Broadcasting using LiFi

Akshay Pathak, Marimuthu Padayachi, Rahul Kosamkar, Saritha LR

Abstract— A person gets frustrated when he faces slow speed as many devices are connected to the same network. As the number of people accessing wireless internet in-creases, it's going to result in clogged airwaves. Li-Fi is transmission of data through illumination by taking the fiber out of fiber optics by sending data through a LED light bulb that varies in intensity faster than the human eye can follow. As Li-Fi is considered to be the optical version of Wi-Fi, some label it as fast and cheap wireless communication system. When LED is on digital 1 is transmitted and when it is off 0 is transmitted. Data can be encoded in the light by varying the flickering rate to generate strings of 1s and 0s. The output appears to be constant to the human eye as the LED intensity is modulated rapidly. This method of using rapid pulses of light to transmit information wirelessly is technically referred to as Visible Light Communication (VLC). Advancements promise a speed of 10 Gbps. Li-Fi can work even underwater. If this technology can be put into practical use, every bulb can be used some-thing like a Wi-Fi hotspot to transmit wireless data and we will proceed toward the cleaner, greener, safer and brighter future. As the growing number of device accessing wireless internet are coming into use airwaves are becoming increasingly clogged making it more and more difficult to get a reliable, high speed signal.

Index Terms— Light-Fidelity(LiFi), Light Emitting Diode(LED), Photodiode, Wireless Communication, Visible Light Communication(VLC), Optical Wireless Communication (OPT).

1 INTRODUCTION

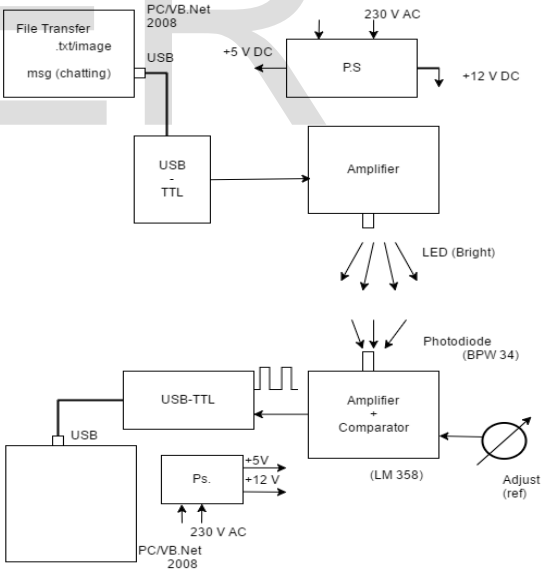
Li-Fi is the term used to label the wireless communication system through an optical source that makes the system fast and cheap. Li-Fi is based upon Visible Light Communication technology where data transmission is made through a light bulb whose intensity varies at a rate faster than the human eye can follow. The fiber out of the fiber optics is replaced by an LED source for the data transmission. The term Li-Fi was introduced by Harald Hass in his TED Global talk on Visible Light Communication "At the heart of this technology is a new generation of high brightness light-emitting diodes", Hass says. Hass also included the transmission process as "Very simply, if the LED is on, a digital 1 is transmitted, if it's off 0 is transmitted. They can be switched on and off very quickly, which gives nice opportunities for transmitted data." The data to be transmitted is first encoded in to the light through varying the rate of flickering that generates different strings of 1's and 0's. Generally, the modulation rate of LED is so rapid that the human eye cannot detect the variation and the output is generated continuously. Li-Fi was mainly designed to overcome the drawbacks of Wi-Fi usage. White LED is expected to replace fluorescent and incandescent lights in future and can be regarded as text generation lighting source. LED can support high speed on and off which can help in acquiring high data rate. Since in case of Li-Fi system optical source of light been used as a data transfer medium it can be safely used at the places where radio waves can harm the environment. Hospitals and Aircraft that are prone to the interference made by the radio waves can now make use of LED light as a safe mode of data transmission with no interference of waves.

2 BACKGROUND OVERVIEW

2.1 Proposed System

1. The main objective of the project is to develop a Light Fidelity data transfer model (Li-Fi Model) for wireless data transmission in the visible light spectrum.
2. Project will try to include following key features:

(a). Wireless Data Transmission and Reception.
(b). Data Transmission in Visible Light Spectrum.
(c). Fast Transmission Rates.



