

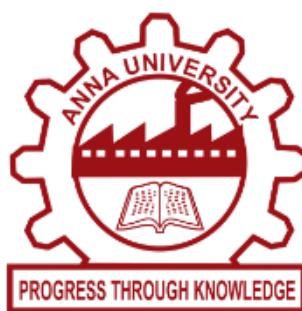
**Li-Fi AUDIO TRANSMISSION**  
**A MINI PROJECT REPORT**

*Submitted by*

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*in partial fulfilment for the award of the  
degree of*

**BACHELOR OF  
ENGINEERING  
IN  
ELECTRONICS AND COMMUNICATION ENGINEERING**



**MADRAS INSTITUTE OF TECHNOLOGY  
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**MAY 2024**

## **BONAFIDE CERTIFICATE**

Certified that this project report "**Li-Fi AUDIO TRANSMISSION**" is the bonafide work of

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## **ACKNOWLEDGEMENT**

We consider it as our privilege and our primary duty to express our gratitude and respect to all those who guided and inspired us in the successful completion of the project.

We would like to express our profound gratitude to **Dr. J. PRAKASH**, Dean, Madras Institute of Technology for providing us with this opportunity and a good environment.

We would also like to extend our sincere thanks to **Dr. P. INDUMATHI**, Head of the Department, Department of Electronics Engineering, Madras Institute of Technology for providing us with the opportunity to carry out a thesis of our choice.

We would also Like to express our great appreciating to **Siva priya**  
Teaching fellow Department of

We also thank all the teaching and non-teaching staff members of the Department of Electronics Engineering for their support in all the aspect.

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## **ABSTRACT**

Li-Fi stands for light-fidelity. Li-Fi is transmission of data using visible light by transmitting data through a LED light bulb that operates so rapidly than the human eye can follow. If the LED is on, the photo detector transmits a binary one; otherwise, it's a binary zero. The idea of Li-Fi was introduced by a German physicist, Harald Hass. The term Li-Fi was first introduced by Haas in his Ted global talk on visible light communication (VLC). According to Hass, the light, which he referred to as "Dlight", can be used to produce higher data rates up to 1 giga bits per second which is much faster than our broadband services used today.

This mini 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.

KEYWORDS: VLC, LEDs, Antennas

CHAPTER	TABLE OF CONTENTS NAME	PAGE NO.
	<b>ACKNOWLEDGEMENT</b>	<b>i</b>
	<b>ABSTRACT</b>	<b>ii</b>
1	<b>INTRODUCTION</b>	1
	1.1 OVERVIEW	1
	1.2 WHAT IS LI-FI?	1
	1.3 HISTORY OF LI-FI	2
	1.4 FEATURES OF LI-FI	2
	1.5 HOW LI-FI WORK?	3
2	<b>PROPOSED MODEL</b>	4
	2.1 BLOCK DIAGRAM	4
	2.2 MATERIALS USED	4
	2.3 LED	5
	2.4 AUDIO JACK	5
	2.5 RESISTOR ( $470\Omega$ )	6
	2.6 9V BATTERY	6
	2.7 SOLAR PANEL	7
	2.8 PRE-AMPLIFIED SPEAKER	7
3	<b>METHODOLOGY</b>	8
	3.1 TRANSMITTER CIRCUIT DIAGRAM	8
	3.2 RECEIVER CIRCUIT DIAGRAM	8
	3.3 WORKING OF AUDIO TRANSFER USING LI-FI	9
	3.4 COMPARISON OF WI-FI AND LI-FI	9
4	<b>RESULTS AND DISCUSSION</b>	
	4.1 OUTPUT	10
	4.2 ADVANTAGES	10
	4.3 CAPACITY	11
	4.4 AVAILABILITY	11
	4.5 LIMITATIONS	11
	4.6 APPLICATION	11
	4.7 FUTURE APPLICATIONS	12
	<b>REFERENCES</b>	12
		13

# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 OVERVIEW**

Over the past few years there has been a rapid growth in the utilization of the RF region of the electromagnetic spectrum. This is because of the huge growth in the number of mobile phones subscriptions in recent times. This has been causing a rapid reduction in free spectrum for future devices. Light-fidelity (Li-Fi) operates in the visible light spectrum of the electromagnetic spectrum i.e. It uses visible light as a medium of transmission rather than the traditional radio waves.

