Visvesvaraya Technological University

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MINI-PROJECT REPORT
5th semester, B.E.

"DATA TRANSMISSION USING LI-FI"

A Project Report submitted to Visvesvaraya Technological University in partial fulfillment of the requirement for the award of degree of Bachelor of Engineering in Electronics and Telecommunication Engineering.

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CERTIFICATE

This is to certify that the mini-project work entitled

"DATA TRANSMISSION USING LI-FI"

Is a bonafide work carried out jointly by

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These students of 5th semester B.E., Electronics and Telecommunication Engineering under our supervision and guidance towards the partial fulfillment of the requirements for the award of the degree of Bachelor of Engineering in Electronics and Telecommunication Engineering as per the university regulations during the year 2024-25.

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ABSTRACT

Li-Fi, short for Light Fidelity, is a revolutionary wireless communication technology that uses light waves to transmit data at high speed and with high security. Li-Fi is one of the future technologies in the wireless communication sector. It is bidirectional, with a very high speed, and is a fully networked communication with a wireless technology similar to Wi-Fi. In the present era, Wi-Fi is the most trending domain. As internet users almost double every year, there is an enormous load on the radio spectrum that leads to congestion. To get better bandwidth, efficiency, and speed, a new technology Li-Fi has evolved. Li-Fi can be simply Wi-Fi, but instead of radio waves, light is used as a medium. Here, data is transmitted using light whose intensity varies faster than the human eye can capture. Instead of using modems, Li-Fi uses LED bulbs with transceivers. Data transmission in Li-Fi is about 100 times faster than in Wi-Fi. Li-Fi provides higher bandwidth, efficiency, availability, and security than Wi-Fi and has already achieved high speed in the lab. Li-Fi can be implemented for public internet access through street lamps to auto-piloted cars that communicate through their headlights. In the future this technology can be implemented for fast data access, especially laptops, smartphones, and tablets that uses the light in a room.

ACKNOWLEDGEMENTS

The satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mentioning of the people whose constant guidance and encouragement made it possible.

We take pleasure in presenting before you, our project, which is result of studied blend of both research and knowledge. We would like to acknowledge the help and encouragement given by various people during the course of the project and thankful to our beloved principal **Dr.Y Vijaya Kumar** for providing excellent academic climate.

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Chapter 1
Preamble

1.1 Introduction

Li-Fi, short for Light Fidelity, is a revolutionary wireless communication technology that uses light waves to transmit data at high speed and with high security. Unlike tradi- tional Wi-Fi, which relies on radio waves, Li-Fi uses visible or infrared light to send and receive data, making it more efficient, reliable, and secure. The technology is based on the concept of Visible Light Communication (VLC), which modulates light signals to carry digital information. Li-Fi has the potential to revolutionize the way we transmit data, particularly in high density environments such as hospitals, airports, and offices, where Wi-Fi signals can be congested and unreliable. By using the existing lighting in- frastructure, Li-Fi can provide a faster, more secure, and more efficient alternative to Wi-Fi, enabling new applications and services that were not possible before. Some of the potential applications of Li-Fi include indoor positioning, augmented reality, smart lighting, and Internet of Things (IoT) devices.

Light Fidelity (Li-Fi) is high-speed wireless communication using visible light. It falls under the category of optical wireless communications. Data transmission takes place through light-emitting diode (LED) bulbs whose intensity varies. Based on this varia- tion, communication occurs digitally. This technology has vast applications where the use of Wi-Fi is limited or banned. It also takes out the adverse health effects of using electromagnetic waves. Unless light is seen, data cannot be hacked and the data trans- mission becomes secure using Li-Fi. Li-Fi uses light and can transmit data at a speed of 10 Mbps, with a goal of increasing to 100 Mbps in the near future. This makes it a promising solution to the potential spectrum crisis warned by the US Federal Communi- cations Commission. Visible light communication (VLC) is the general term that refers to any use of the visible light spectrum to transmit information, including Li-Fi. The technology has numerous applications in areas where Wi-Fi is restricted or prohibited, and it eliminates the negative health effects of electromagnetic waves.

Li-Fi is ten times cheaper than Wi-Fi, making it a more cost-effective solution. One of the significant advantages of Li-Fi over Wi-Fi is that it can be used in areas with electromagnetic sensitivity, such as nuclear power plants and airplanes, without causing interference. The range of Li-Fi is shorter since light waves cannot penetrate walls, but this makes it more secure against hacking. Li-Fi also has almost no limitations on capacity, making it ideal for compact wireless data coverage and mitigating radio interference problems. While Wi-Fi is used for wireless coverage within a specific area, Li-Fi is focused on transmitting multimedia data between two terminals using LEDs.
Harald Haas from the University of Edinburgh coined the term Li-Fi in his 2011 TED Global talk and helped set up a company to market it. Pure VLC, an original equipment manufacturer (OEM) firm, was established to commercialize Li-Fi products for integration with existing LED- lighting systems. In 2011, companies and industry groups formed the Li-Fi Consortium to promote high-speed optical wireless systems and overcome the limited amount of radio-based wireless spectrum available by exploiting a completely different part of the electromagnetic spectrum. Li-Fi and Wi-Fi have differences related to congestion, density, security, safety, and speed. The more Wi-Fi-enabled device exists, the more congestion may occur. In the technology of Wi-Fi, we can't add more routers if the user is increased, while we can add the light in Li-Fi. Efficiency and safety of the internet are the dominating issues right now. The performance of Li-Fi is claimed to be better than the performance of Wi-Fi. The rated speed of Li-Fi is 1000 times faster than Wi-Fi. For the safety of the internet, Li-Fi is more secure than Wi-Fi based on the spread of the signal. Li-Fi has a light characteristic that light cannot go through the wall. It is different from the signal of Wi-Fi and can go through anywhere.The vulnerability exists if there is leakage in the wall while having indoor communication. A security threat that may exist is an intruder can spoof the data using the leakage wall. Li-Fi has the potential to revolutionize the telecommunications industry by providing a faster and more secure wireless communication solution that is cost-effective and has no negative health effects.

1.2 Aim of the project

To transmit data i.e text and image bidirectionally using light-fidelity

1.3 Objectives

- To design and implement the Transmitter using Light-Fidelity.
- To setup and execute the Receiver using Light-Fidelity.
- To provide data communication(i.e text and image) using visible light spectrum.

1.4 Methodology

Li-Fi has a light emitter on one end i.e. an IR LED transmitter, and a IR Photodiode(light sensor) on the other. The data input to the LED transmitter is encoded into 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. Data must be converted from electrical to optical signals in order to transmit.
The data will be converted as binary values and transmitted through light using the Li-fi transmitter.The light from the transmitter side is received by the IR Photodiode(li-fi receiver).At the receiver side the optical signals are converted to electrical signals. So the user can view the results.

1.5 Problem Statement

Wi-Fi has been revolutionized the way we connect to the internet. Wi-Fi comes with some fundamental problems in terms of speed, security, cost, limited bandwidth, health concerns with radio waves, and inefficient power consumption. If Li-Fi is implemented successfully, it will resolve the problems that are associated with Wi-Fi.

1.6 Limitations

External source of light can create noise signals and create glitch with the original signal.

Flickering is the most fundamental challenge that requires attention. LEDs are expected to have ON/OFF operations and these two operations are required to be performed with synchronization in order to get both the illumination as well as communication. When a stream of packets of data is communicated the LED does ON/OFF and hence the coverage illumination gets affected. Also, frequent fluctuations can affect human eye vision in long run.

Li-Fi finds its potential usage in localized environment because light cannot surpass through the walls of a room or any opaque object. Even the intensity is affected in a translucent medium. Till this situation is taken care of; wide area adoption of Li-Fi remains uncertain.

A clean visible line of sight is essential for proper communication via Li-Fi. So if we don't get proper line of sight that system cannot be harnessed to its full capability.

1.7 Organization of the Report

The report follows a structured approach, starting with an introduction to the project's objectives and significance. It includes a literature review, methodology, system architec- ture, implementation details, results, evaluation, discussion, and conclusion. References and appendices supplement the main content, ensuring clarity and comprehensiveness.