2.2 Tranmitter Side

Basically, we can transfer data between multiple devices for example data transfer from one PC to multiple PC. At the transmitter end we are going to use Visual Studio 2008 tool for selecting file which to be transmitted at the receiver end.

2.3 Receiver Side

At the receiver end we use same Visual Studio 2008 tool to see the file which is to be received. Photo diode is used on the re-

ceiver side for receiving the data. Since the signal of photo diode is quite weak we make use of transistor to amplify the signal.

2.4 Explanation of blocks

- **Power Supply (P.S):**
  This unit will supply the various voltage requirements of each unit. This will be consisting of transformer, rectifier, filter and regulator. The rectifier used here will be Bridge Rectifier. It will convert 230VAC into desired 5V/12V DC.

- **USB + TTL:**
  At the transmitting end, we use an USB interface which is easy to connect to the computer; but USB level data cannot be given directly to light source so we need to convert it into serial data format as per the protocol. For this, a USB to TTL converter is being used.
  At the receiving end,we use an USB interface which is easy to connect to the computer; but TTL level data cannot be given directly to computer so we need to convert it into serial data format as per the protocol. For this, a USB to TTL converter is being used.

- **Amplifier:**
  To transmit data, the data which was given is an electronic signal pulse so it needs to be amplified. Hence, an amplifier is used which amplifies the signal and transmits it to the photodiode through the LED(i.e. Torch) light.

- **LED (Light Emitting Diode):**
  A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode, which emits light when activated. A bright LED Torch will be used for transmission. The flickering of light will be the indication for data transmission.

- **Amplifier + Comparator:**
  This block is at the receiving end. It consists of:
  1. A BPW 34 photodiode is used to capture the transmitted. BPW34 is a PIN photodiode with high speed and high radiant sensitivity in miniature, flat, top view, clear plastic package. It is sensitive to visible and near infrared radiation.
  2. An LM358 Op-Amp. The LM358 is a low power dual channel op-amp that can operate two op-amp for a single power supply. It can handle 3-32V DC supply & source up to 20mA per channel.
  3. The variance resistor (i.e. Preset) is connected to the amplifier to adjust the intensity of light. The data is received and the status is displayed on the screen. To receive data, as this is AC, we make use of bridge rectifier to rectify in order to convert it to DC. After it is rectified it is filtered and connected to USB or TTL.A voltage regulator i.e. 7805 is attached.

3 Components required for the project

1. LED

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons.

2. Photodiode

We will be using Photodiode BPW34. BPW34 is a PIN photodiode with high speed and high radiant sensitivity in miniature, flat, top view, clear plastic package. It is sensitive to visible and near infrared radiation.

3. LM 358 Op Amp

The LM358 is a low power dual operational amplifier integrated circuit originally introduced by National Semiconductor. It is used in detector circuits. It is an 8-pin integrated circuit, comprising two operational amplifiers at low power. The LM358 is designed for general use as amplifiers, high-pass filters and low, band pass filters and analog adders.