### **1.2 WHAT IS Li-Fi?**

With the boom of Smart Phones, Internet of things (IoT), Industrial Automations, Smart Home Automation systems etc. The demand for internet is also growing exponentially. The technology has evolved so much that everything from our car to our refrigerator needs a connection to the internet. This raises other questions like; Will there be enough bandwidth for all these devices? Will these data be secure? Will the existing system be fast enough for all these data? Will there be too much conjunction on network traffic?

All these questions will be tackled by upcoming technology called Li-Fi. Li-Fi stands for Light-Fidelity. Li-Fi is transmission of data using visible light by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. If the LED is on, the photo detector registers a binary one; otherwise, it's a binary zero.

### **1.3 HISTORY OF Li-Fi**

The idea of Li-Fi was introduced by a German physicist, Harald Hass, which he also referred to as Data through Illumination. The term Li-Fi was first used by Haas in his TED Global talk on Visible Light Communication.

According to Hass, the light, which he referred to as Dlight, can be used to produce data rates higher than 1 Giga bits per second which is much faster than our average broadband connection.

### **1.4 FEATURES OF Li-Fi**

The high-speed achievement of Li-Fi can be explained using frequency spectrum of Electromagnetic Radiations. From the electromagnetic spectrum we can see that the frequency Band of the visible light is in between 430thz to 770thz and that of Radio Frequency Band is in between 1Hz to 3thz, Hence the Frequency Bandwidth of the visible light is about 400 Times greater than the Radio Frequency Bandwidth. So, a greater number of bits can be transferred through this Bandwidth than in the radio frequency bandwidth. Hence Data rate will be higher in the Li-Fi and higher speed can be achieved. Using Li-Fi we can transmit any data that can be transferred using conventional Wi-Fi network. That can be Images, Audio, Video, Internet connectivity, etc., But the advantages over the Wi-Fi Network are High speed, Increased Security, many number of Connected Devices, and Less cost. In coming years number of devices that support Li-Fi will hit the Market. It is estimated that the compound annual growth of Li-Fi market will be of 82% from 2015 to 2018 and to be worth over \$6 billion per year by 2018.

## **1.5 HOW Li-Fi WORK?**

Every LED lamp should be powered through an LED driver, this LED driver will get information from the Internet server and the data will be encoded in the driver. Based on this encoded data the LED lamp will flicker at a very high speed that cannot be noticed by the human eyes. But the Photo Detector on the other end will be able to read all the flickering and this data will be decoded after Amplification and Processing. The data transmission here will be very fast than RF. Here we are using Solar panel at the receiving end to sense light.

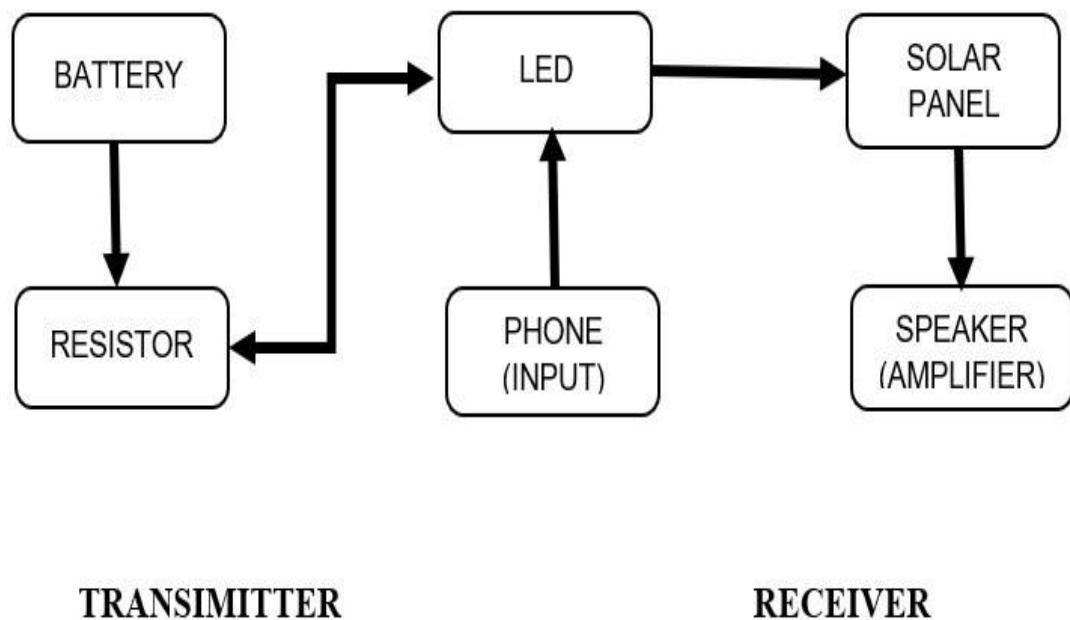
Transmitting data through photo diodes has been happening for a long time through our IR Remotes. Every time we pressed a button on our Television remote the IR LED in the Remote pulses very fast this will be received by the Television and then decoded for the information. But this old method is very slow and cannot be used to transmit any worthy data. Hence with Li-Fi this method is made sophisticated by using more than one LED and passing more than one data stream at a given time. This way more information can be passed and hence a faster data communication .