Chapter 2

Theoretical Background

2.1 Literature Survey

[1] Vasuja, M., Mishra, A.K., Chauhan, U.S., Chandola, D. and Kapoor, S., 2018, April. Image transmission using li-fi. In 2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT) (pp. 287-292). IEEE.

We went from 56kbps wired ARPANET connections limited to the US military in the 1960s, to unimaginably fast wireless 100 Mbps connections in the 2010s.

But what the future holds will certainly blow your mind 1Gbps or more and that is still an understatement LIGHT FIDELITY it is or popularly known as Li-Fi.

The two-major prospect being aimed is extension or enhancement of the wireless services and to support the number of the exponentially growing user which the RF spectrum is unable to provide due to a limited spectrum of radio waves.

So, Li-fi that is based on the visible light spectrum is being designed. It uses a LED and a photodiode or phototransistor to transmit and receive data respectively. Li-fi can be compared with the existing wireless technology i.e. Wi-Fi in terms of speed and security which the former provides better.

The aspiration of this research paper is cunning a prototype of Li-fi transmitter and receiver to transmit data. The schematic design was made using Proteus 8 professional. Software coding was done on C language and PIC microcontroller is used. Successful transfer of image and text were achieved. As a deduction, this work gives an originative way of scheming a Li-Fi Prototype.

[2] Hassan, R., Flayyih, M.S., Mahdi, A., Inn, A., Sadeq, A.S. and Murad, D.F., 2020, October. Visibile light communication technology for data transmission using li-fi. In 2020 2nd International Conference on Computer and Information Sciences (ICCIS) (pp. 1-5). IEEE.

Handling data transmission for radio signals became one of the most important concerns, giving birth to Light as a significant alternative.

Visible Light Communication (VLC) arose as an effective option for data communication. Light Fidelity (Li- Fi) is one of VLC technologies and represents a new technique operating with light signals in order to transmit data a source to a destination.

It guarantees several benefits and can overcome different limitations of Wi-Fi tech- nologies including security issues, media obstacles, and radio interference. Li-Fi technologies are adopted for experimental usage and does not extensively arise in industry. The adoption of Li-Fi technology in industry, it is necessary to measure the performance of data transmission several data types requiring to be supported.

The purpose of this paper is to investigate the performance of data communication using VLC. This research is based on an implementation for different types of data transmission through Li-Fi.

The methodology that has been adopted for this study consists on a simulation topology by NS-3 which has been built to study the performance TCP and UDP protocols in Li-Fi environment for VLC communication. Various types of data have been transmitted through an appropriate designed model.

The simulation results show the differences between the two common algorithms. The implementation explained the needs for Li-Fi data transmission. Indeed, this work show a successful audio, text, and images transfer through VLC technology.

[3] Leba, M., Riurean, S. and Lonica, A., 2017, June. LiFi—The path to a new way of communication. In 2017 12th Iberian conference on information systems and technologies (CISTI) (pp. 1-6). IEEE.

Important research efforts have been directed over the past ten years, towards exploring alternative parts of the electromagnetic spectrum that could potentially offload a large portion of the network traffic from the overcrowded radio frequency (RF) domain.

Due to the latest improvements, the optical wireless communication (OWC) proves to be a viable alternative solution to the issues of forthcoming radio frequency RF spectrum crisis, especially in certain places and situations.

Currently, most mobile data traffic is consumed indoor, where light fidelity (LiFi) which is related to visible light communication (VLC) offers lots of specific advan- tages, and effective solutions to the many issues of wireless communication.

The current paper summarizes most of the research, developments and applications achieved so far and looks at the different aspects of the strengths and weaknesses, implementations, challenges, VLC IEEE standard and data modulation techniques of the VLC and specific LiFi's new coined optical wireless communication technol- ogy.

[4] Javale, D., Sashittal, C.A., Wakchaure, S., Phadnis, A.M., Patil, S.S. and Shahane, R.S., 2018, August. A new approach to wireless data transmission using visible light. In 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA) (pp. 1-4). IEEE.

Wireless Communication has established itself as an efficient and reliable medium for data transfer. But with the number of end users increasing exponentially and the availability of radio spectrum diminishing at a fast pace there is a need of an alternate approach for data transfer.

The optical wireless communication proves to be an efficient alternate solution to solve the radio frequency spectrum crisis and also to overcome the constraints of the Wireless-Fidelity (Wi-Fi) technology.

The LEDs used in our daily lives for the purpose of providing light when integrated with Li-Fi technology can make an efficient communication network for data trans- fer.

This paper proposes cost-effective and working application of the Li-Fi technology to overcome the constraints of the existing data transmission technologies and to provide an alternate data transmission medium which built on the existing infras- tructure.

[5] Johri, R., 2016, April. Li-Fi, complementary to Wi-Fi. In 2016 International Conference on Computation of Power, Energy Information and Commuincation (ICCPEIC) (pp. 015-019). IEEE.

Nowadays,Wireless-Fidelity(Wi-Fi) gives you the speed of 150 mbps according to standards of IEEE 802.11n, but not enough to fulfill the need of desired users over the network.

In order to remove this drawback of Wi-Fi, a new technology is developed by Germen physicist Harald known as Li-Fi which provides transmission of data via LED bulb whose intensity varies in a much faster speed that it could not be able to be detected by the naked eye.

According to Harald Haas, in this technology we can achieve the data rate much speedier than 10 mbps, which is very much greater than our LAN(Local Area Network).

Li-Fi is very advantageous over Wi-Fi as it uses VLC by which we can utilize the maximum 60 GHz spectrum. Though this technology has numerous advantages over Wi-Fi but on other side it also has few drawbacks like, range is very short as compared to Wi-Fi, if user want to transmit back then it is not possible etc.

So due to these reasons Li-Fi will not entirely replace the Wi-Fi technology but it will compliments the Wi-Fi technology. So, both the technologies will work together for the maximum utilization of unlicensed 60 GHz spectrum.

2.2 Summary

The above discussed papers presented us with a broad perspective on how to tackle what we have aimed for and gave us the different possible approaches to follow to build our project Data Transmission using Li-Fi.

Chapter 3

Design and Implementation

3.1 Block Diagram

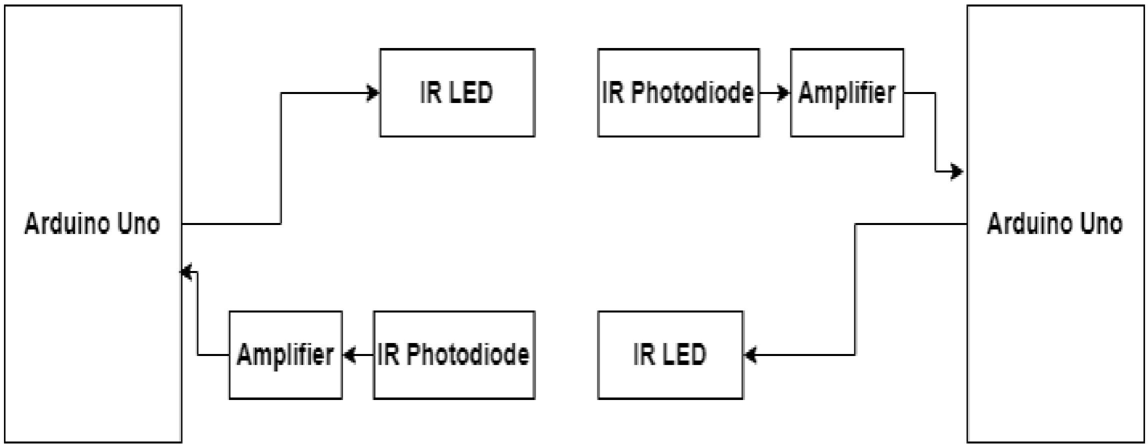

Figure 3.1: Block Diagram

3.2 Working Principle

Image transmission is achieved through the use of Arduino microcontrollers, infrared (IR) components, and signal amplification circuitry. The process begins with the image data being transmitted between computers using arduino using Li-Fi technology. This data is modulated onto an infrared light signal emitted by an IR LED. Before transmission, the image is converter to binary using python which will be transmitted using Led. On the receiving end, an IR photodiode detects the modulated IR light carrying the image data. The detected signal is then processed by the receiver Arduino. A crucial component in this setup is the potentiometer, which acts as a threshold adjustment mechanism for the photodiode. By tweaking the potentiometer, the sensitivity of the photodiode can be finely tuned, allowing for optimal detection of the modulated IR signal amidst ambient light and noise. Once the signal is received and processed, the image data can be utilized in various ways, such as displaying it on a screen or storing it for further analysis. This Li-Fi system offers a wireless means of transmitting data using light waves, with the added advantage of being immune to radio frequency interference and offering potentially higher data transmission speeds compared to traditional radio- based methods. Through the integration of Arduino microcontrollers and carefully chosen components, this setup demonstrates a practical implementation of Li-Fi technology for image transmission applications.