6 Diagrams

6.1 Circuit Diagram

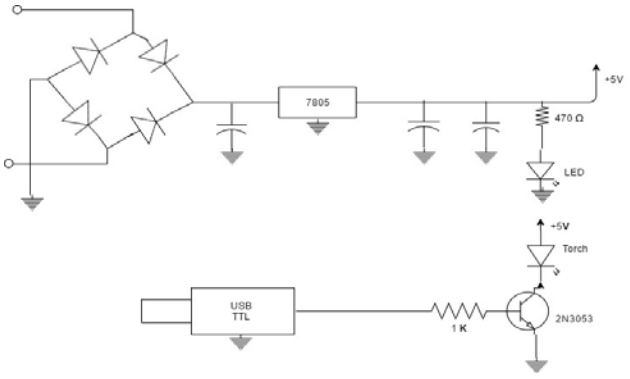


Fig. 1. Power Supply and Transmitter

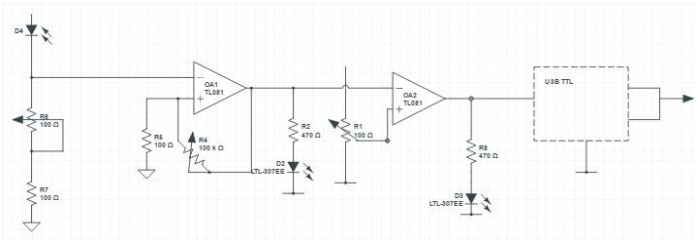


Fig.2. Reciver Circuit Diagram

6.2 Flowcharts

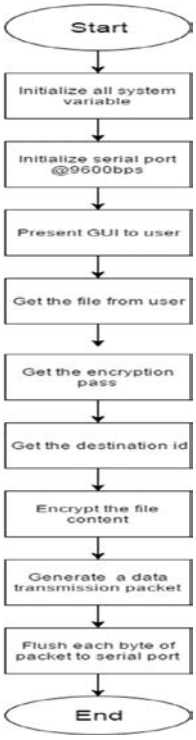


Fig 3. Flowchart of Transmitter

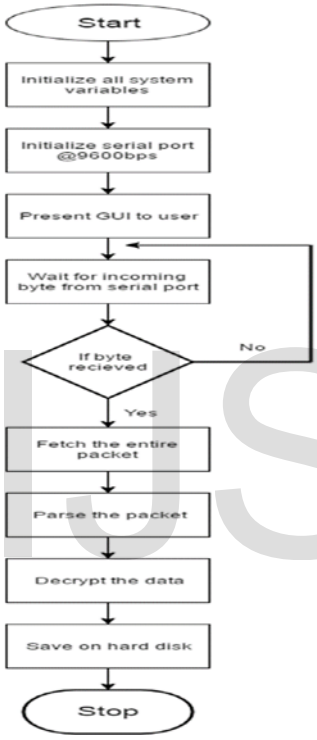


Fig.4. Receiver Flowchart

6.2 DFD Diagrams

A. DFD level 0:

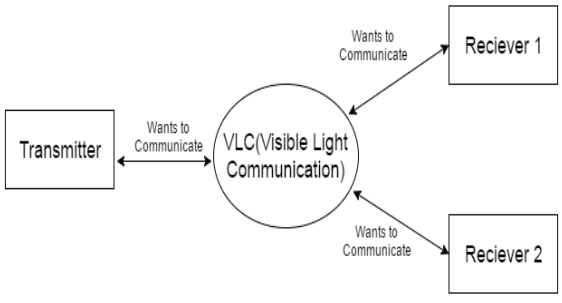


Fig.5. DFD level 0

The level 0 is the basic level describing in any system in a Data Flow Diagram. This level introduces the basic functionality of our system. The level 0 Data Flow Diagram for our proposed system is as shown above. It consists of actors and process, where the actors can be as many computers, which are connected to our proposed system. When the transmitter wants to send any data or file they get connected to the system.

B. DFD level 1:

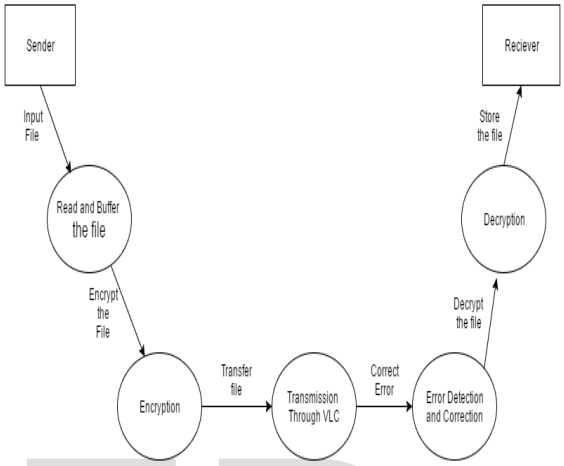


Fig.6. DFD level 1

Level 1 of Data Flow Diagram for our proposed system is detailed level for file transfer process. It gives more detailed information about the file transfer process. It shows the highest-level functionality for our proposed system. Sender will input the file which he wants to send to the receiver. It will read and buffer the file and then encrypt that file with one common password. After encrypting the file sender will transmit that file through Visible Light Communication (VLC). If there is any error or noise it will detect it and amplified, it using variance resistor and then decrypt the file using same password. After decrypting a file receiver will store it in hard disk.