The Implementation of The Basic Li-Fi Based Prototype for Transmission of Sound Signal from Transmitter to Receiver with The Help of Visible Light Communication. The Model Will Transmit Digital Signal Via Direct Modulation of The Light on The Detector Which Detects the Signal at The Receiver Section. In Addition to The Operation, This Prototype Enables Investigation into The Features of The Visible Light and LEDs Incorporated in The Communication Model.

## CHAPTER 2

### PROPOSED MODEL

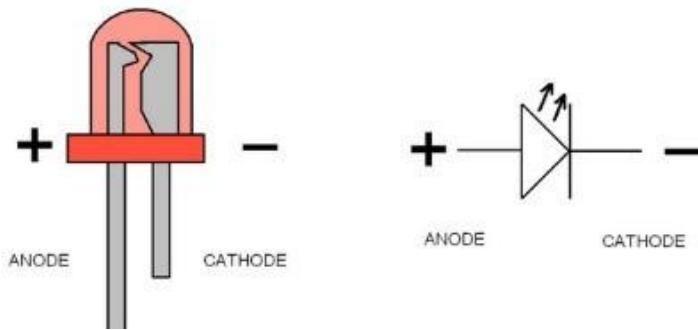
#### 2.1 BLOCK DIAGRAM:



#### 2.2 MATERIALS USED:

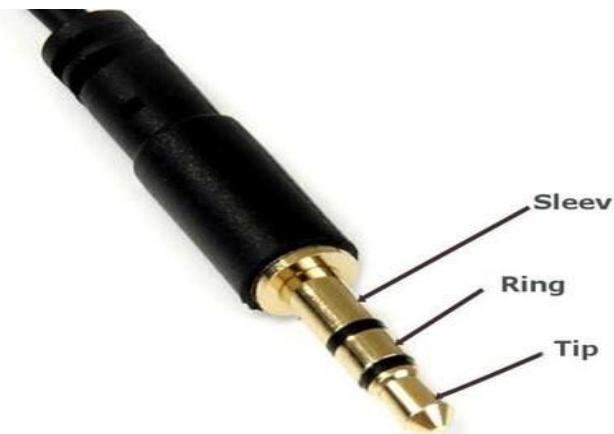
- 1) LED
- 2) 3.5 mm Jack
- 3) 9V Battery
- 4) Pre amplified speaker
- 5) Solar panel
- 6)  $470 \Omega$  Resistor

## 2.3 LED:



LED, in full light-emitting diode, in electronics, a semiconductor device that emits infrared or visible light when charged with an electric current. An electrical current pass through a microchip, which illuminates the tiny light sources we call LEDs and the result is visible light.

## 2.4 AUDIO JACK:



A **phone connector**, also known as **phone jack**, **audio jack**, **headphone jack** or **jack plug**, is a family of electrical connectors typically used for analog audio signals. Three-contact versions are known as *TRS connectors*, where *T* stands for "tip", *R* stands for "ring" and *S* stands for "sleeve".

## 2.5 RESISTOR ( $470\Omega$ ):



$470\Omega$  Carbon Film Resistors are typical axial-lead resistors, which have much better temperature stability and provide lower noise, and are generally better for high frequency or radiofrequency applications.

## 2.6 9V BATTERY:



The **nine-volt battery**, or **9-volt battery**, is a common size of battery that was introduced for early [transistor radios](#). It has a rectangular prism shape with rounded edges and a polarized snap connector at the top. The nine-volt battery format is commonly available in primary carbon-zinc. Most nine-volt alkaline batteries are constructed of six individual 1.5 V LR61 cells enclosed in a wrapper.