3.3 Circuit Diagram

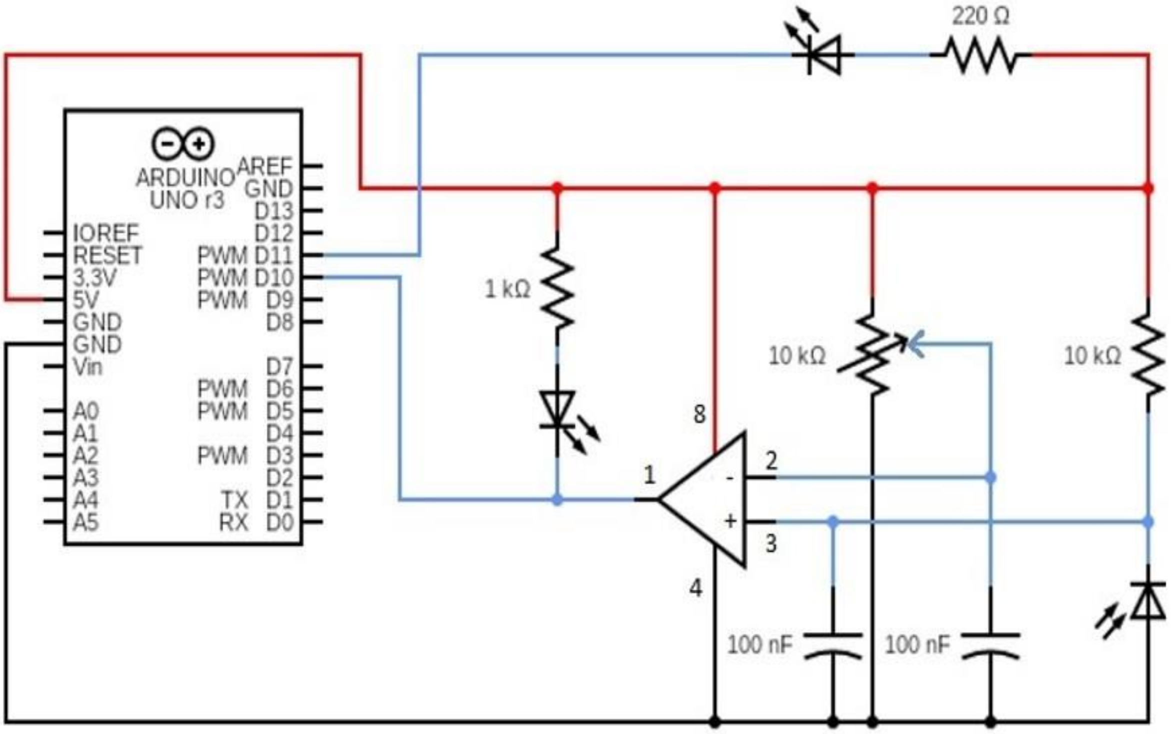

Figure 3.2: Circuit Diagram

3.4 Implementation

Transmitter Arduino: Initiates the transmission process

Image Data: The data representing the image to be transmitted.

Computer Interface: Facilitates communication between the Arduino and the com- puter.

Receiver Arduino: Receives the transmitted image data.

Op-Amp: Amplifies the signals to enhance reception reliability.

Infrared (IR) Photodiode: Detects the modulated IR light.

Infrared (IR) LED: Emits modulated IR light carrying the image data.

Potentiometer: Adjusts the threshold of the photodiode for optimal sensitivity.

Display or Output Device: Displays or utilizes the received image data.

