular due to their thin profile, low power consumption, and ability to display images with high resolution and color accuracy.

Here's a brief overview of how LCD displays work:

Liquid Crystals: LCDs use liquid crystals—molecules that can align themselves in response to an electric current. These liquid crystals are sandwiched between two transparent electrodes and glass substrates.

Polarization: The glass substrates have polarizing filters applied to them. One filter is aligned horizontally, while the other is aligned vertically. This creates a grid pattern across the display.

Electric Field: When an electric current is applied to the electrodes, it alters the orientation of the liquid crystals. This change in orientation affects the polarization of light passing through them.

Colour Filters: In colour LCDs, colour filters are used to generate the desired colours. These filters are typically red, green, and blue (RGB), and they are arranged in a grid pattern corresponding to the pixels on the display.

Backlight: Most LCDs require a backlight to illuminate the display. This backlight can be provided by LEDs (Light Emitting Diodes) positioned behind the LCD panel. The light passes through the liquid crystals and colour filters to produce the final image.

LCDs offer several advantages, including:

High Resolution: LCDs can display images with high resolution, making them suitable for applications where clarity is essential.

Low Power Consumption: LCDs consume less power compared to other display technologies like CRTs (Cathode Ray Tubes), making them ideal for battery-powered devices.

➤ LIFI RECEIVER



Fig:4.11 : LI-FI RECEIVER

Li-Fi, short for Light Fidelity, is a wireless communication technology that uses light to transmit data. While Wi-Fi uses radio waves, Li-Fi uses visible light or infrared as the medium for data transmission.

A Li-Fi receiver, also known as a Li-Fi dongle or receiver module, is the device that captures the modulated light signals and decodes them into data. This receiver typically consists of a photodetector, such as a photodiode or phototransistor, which detects the light signals, and electronic circuitry to process and decode the signals into usable data.

Li-Fi receivers are often connected to computing devices, such as laptops, smartphones, or IoT devices, enabling them to communicate wirelessly via light. These devices need to be equipped with compatible hardware and software to support Li-Fi technology.

One of the advantages of Li-Fi is its potential for high-speed data transmission, as light can carry much more data than radio waves. Additionally, Li-Fi offers benefits such as increased security (since light signals are confined to a specific area) and reduced interference compared to traditional Wi-Fi networks. However, Li-Fi also has limitations, such as its reliance on line-of-sight communication and susceptibility to environmental factors that can affect light transmission.

➤ UART CABLE



Fig:4.12 : UART

A UART (Universal Asynchronous Receiver-Transmitter) cable is a type of serial communication cable used to transmit data between electronic devices. It consists of multiple wires that facilitate bidirectional communication between devices, typically a computer and another electronic device like a microcontroller, sensor, or modem.

UART cables are commonly used in embedded systems, robotics, and electronics prototyping for programming, debugging, and data exchange. They typically have connectors on both ends, such as DB9 or DB25 connectors, with each wire serving a specific function, including data transmission, data reception, ground, and optional flow control signals.

UART communication is asynchronous, meaning that data is sent without a shared clock signal. Instead, data is transmitted in packets or bytes, with each byte typically consisting of start and stop bits for synchronization. UART cables are versatile and widely used due to their simplicity, reliability, and ease of implementation in various electronic systems.

➤ STEP DOWN TRANSFORMER

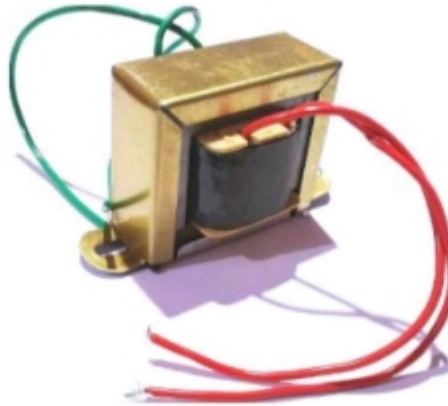


Fig:4.13 : STEP DOWN TRANSFORMER

A step-down transformer is a type of transformer that reduces the voltage from its input (primary) side to its output (secondary) side. This type of transformer is commonly used in electrical systems to convert high voltage to low voltage, making it suitable for various applications where lower voltage levels are required.

The construction of a step-down transformer typically consists of two sets of coils wound around a common magnetic core. The primary coil, which receives the input voltage, has more turns than the secondary coil, resulting in a higher voltage on the primary side compared to the secondary side. When alternating current (AC) flows through the primary coil, it induces a changing magnetic field in the core, which, in turn, induces a voltage in the secondary coil.

The ratio of the number of turns in the primary coil to the number of turns in the secondary coil determines the voltage transformation ratio of the transformer. For example, if the primary coil has twice as many turns as the secondary coil, the transformer will halve the input voltage.

CHAPTER 5

RESULT AND ANALYSIS

In this study, we successfully used Li-Fi technology to transmit the video. We transmitted the video of the size 104KB and the duration is 58 seconds in a distance of 1 meter. At the receiving end, it takes 58 seconds to receive the video. Normally, the Li-Fi speed is 224GB/s, but the time delay is due to the USB to RS232 converter used for transmitting and receiving the video.

TABLE: 5.1 : Analysed Existing Data

Existing Model	
File size	Time (seconds)
104 KB	114
120 KB	223
189 KB	342

TABLE: 5.2 : Analysed Proposed Data

Proposed Model	
File size	Time (seconds)
104 KB	58
120 KB	98
189 KB	186

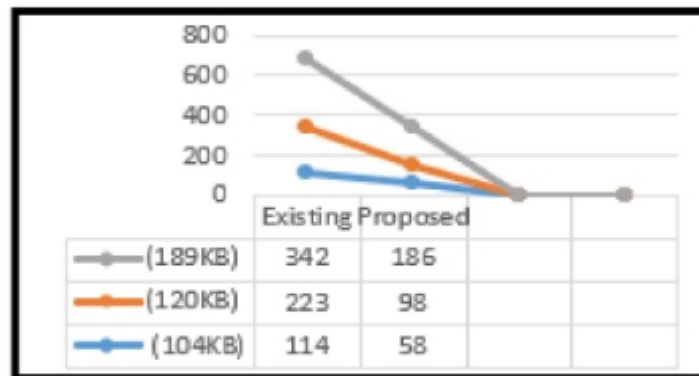


Fig: 5.1 : COMPARISION IN LINE CHART



Fig: 5.2 : COMPARISION IN COLUMN CHART

CHAPTER 6

CONCLUSION

Light Fidelity (Li-Fi), which quickly transmits data via light waves, is a useful solution for video transmission. Compared to more popular radio frequency-based technologies like Wi-Fi, it may offer better security, more bandwidth, and less interference. Due to its quick data transfer speeds, Li-Fi is a recommended alternative for video transmission applications, especially in places with high population areas. Li-Fi has the potential for video transmission and have a big impact on communication technologies down the line with more research and advancement.

The utilization of Li-Fi for video transmission offers a promising avenue for enhancing communication technologies. Li-Fi's ability to transmit data through light waves presents several advantages, including higher data rates, increased security, and reduced interference compared to traditional radio frequency-based methods like WiFi. In conclusion, the integration of Li-Fi into video transmission systems holds immense potential for revolutionizing the way we communicate, stream, and transmit video content, paving the way for a more efficient and secure digital future.

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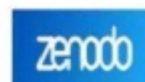
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