## **2.7 SOLAR PANEL:**



Solar panel is the collection of solar cells which are sensors of light or other electromagnetic radiation.[1] There is a wide variety of photodetectors which may be classified by mechanism of detection, such as photoelectric or photochemical effects, or by various performance metrics, such as spectral response. Semiconductor-based photodetectors typically have a p–n junction that converts light photons into current. The absorbed photons make electron–hole pairs in the depletion region. Solar cells convert some of the light energy absorbed into electrical energy.

## **2.8 PRE-AMPLIFIED SPEAKER:**

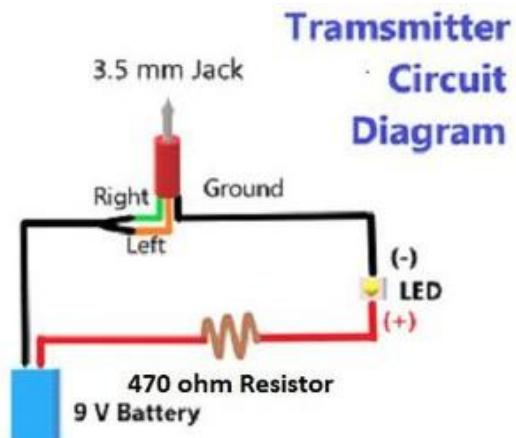


Speakers are made up of a cone, an iron coil, a magnet, and housing (case). When the speaker receives electrical input from a device, it sends the current through the causing it to move back and forth. This motion then vibrates the outer cone, generating sound waves picked up by our ears.

## CHAPTER 3

### METHODOLOGY

#### 3.1 TRANSMITTER CIRCUIT FOR Li-Fi:



On transmitter side, we have white Bright LED and a battery which are connected to 3.5mm jack and jack will be connected to audio source. Here we are using battery to power up the LEDs because there is less power coming from the audio source which is not enough to power the LEDs.

#### 3.2 RECEIVER CIRCUIT FOR Li-Fi:



On receiver side, we are using Solar panel and a speaker which is connected by an Aux cable.

### **3.3 WORKING OF AUDIO TRANSFER CIRCUIT USING Li-Fi:**

In transmitter side, when we connect 3.5mm jack to audio source LED will glow but there is no fluctuation in the intensity of light when the audio source is OFF. As soon as you play the audio, you will see that there is frequent change in intensity of light. When you increase the volume, LEDs intensity is changing faster than the human eye can follow.

Solar panel is so sensitive that it can catch small intensity change and correspondingly there is change in the voltages at output of solar panel. So, when the light of LED falls on the panel, voltages will vary according to the intensity of light. Then voltages of solar panel are fed into amplifier (Speaker) which amplifies the signal and giving the audio output through the speaker connected to the amplifier.

Output will come as long as solar panel is in contact of LEDs. You can put the LEDs at max. 15-20cm distance from the solar panel to get the clear audio output. You can further increase the range by increasing the area of solar panel and higher wattage Power LED.

### **3.4 COMPARISON BETWEEN Li-Fi AND Wi-Fi:**

Li-Fi is a term used to describe visible light communication (VLC) technology applied to high-speed wireless communication devices. It acquires the name due to the similarity in the operation of Wi-Fi, only using visible light instead of radio. Wi-Fi is great for basic wireless connectivity within buildings, and Li-Fi is ideal for high density wireless data coverage in confined area and is used for very large-scale applications.