3.5 Flowchart

3.5.1 Transmitter Section

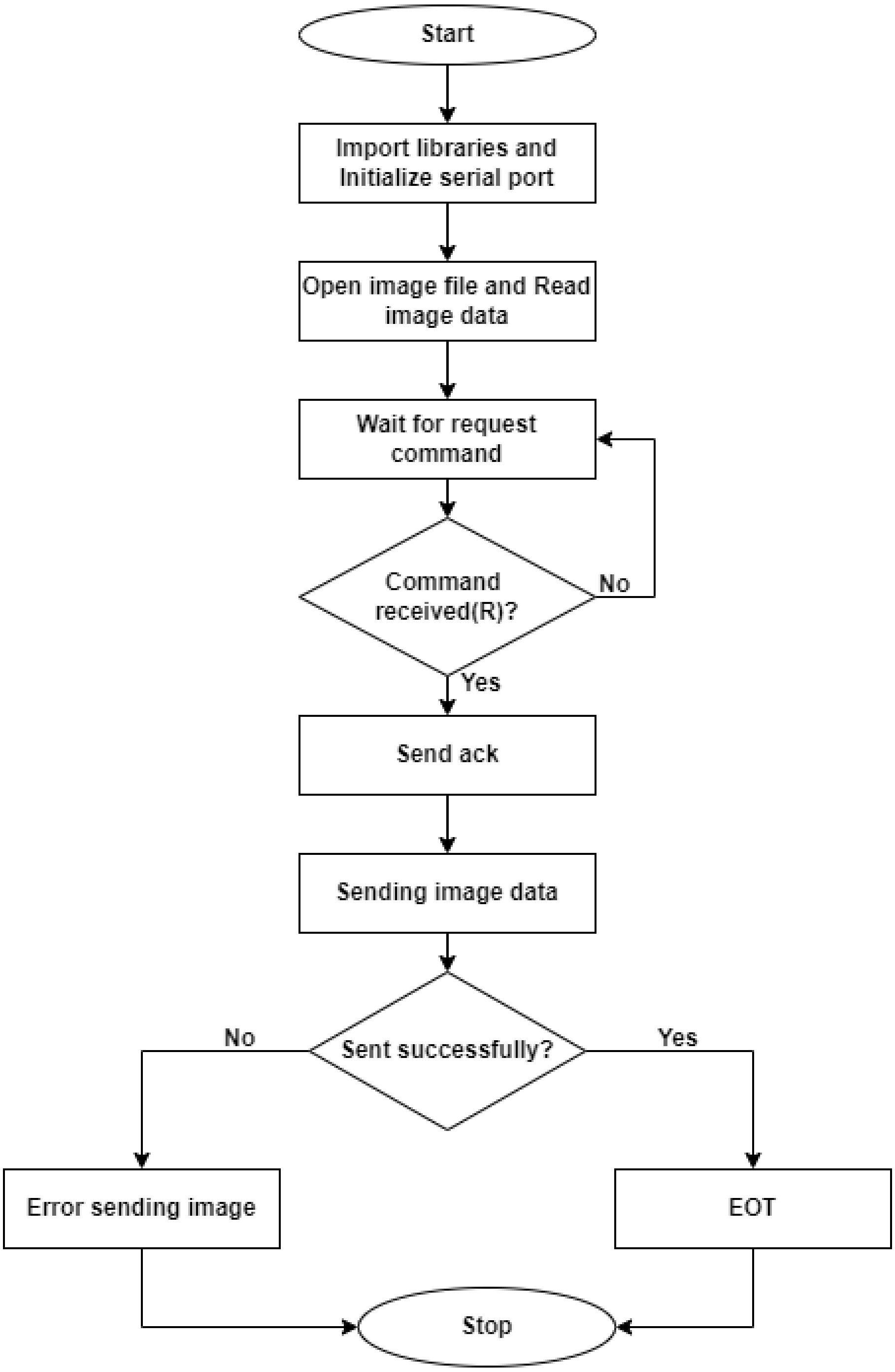

Figure 3.3: Transmitter Section

3.5.2 Receiver Section

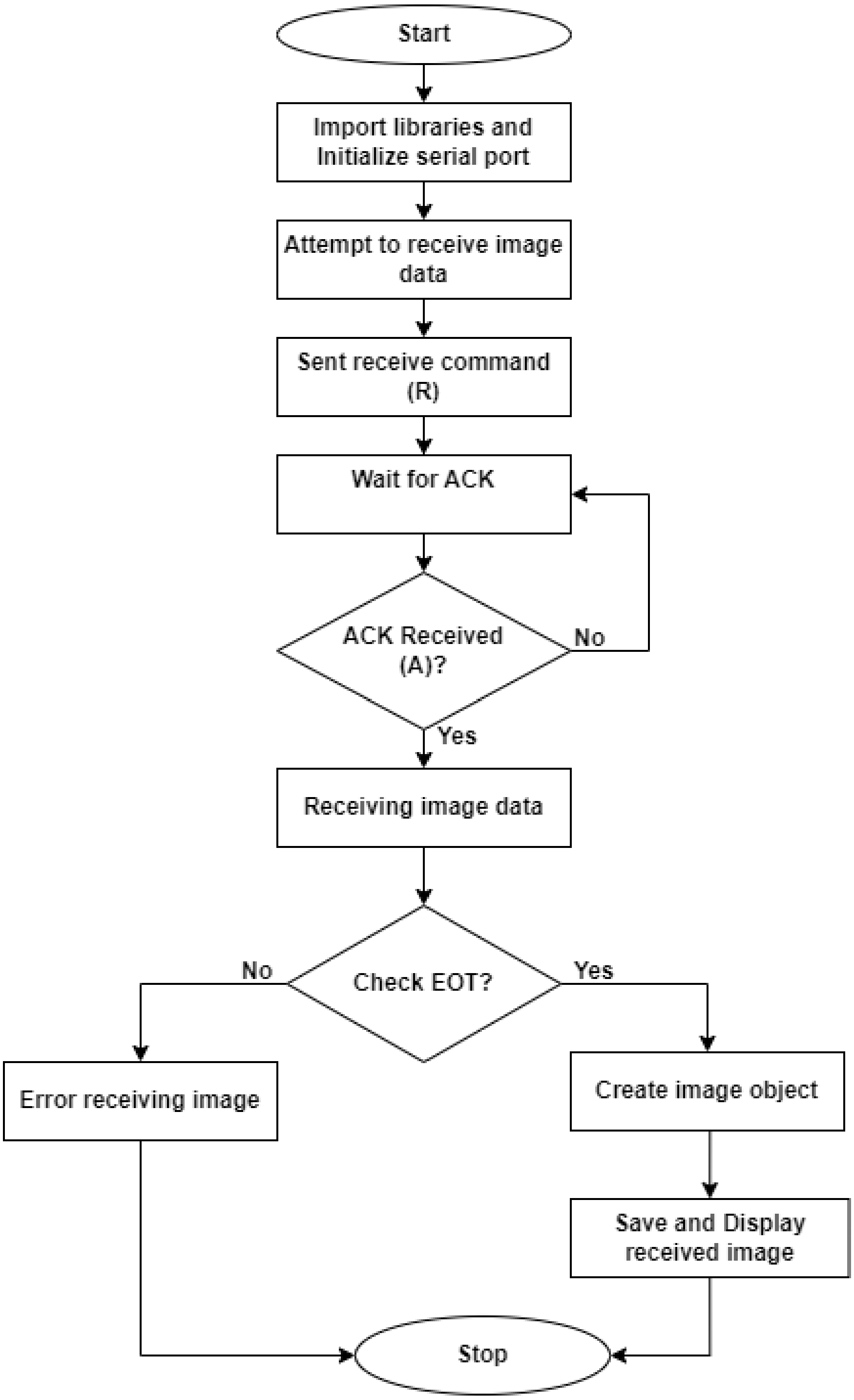

Figure 3.4: Receiver Section

Chapter 4

Hardware and Software Description

4.1 Hardware Requirements

4.1.1 Arduino Uno

Figure 4.1: Arduino Uno

Arduino is a microcontroller board based on the ATmega328P. It 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. It contains everything needed to support the microcontroller. Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform for an extensive list of current, past or outdated boards see the Arduino index of boards.

4.1.2 IR LED

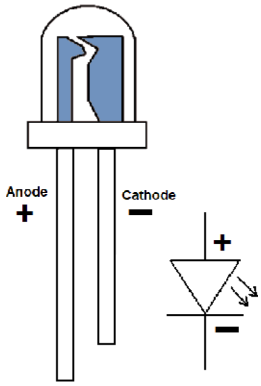

Figure 4.2: IR LED

Technical specifications:

Forward current (IF) is 100mA (normal condition) and 300mA (max.)

1.5A of surge forward current

1.24v to 1.4v of forward voltage

Temperature for storage and operation varies from -40 to 100

Soldering Temperature should not exceed 260

Power Dissipation of 150mW at 25 (free air temperature) or below

Spectral bandwidth of 45nm

Viewing angle is 30 to 40 degree

Features:

High Reliability

Excessive radiant intensity

Forward voltage is low

Having lead spacing of 2.54mm

Maximum wavelength is 940nm

Pb free

RoHS certified

Easy to use with breadboard or perf board

Package type is T-1 3/4

4.1.3 IR Photodiode

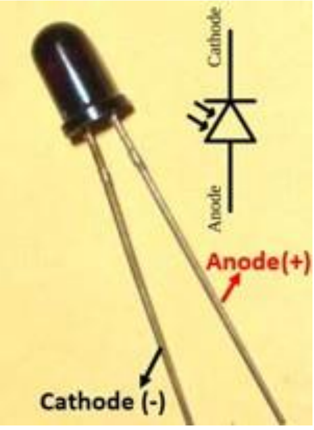

Figure 4.3: IR Photodiode

Technical specifications:

Wavelength Sensitivity: 940nm

Open Circuit Voltage: 0.39V

Reverse breakdown voltage: 32V

Reverse Light current: 40 micro Amp

Reverse Dark current: 5 nA

Rise Time/ Fall Time: 45/45nS

View Angle: 80 deg

Package: 5mm

4.1.4 Opamp

Figure 4.4: Opamp

Features and Specifications:

Integrated with two Op-Amps in a single package

Wide power supply Range 1. Singe supply – 3V to 32V 2. Dual supply – 1.5V to 16V

Low Supply current – 700uA

Single supply for two op-amps enables reliable operation

Short circuit protected outputs

Available packages: TO-99, CDIP, DSBGA, SOIC, PDIP, DSBGA

4.2 Software Requirements

4.2.1 Aurdino IDE

Figure 4.5: Aurdino IDE

The Arduino IDE (Integrated Development Environment) is a software platform used for writing, compiling, and uploading code to Arduino boards. Arduino is an open- source electronics platform based on easy-to-use hardware and software. The Arduino IDE provides a simple interface for writing code in the Arduino programming language, which is essentially a simplified version of C/C++.

4.2.2 Visual studio Code

Figure 4.6: VS Code

Visual Studio Code, also commonly referred to as VS Code,[9] is a source-code editor developed by Microsoft for Windows, Linux, macOS and web browsers.[10][11] Features include support for debugging, syntax highlighting, intelligent code completion, snippets, code refactoring, and embedded version control with Git. Users can change the theme, keyboard shortcuts, preferences, and install extensions that add functionality.

