

## Li-Fi based Data and Audio Communication

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### ABSTRACT

*Li-Fi is one of the wireless technologies which uses visible light for communication. Li-Fi has achieved remarkable success in every field of communication as it uses visible light which has high speed, more security and less interference due to which large capacity wireless data transmission is possible. The objective of this paper is to transmit text (Hexadecimal characters) and Audio information using light as carrier. The high flickering LED and LASER is used as a source to transmit text data and audio respectively.*

*It is possible to achieve text data transmission of up to 2m by using LDR as the detector. In case of audio transmission, solar panel is used to receive the audio signals and around 15feet.*

**Keywords - Li – Fi technology, VLC (Visible Light Communication), LED (Light Emitting Diode), LDR (Light Dependent Resistor), LOS (Line ofSight).**

### 1.1 INTRODUCTION

As the demand for wireless data communication is increasing rapidly, new technologies are arriving which uses the different frequencies in electromagnetic spectrum as the carrier for transmitting data wirelessly. Wi-Fi is one such method which uses radio waves to communicate wirelessly within an area. As radio waves have some drawbacks, it is replaced by visible light and hence the emerged technology is called Li-Fi technology. Li-Fi technology uses visible light frequency (430THz- 770THz) which is comparatively higher than that of radio wave frequency (3kHz – 300GHz). LED is used as a source of VLC (380nm – 740nm) to transmit information. LED which is used as the source for text data transmission has high brightness, low cost, small size, low power consumption, long lifetime and low heat radiation and hence it is used as a substitute for established radio waves.

High flickering LED is used to transmit data, wherein the change in current intensity is detected by photo detecting resistor and is not visible to human eyes. When the LED is Off, data '0' is transmitted and similarly when it is on data '1' is transmitted.

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

In reference with [2] audio transmission using Li-Fi have been implemented. They have implemented Li-Fi transmitter module consisting of amplifiers and power LED whereas the LI-Fi receiver module consists of

amplifiers and LDR. They have used a way like Wi-Fi hotspots which are used to transmit the data wirelessly. This reduces the electrical overhead and is ecofriendly and hence the environment will be more radiation free zone.

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

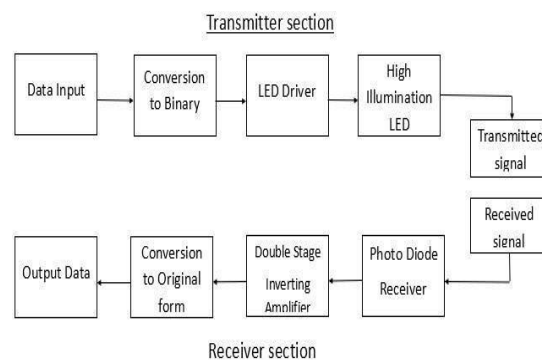
## II. OBJECTIVE

The objective of the proposed work is outlined as below:

1. To design and implement a prototype module of Li-Fi (visible light communication).
2. To transmit and receive text Data and Audio information using light as a carrier.

## III. METHODOLOGY

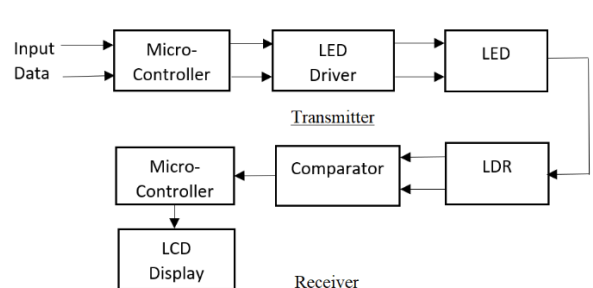
LEDs are used as the source of light. The basic principle behind the working of this technology is – if the LED is ON, digital HIGH will be transmitted and if LED is OFF, digital LOW will be transmitted. The LED flickers due to the large and subtle variation in the current, which is at the rate of 10 Gbps so that the data is transmitted at a very high speed. The flickering rate of LEDs is varied so that the information encoded can be obtained in different sets of 0's and 1's.



The input data is given to the LED driver in the form of 1's and 0's which works on the principle of on and off keying. This makes the high illumination LED which is connected to the LED driver to flicker at a high rate and hence transmitting the optical pulses. These pulses are

## IV. DATATRANSMISSION

### 1. Block Diagram



### 2. Design

The signals detected by the LDR are fed to the comparator where the received voltage are compared with the reference voltage. If the received voltage is higher than the reference voltage, it is considered as binary high. If the received voltage is lower than the reference voltage, it is considered as binarylow.