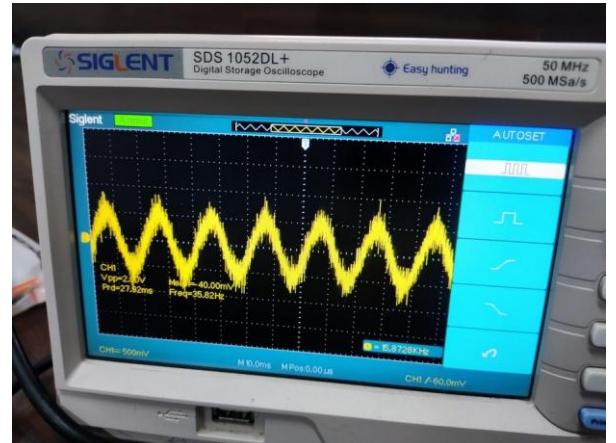
## CHAPTER 4

### RESULT AND DISCUSSIONS

#### 4.1 OUTPUT:



The given signal is a power signal



Input signal

Input frequency: 50Hz Output

frequency: 465Hz

#### 4.2 ADVANTAGES:

Li-Fi technology is based on LED's or other light source for the transfer of data. The transfer of the data can be with the help of light, no matter the part of the spectrum that they belong. That is, the light may belong to the invisible, ultraviolet or the visible part of the spectrum. Also, the transmission rate of the communication is more than sufficient for downloading movies, games, music at a short period of time. Also, Li-Fi removes the drawbacks that have been put on the user by the Wi-Fi.

#### **4.3 EFFICIENCY:**

Data transmission using Li-Fi is very cheap and requires less consumption. Led lights consume less energy and are highly efficient and long lasting.

#### **4.4 CAPACITY:**

It has 400 times wider bandwidth than the present radio waves in the electromagnetic spectrum. Also, light sources are already being installed in our surroundings from years before. So, Li-Fi has got better capacity and also the infrastructures are already available.

#### **4.5 AVAILABILITY:**

Availability is not a Problem Faced as Huge Number of Light Sources Are Present Everywhere. There Are Billions of Light Bulbs Fixed Worldwide, That They Just Need to Be Replaced with LEDs for Proper Transmission of Data. Security Light Waves Do Not Penetrate Through Walls. So, They Can't Be Intercepted and Misused. Therefore, There Is No Security Issues Faced in Li-Fi. No Limit for Connectivity. The Capability of Transferring High Speed Data Through Li-Fi Ensures That Large Number of Users Can Be Connected, Since Speed Will Not Be Throttled or Slowed Down.

#### **4.6 LIMITATIONS:**

- i. Li-Fi cannot penetrate through walls the artificial light used cannot penetrate through walls and other opaque matters which radio waves are capable of doing.
- ii. So, a Li-Fi enabled end device (through its inbuilt photo-receiver) will never Li-Fi audio transmission international conference on innovative and advanced technologies in engineering (march-2018). Be as fast and handy as a Wi-Fi enabled device if any obstacle gets into a way while transmission or reception.

## **4.7 APPLICATION:**

There are plenty of applications of this technology, from internet access around our surroundings through street lamps to auto-piloted cars that communicate through their headlights. Applications of li-fi can be extended in areas where the wi-fi technology does not entertain its presence like medical technology, power plants and various other areas. Since li-fi just make use of visible light, it can be used safely in aircrafts and hospitals where wi-fi technology is banned because the transmission of RF is prone to interference.

## **4.8 FUTURE APPLICATIONS:**

### **EDUCATION SYSTEMS:**

Li-Fi is the latest technology that can provide maximum speed internet access and vast internet connectivity. So, it can replace wi-fi at educational institutions and also at companies where the users can make use of li-fi with the same speed intended in a particular area.

### **MEDICAL APPLICATIONS:**

Operation Theatres (Ots) Do Not Allow Wi-Fi Connection Due to Harmful Radiations. The Usage of Wi-Fi at Hospitals Interferes with The Mobile and Personal computers which blocks the signals for monitoring equipment's. So, it may be tremendously dangerous to the patient's health. To overcome this and to make operation theatre tech savvy li-fi can be used to accessing internet and to control medical equipment's. This can even be beneficial for robotic surgeries and other automated procedures.

**APPLICATIONS IN SENSITIVE AREAS POWER PLANTS:**

- i. Need fast, inter-connected data systems so that demand, grid integrity and core temperature (in case of nuclear power plants) can be monitored easily.
  - ii. Wi-Fi do have many other radiations which are bad for sensitive areas surrounding the power plants. Li-Fi offers safe, fast connectivity for all areas of these sensitive locations. This can also save money as compared to the currently implemented systems. Also, the pressure on a power plant's own reserves could be less compared to the present scenario.
  - iii. Li-Fi can also be used in petroleum or chemical plants where other transmission or frequencies could be hazardous and may cause damage to the surroundings.
- REPLACEMENT:** For other technologies Li-Fi does not make use of radioactive waves. So, it can be easily used in the places where Bluetooth, infrared, Wi-Fi etc. are usually banned and are strictly offensive.

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