Chapter 5
Results and Discussions

The experiment aimed to transmit data using light and visualize the transmission process using a IR LED. The system utilized an Arduino Uno and various other components. However, the results obtained were distorted due to multiple sources of noise, such as sunlight, misalignment and distance between IR LED and the light sensor, and low sen- sitivity of the sensor to light. Despite the presence of noise, the system was able to successfully transmit data using light and visualize the transmission process through a set of blinking LED. The receiver section of the system was able to receive the transmit- ted data.

5.1 Transmitter and Receiver section implementation

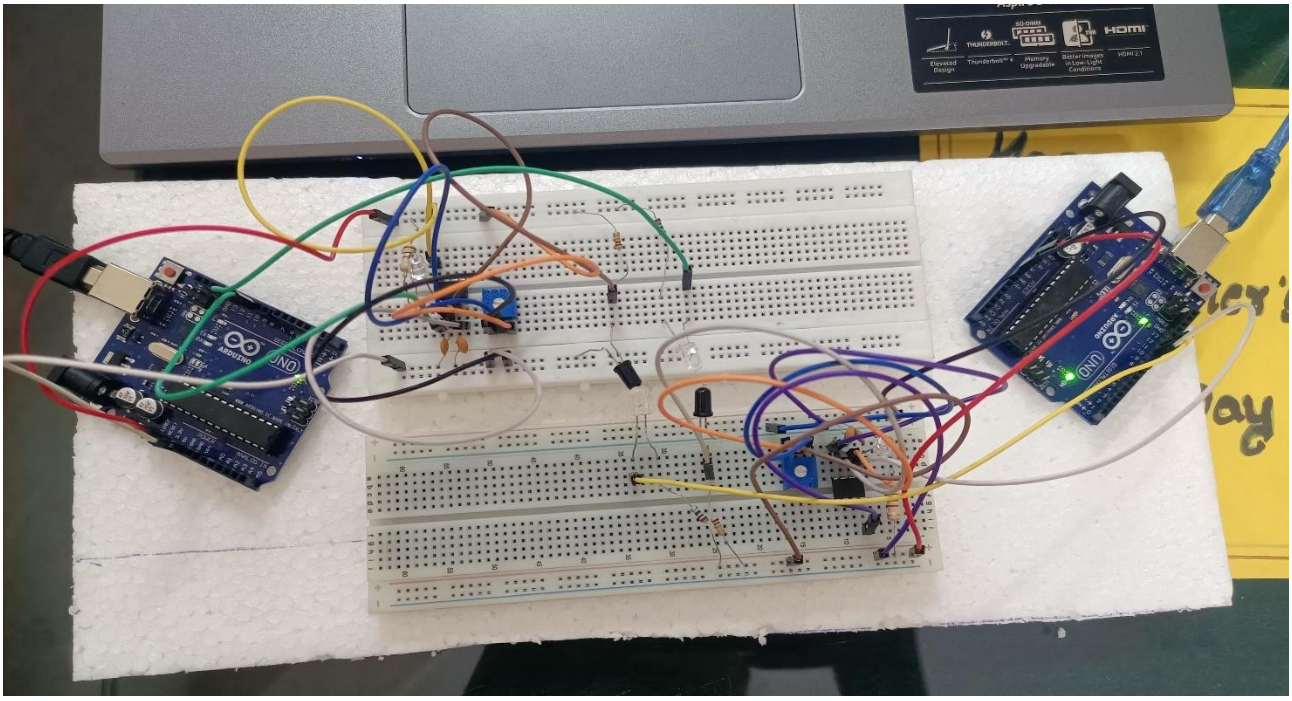

Figure 5.1: Transmitter and Receiver section of Light-Fidelity is implemented.

5.2 Text Transmission

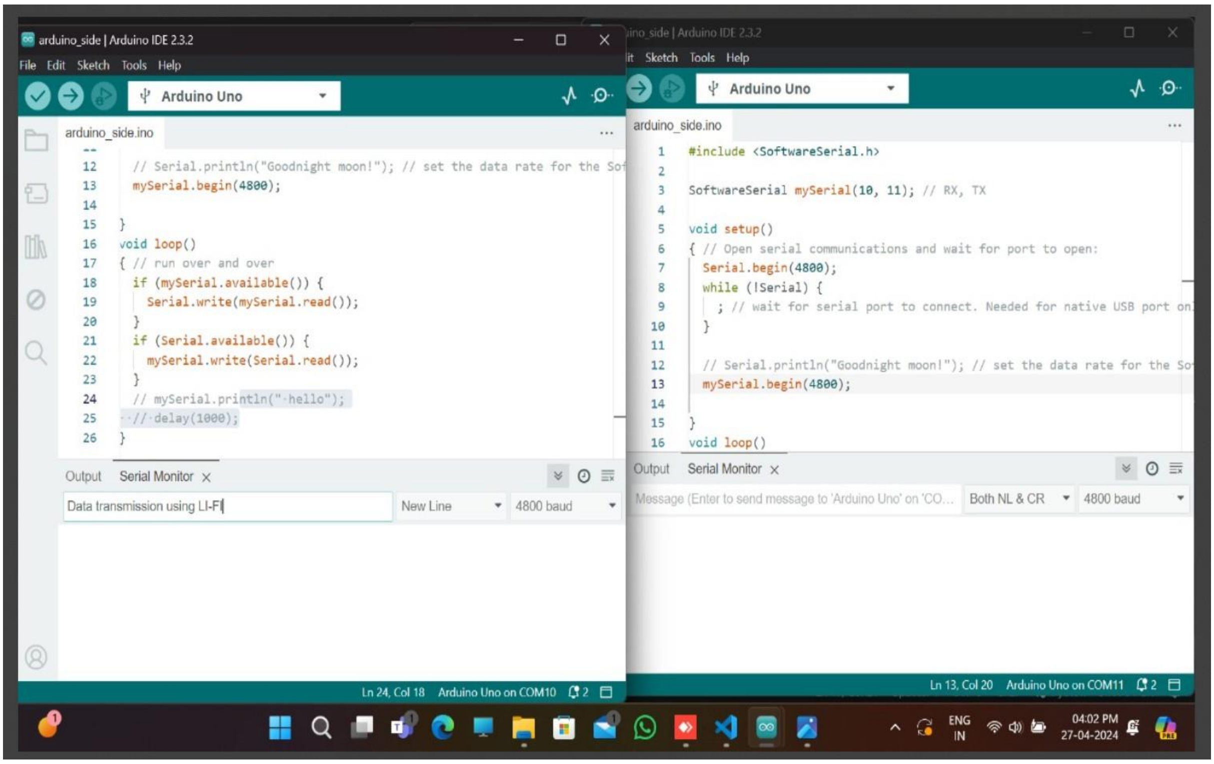

Figure 5.2: Transmitting text data using IR LED as an transmitter and IR Photodiode as an receiver at the transmitter side.