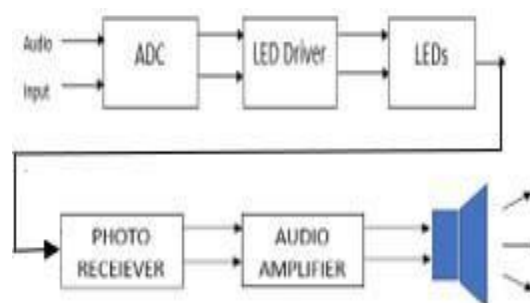
### 3. Working

The data input is given from Hex Keypad or through serial communication. This signal is transmitted to the Micro controller which converts the signal to Binary0's detected by the detecting devices (LDR in case of data reception and solar panel in case of audio reception). The received signals are amplified and converted to original form. or 1's, this binary data is fed to LED driver for switching ON and OFF the LED. These light signals consist of input data. These signals are transmitted towards the receiver. Input data is also displayed on the LCD Display for verification.

The transmitted light signal is received by the photo receiver. Here we have used LDR as Photo receiver. Data is received as analog signal whose amplitude varies. These signals are not binary signals, hence the received signal in analog form cannot be fed to the micro controller. This signal is converted to digital signal using comparator with the help of op-amp. Comparator output is given as input to the micro controller. Based on the signal received the data is displayed on the LCDdisplay.

## V. AUDIOTRANSMISSION

### 1. Block Diagram



### 2. Design

The audio amplifier gain is internally set to 20db but can be increased to 200db by using a resistor and capacitor between pin1 and pin8 or just with a capacitor. The output signal as both AC and DC components and DC component cannot be fed to the speaker so to remove this DC component capacitor is used at pin5. Along with this capacitor, a filter circuit is used to remove high frequency oscillations or noise. Pin7 can be grounded using a capacitor or left open for stability.

### 3. Working

The audio input signal is given through media players. These analog signals are converted to digital switching signal using transistor, for switching ON and OFF the LED. These signals are then transmitted.

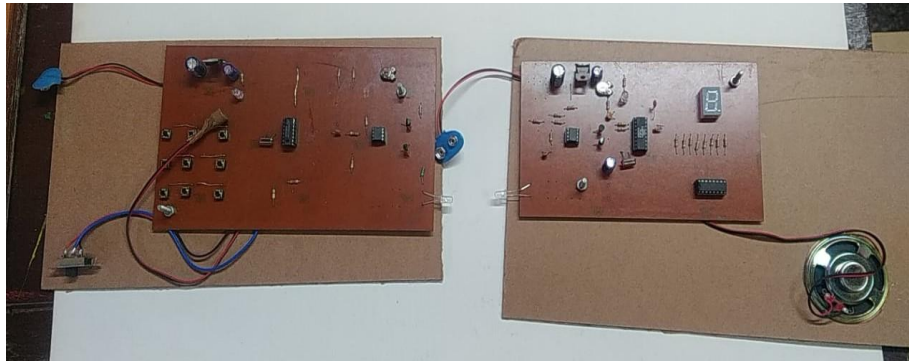
The transmitted light signal is received by the photo receiver. Here we have used Solar cell as Photo receiver. These received signals are fed to amplifier. The signals are amplified using audio amplifier and these amplified

signals are given to speakers.

## VI. IMPLEMENTED RESULTS AND ANALYSIS

Trans-reception of the audio and text files is successfully implemented using Visible light as the carrier. The following observations are made.

- 1) As the distance between the transmitter and receiver increases, the received signal quality decreases.
- 2) The experimental result defines that maximum distance achieved in visible light communication system is approximately 2m for data transmission and around 15ft for audio transmission.
- 3) The received data is affected if the angle between the receiver and LOS of the LED changes.



## VII. APPLICATIONS

Each light fixture in Li-Fi becomes a separate data channel and these channels can supply different data to separate light pool which is delivered at a full rated download speed for that channel. Below are some of the applications of Li-Fi.

- 1) Medical field – As the radio waves are harmful for the patients, Wi-Fi is usually prohibited in the hospitals. So, Li-Fi technology can be used as it uses visible light for communication.
- 2) Under water application – Visible light can be used for under water communication as it has wide range and bandwidth. Radio wave communication is not possible as radio waves cannot penetrate under water, and high attenuation environment. And by using Li-Fi technology, energy consumption of the underwater vehicles is also reduced.
- 3) Aircrafts and petrol bunks – Li-Fi can be used in highly inflammable areas as there would not be any interference with the inflammable objects.
- 4) Nuclear power plants – In electromagnetic sensitive areas like nuclear power plants, Li-Fi can be used as the use of Wi-Fi is forbidden.
- 5) Indoor Navigation – Li-Fi can be used for communication inside cinema theatres, government offices, work offices or any indoor locations where each LED source acts as the hotspot.

## VIII. CONCLUSION AND FUTURESCOPE

Li-Fi is an emerging technology, as the radio wave communication has certain drawbacks. This technology can transmit data with the speed of 100gbps approximately which is entirely greater than radio waves. Li-Fi is categorized as reliable communication technique as it provides high data security transmission with low cost.

In the proposed work, Li-Fi module for transmitting and receiving the text data and audio is built and tested successfully. It is possible to achieve text data transmission of up to 2m by using LDR as the detector. audio

transmission of around 15 feet using solar panel in the receiver side.

In future, this work can be enhanced by

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

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