6.3 Usecase Diagram

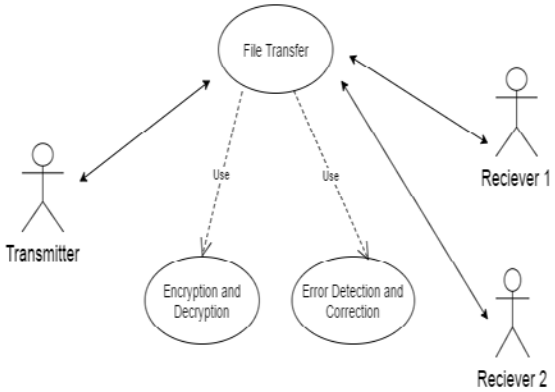


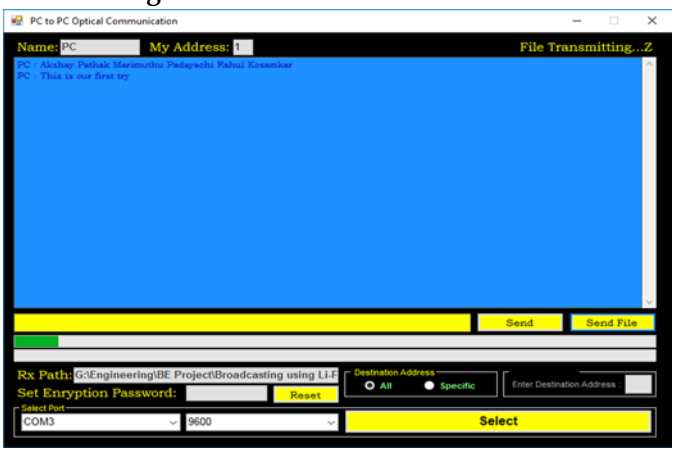
Fig.7. Use Case diagram

Following use case diagram describe how transmitter will

transmit data or file to the receiver. Transmitter will select the file from computer which he wants to send. It will encrypt that file with one common password and at the receiver end receiver will decrypt that file with the same password.

6.4 Experimental Results

Transmitting window



File being received by two laptops simultaneously

6.5 Data transfer speed

For text transfer

Size	Time (sec)
100KB	20
550KB	96
876KB	178

For image transfer

Size	Time (sec)
44KB	25
59KB	30
267KB	200

7 End Sections

Conclusion

The possibilities are numerous and can be explored further. If this technology can be put in to practical use, every bulb can be used something like a WiFi hotspot to brighter future. Although there are some barriers as in how the data would be transmitted over vast distances. At this point we're left with more questions than answers. But given the implications and implementations in the given time by of such a promising technology, it is only a matter of time before we find out the answers to this next generation LiFi or Light Fidelity Technology.

Acknowledgment

Thanks to the guide Prof. Saritha L.R who have contributed towards development of the project.

References

[1] V´ıctor Monz´on Baeza1, Matilde S´anchez-Fern´andez1, Ana Garc´ıa Armada1 and Antonio Royo2 1, "Testbed for a LiFi System integrated in Streetlight" Department of Signal Theory and Communications. Universidad Carlos III de Madrid, Spain.

[2] WANG Jia-yuan,ZOU Nian-yu,WANG Dong, "Experimental Study on visible light communication based on LED", www.sciencedirect.com/science/article/pii/S1005888511604226.

[3] Jyoti Rani, Prerna Chauhan, Ritika Tripathi, "Li-Fi (Light Fidelity)-The future technology In Wireless communication" , International Journal of Applied Engineering Research, ISSN 0973-4562 ,Vol.7, No.11 ,2012.

[4] Rahul.R.Sharma, Raunak, Akshay Sanganal, "Li-Fi Technology", www.ijcta.com/documents/volumes/vol5issueI/ijcta2014050121.pdf.

[5] A Framework for Simultaneous Message Broadcasting Using CDMA-based Visible Light Communications .Yan-Ann Chen, Yi-Ting Chang, Yu-Chee Tseng, Fellow, IEEE, and Wen-Tsuen Chen, Fellow, IEEE