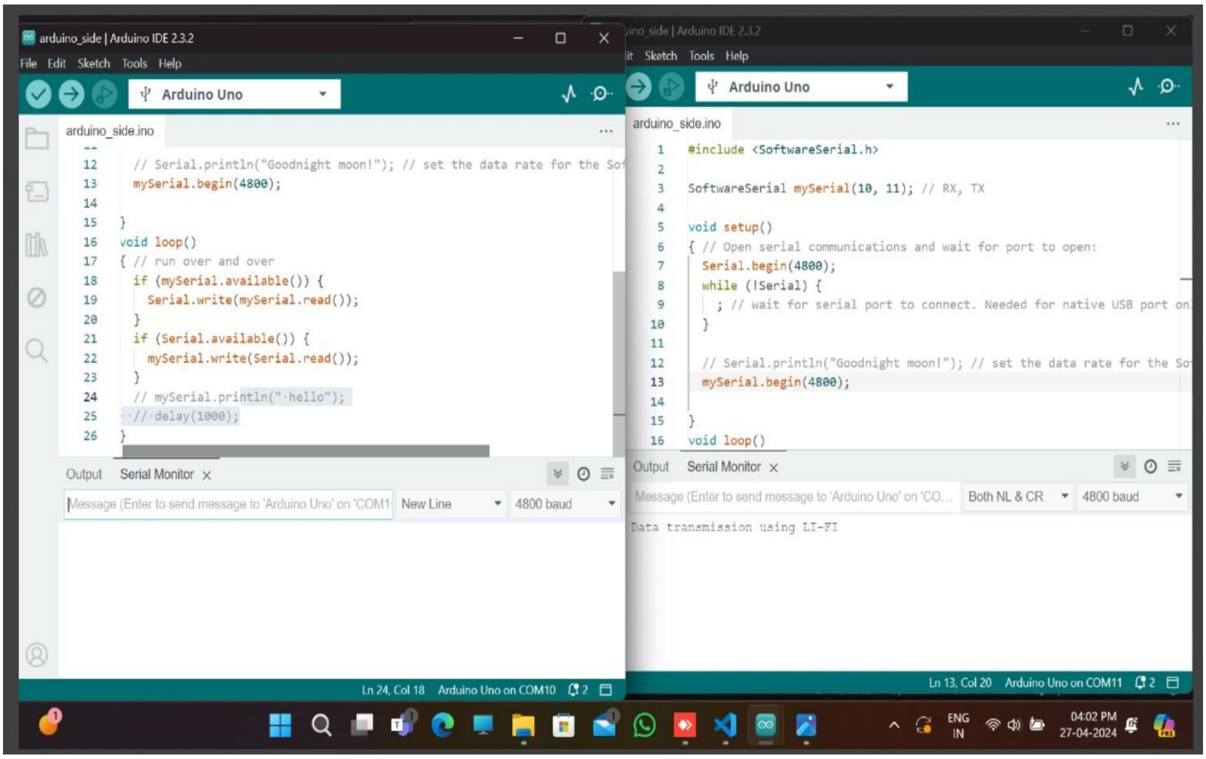

Figure 5.3: Received text data using IR LED as an transmitter and IR Photodiode as an receiver at the receiver side.

Any Word of length(For example)	Baud rate	Time taken(in sec)
5 (hello)	1200/2400	0.25/0.18
10 (sincetoday)	1200/2400	0.48/0.37
20 (ThelightfromtheSolar)	1200/2400	0.69/0.54
40 (Externalsourceoflightcancreatenoisy-image)	1200/2400	0.82/0.74
60 (Acleanvisiblelineofsightisessentialfor-propercommunicationvia)	1200/2400	0.99/0.87

Table 5.1: Analysis of Text Transmission for different word length

5.3 Image Transmission

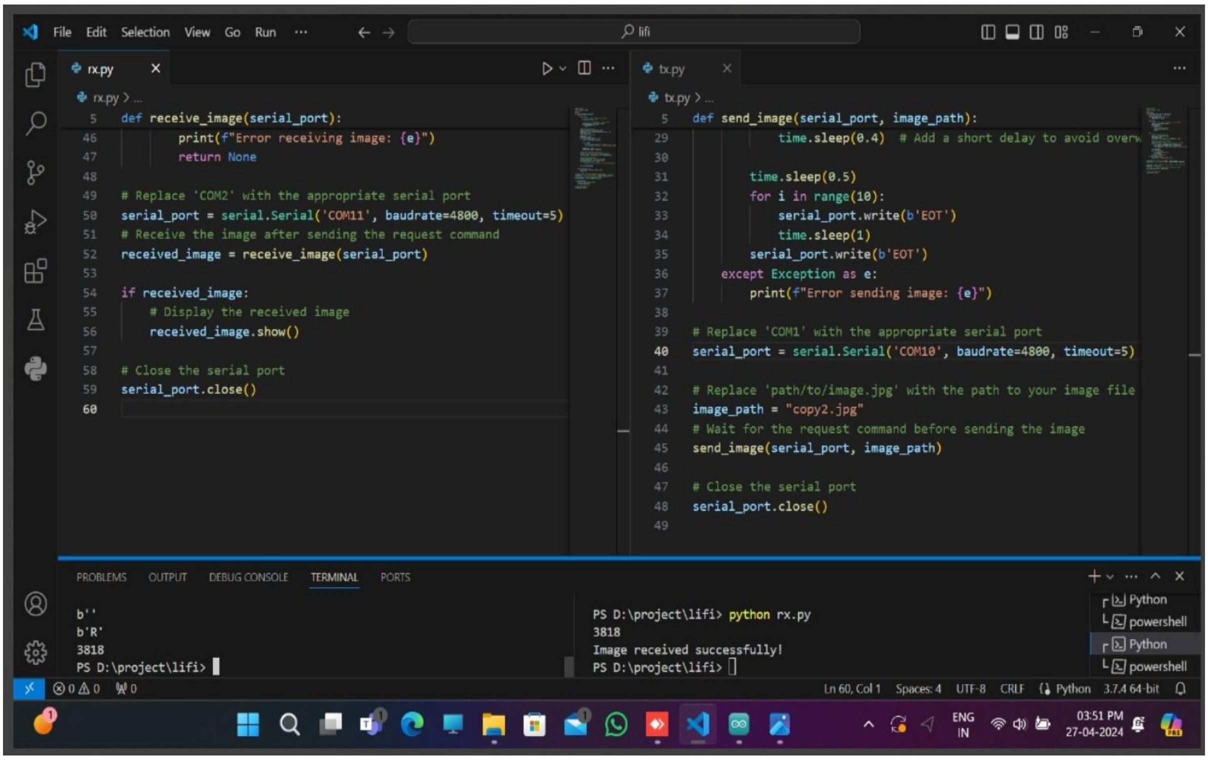

Figure 5.4: Transmitting image using IR LED as an transmitter and IR Photodiode as an receiver at the transmitter side.

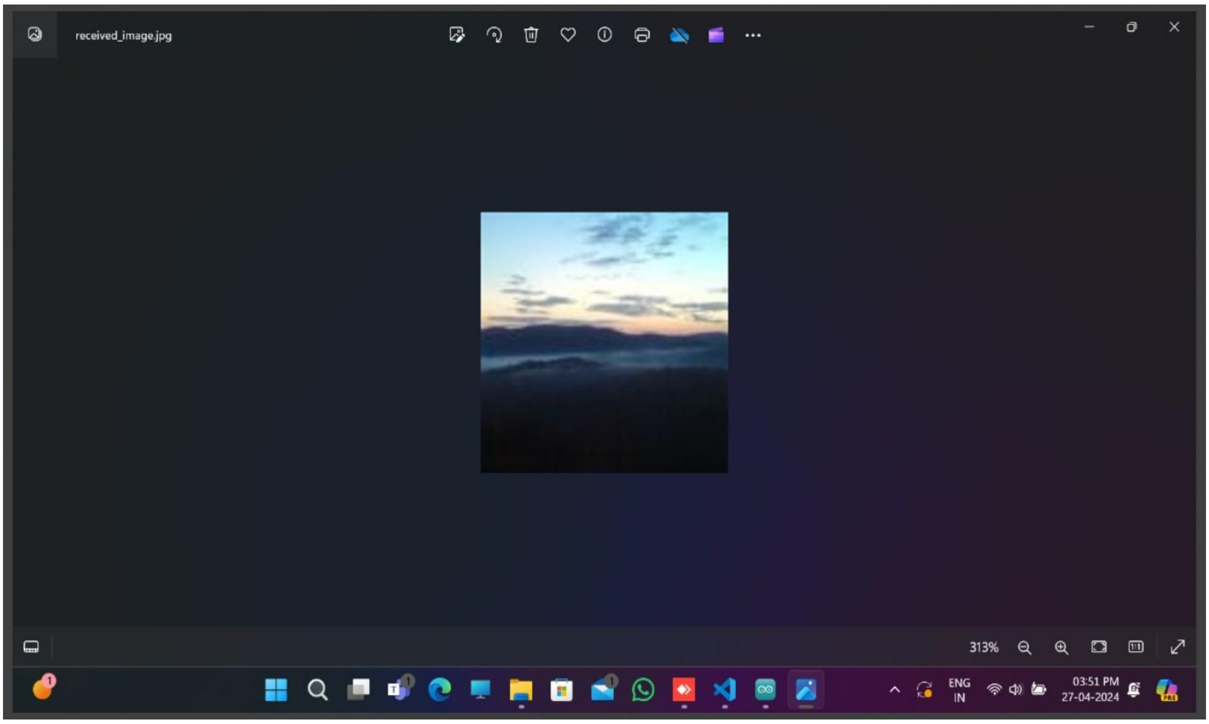

Figure 5.5: Received image using IR LED as an transmitter and IR Photodiode as an receiver at the receiver side(5kb image).

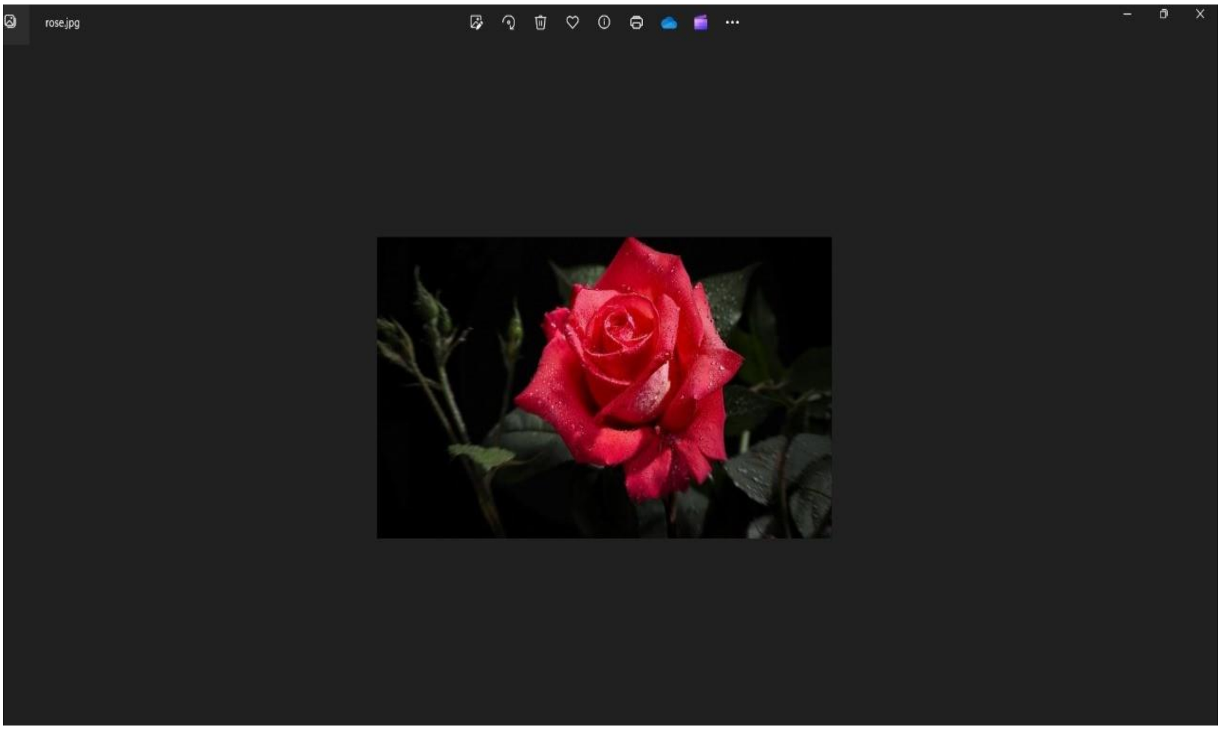

Figure 5.6: Received image using IR LED as an transmitter and IR Photodiode as an receiver at the receiver side(50kb image).

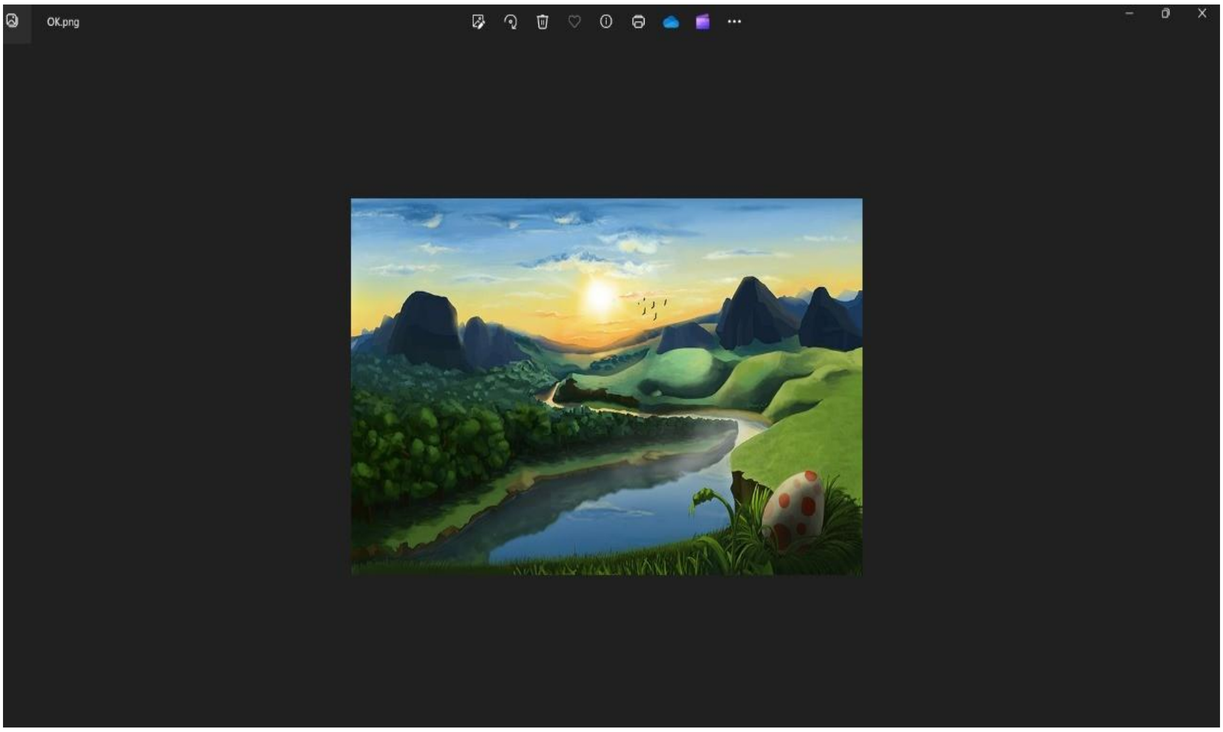

Figure 5.7: Received image using IR LED as an transmitter and IR Photodiode as an receiver at the receiver side(100kb image).

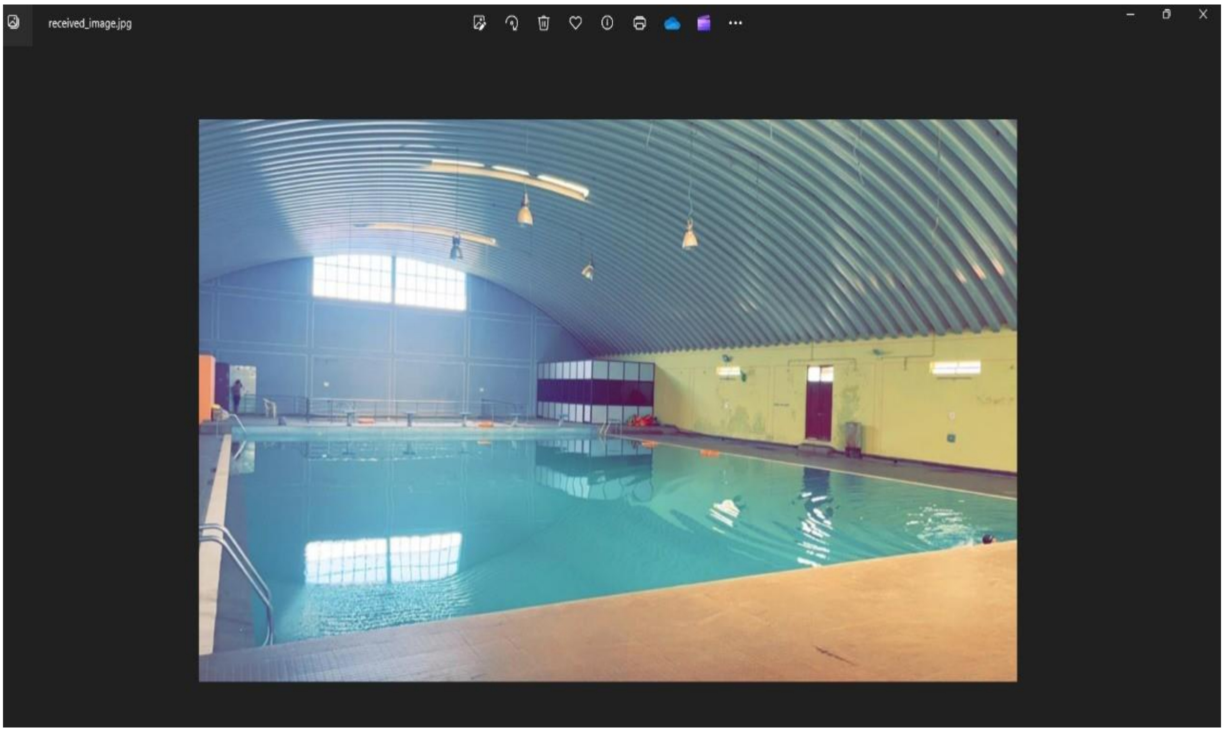

Figure 5.8: Received image using IR LED as an transmitter and IR Photodiode as an receiver at the receiver side(500kb image).

Figure 5.9: Received image using IR LED as an transmitter and IR Photodiode as an receiver at the receiver side(1Mb image).

Any Image of size(For example)	Baud rate	Time taken
5 Kb (Figure5.5)	1200/2400	36.56/21.61 sec
50 Kb (Figure5.6)	1200/2400	6.04/03.22 min
100 Kb (Figure5.7)	1200/2400	12.47/07.34 min
500 Kb (Figure5.8)	1200/2400	61.39/36.7 min
1 Mb (Figure5.9)	1200/2400	124.78/73.4 min

Table 5.2: Analysis of Image Transmission for different image sizes

Chapter 6

Conclusion and Future Scope

6.1 Conclusion

Based on the findings and results obtained from the project ”Data Transmission Using Li-Fi,” one can conclude that the implementation of Li-Fi technology for data transmission has shown promising results. The successful transmission of text and image data using Li-Fi is demonstrated.

Furthermore, the project has highlighted the importance of effective hardware components like Arduino Uno, IR LED, and IR Photodiode in the successful implementation of data transmission using Li-Fi. The seamless integration of these components has contributed to the overall success of the project.

In conclusion, the project on data transmission using Li-Fi has provided valuable insights into the feasibility and effectiveness of implementing this innovative technology. The analysis of text transmission for different word lengths has demonstrated the high-speed capabilities of Li-Fi, with varying baud rates showing consistent transmission times.

The analysis of image transmission for different image sizes is demonstrated. However, certain limitations related to external light sources, flickering, and the need for a clean line of sight highlight areas that require further attention and improvement for widespread adoption.

6.2 Future Scope

As light is everywhere and free to use, there is a great scope for the use and evolution of LiFi technology. If this technology becomes mature, each Li-Fi bulb can be used to transmit wireless data. As the Li-Fi technology becomes popular, it will lead to a cleaner, greener, safer communications and have a bright future and environment. The concept of Li-Fi is deriving many people as it is free (require no license) and faster means of data transfer. If it evolves faster, people will use this technology more and more.

With the growing technology and increasing use of the internet services, possibities are very high that use of Lifi Technology will be soon in practice. Every bulb will be replaced by Lifi bulbs and might be used like a wifi hotspot for the transmission of data. Using Lifi technology will grant a cleaner, greener and brighter future and environment. The concept of lifi is spreading so fast as it is easy to use, it is attracting interest of people. The use of lifi technology gives a very golden opportunity to replace or to give alternative to the radio based wireless technologies. As the number of people and the access of internet is increasing on such a large scale , accessing internet through Wi-Fi will soon be insufficient as the usage is increasing but the bandwidth remains the same. As network traffic will increase it will result in lowering the speed of accessing the internet thus more increasing prices. Thus the use of Lifi will increase thespeed of data transfer and also it is accessible in many banned places thus it will be available for all.

Chapter 7

Appendix

7.1 Text Transmission

7.1.1 Transmitter and Receiver Section

```
#include< SoftwareSerial.h >
SoftwareSerial mySerial(10, 11); // RX, TX
void setup()
// Open serial communications and wait for port to open:
Serial.begin(4800);
while (!Serial)
; // wait for serial port to connect. Needed for native USB port only

// Serial.println("Goodnight moon!");
// set the data rate for the SoftwareSerial port mySerial.begin(4800);
void loop() // run over and over
if (mySerial.available())
Serial.write(mySerial.read());

if (Serial.available()) mySerial.write(Serial.read());
// mySerial.println(" hello");
// delay(1000);
```

7.2 Image Transmission

7.2.1 Transmitter section

```
import serial
#from PIL import Image
#import io
import time
def send_image(serial_port, image path):
# Open the image file
with open(image_path, 'rb') as f:
image_ data = f.read()
whileTrue :
#Waitfortherequestcommandf romthereceiver
command = serial_port.read(1)
print(command)
if command == b'R':
# Send an acknowledgment
serial_port.write(b'A')
break
try : #Sendtheimagesizefirst
image_size = len(image_data)
print(image_size)
serial_port.write(image_size.to bytes(4, 'big'))
#Sendtheimagedatainchunks
chunk_size = 512 # Adjust the chunk size as needed
for i in range(0, len(image_data), chunk_size):
serial_port.write(image_data[i:i+chunk_size])
time.sleep(0.4) # Add a short delay to avoid overwhelming the receiver
time.sleep(0.5)
foriinrange(10) :
serial_port.write(b'EOT')
time.sleep(1)
serial_port.write(b'EOT')
except Exception as e:
print(f"Error sending image: e")
#Replace'COM 1'withtheappropriateserialport
serial_port = serial.Serial('COM10', baudrate=4800, timeout=5)
#Replace'path/to/image.jpg'withthepathtoyourimagefile image
path = 'copy2.jpg'
#Waitfortherequestcommandbeforesendingtheimage
send_image(serial_port, image path)
```

```
#Closetheserialport
serial_port.close()
```

7.2.2 Receiver Section

```
import serial
from PIL import Image
import io
#2.788
defreceive _image(serial _port) :
try : whileTrue :
#Sendtherequestcommandtothesender
serial _port.write(b'R')
# Wait for an acknowledgment from the sender
acknowledgment = serial_port.read(1)
ifacknowledgment == b'A' :
break
# Receive the image size
image_size_bytes = serial_port.read(4)
image_size = int.from bytes(image size bytes,' big')
print(image_size)
#Receivetheimagedata
image_ data = b''
termination_signal = b''
whiletermination _signal! = b'EOT' :
chunk = serial port.read(512)
if not chunk:
# Handle incomplete data or timeout
raise ValueError("Failed to receive complete image data")

    image_data+ = chunk
termination_signal = chunk[−3 :]
print("Image received successfully!")
# Create an Image object from the received data
received_image = Image.open(io.BytesIO(image _data))
# Save the received image
received _image.save("received image.jpg")
termination_signal = serial_port.read(3)
#iftermination signal! = b'EOT' :
#print("Error : Transmissionterminatedunexpectedly.")
returnreceived _image
```

```
except Exception as e:
print(f"Error receiving image: e")
return None

    # Replace 'COM2' with the appropriate serial port
serial_port = serial.Serial('COM11', baudrate = 4800, timeout = 5)
#Receivetheimageaftersendingtherequestcommand
received_image = receive_image(serial_port)
ifreceived_image :
#Displaythereceivedimage
received_image.show()
# Close the serial port
serial_port.close()
```

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