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# Automated Billing System Using LI-FI

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***ABSTRACT*— The latest uproar in this era is about a technology termed as Light Fidelity or more commonly known as Li-Fi. This is a much more secure method of transmission compared to existing technologies. Li-Fi is transmission of data through illumination of the LED by taking the fiber out of the fiber optics by sending data through the LED light bulb that varies in intensity faster than the human eye can follow. This research paper aims at designing a Li-Fi transceiver using PIC Microcontroller that is able to transmit digital data. Hence this research work gives an innovative way of designing a transceiver which works by using off the shelf low cost components and using visible light spectrum.**

**KEYWORDS- Visible Light Communication, LED, PIC microcontroller.**

## I. INTRODUCTION

In today's time wireless communication has become the integral part of our life. There are many technologies that can be used for wireless communication. Li-Fi is one of those. Undoubtedly, Li-Fi is very emerging technology that has large applications in both our personal and professional life. But due to tremendous use, RF bands are getting scarce and also they are restricted at airplanes and hospitals. Some of the issues related with Li-Fi are its Distance, Efficiency, Availability and Security. Also at billing desk we require calm environment and a situation where there is no need for scanning each and every items. These issues led to development of a new concept called LI-FI for short range communication, which can be used at malls or supermarkets [1]. In this technology the light waves are modulated according to the information which is to be sent. At bill desk we are using LI-FI to decrease the shopping time at bill desk and save time.Its main components are LED, photodiode, amplifier and microcontroller. Automated Billing system has many advantages such as, shorter queue at bill desk, faster and more efficient services, and minimization of queue and Customers satisfaction while keeping the item in the trolley.

## II. BASIC COMPONENTS

### *A. LED*

LED refers to light emitting diode. It is a p-n junction diode, which emits light when activated. When a certain voltage is applied to LED then energy, get released due to the combination of electron and holes in the form of photons. The colour of the light depends on the band gap of the semiconductor used to make LED. This effect is called electroluminescence. It is used at transmitting end [1-2].

### *B. Photodiode*

Photodiode is a device that converts light into current. The current is produced due to the breakage of bonds between electrons and holes when photons are absorbed by it. Small amount of current also flows through photodiode when no light falls on it which is called dark current.

### *C Microcontroller*

The PIC16F877A is a CMOS flash-based 8-bit microcontroller, which has operating frequency of 20 MHz. Its main function is to control the APR. It serially send the recorded audio file from APR to the transmitting modules.

### *D. Amplifier*

The output current from the photodiode is very small which is difficult to detect. So to amplify it and to covert that amplified current into equivalent voltage we require a trans impedance amplifier.LM358 can be used for the same purpose.

### *E. USB TO TTL converter*

On the receiver side the data received by the photo diode is fed to amplifier, the amplifier provides with a TTL signal which is to be converted into USB/CMOS signal. In order to convert the signal we use a cp2102 module.

## III. RELATED WORK

Each trolley will contain a LI-FI receiver present at front end. According to Zubin Thomas et. Al. LI-FI can be used at shopping malls for automatic billing , assuming that every good will have LI-FI transmitter and the mobile have LI-FI receiver integrated via On-The-Go (OTG) communication in shopping cart. RFID [5] can also be used for shopping. Each item will be having a unique RFID tag

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that can be used for billing in the trolley.Amit Hatekar et. al. [6] suggested that billing system can be done more efficiently by using GSM with RFID. In addition to the RFID tag, GSM technology can also be used to send the payment information to the user. [7] The LED transmitter is placed in trolley front end and reciever will be there at bill desk. The technology can be used to avoid rush with the help of the data transmitted from trolley. G. Vidhya Krishnan et.al. [8] explains the benefits and use of LI-FI for smart trolley and its practical consideration. Paper[9-12] explains benefits of automated billing system and wireless communication. The spectrum will provide high data rates with low latency and high security [13-14] in Wireless communication. Our contribution in automated billing system technology is to have wireless communication between trolley and bill desk using LI-FI.

## IV. SYSTEM MODEL

In order to design the system, the "Line of sight" between receiver and transmitter is required to send the data. LI-FI uses visible light communication or infrared and near-UV spectrum waves, which can be achieved by using LED (light emitting Diode). There is requirement of transmitter as well as a receiver so as to achieve the concept of wireless communication system, as the LI-FI refers to the Light fidelity which is also a wireless communication system and it will transmit data using Electromagnetic wave(Light) therefore it requires a transmitter circuit and receiver circuit. Here, trolley is acting as a transmitter because the transmitter circuit i.e. LED and Bill desk as a receiver.

On the receiving end there will be a photo-detector to sense the change in light transmitted from LED, and so as to meet the requirement of "Line of sight" we are connecting the receiver circuit on the billing desk. As mention in Fig.1 there are five major components of transmitter i.e. microcontroller, RFID reader and tags, IFI transreciever, LED. Data or Information of the user stored in the microcontroller, it will contain the quantity of the item, price of the product.

Microcontroller is an intelligent device which is able to process user's commands and gives the relevant output. Microcontroller will process the algorithm of sending the data from memory to LED in modulated form.

The system gets the input from RFID receiver. when the user inputs the data, the data is displayed on the LCD as well as stored temporarily in the microcontroller. When the user is done shopping the whole total and the amount of products purchased is displayed on the screen. At the cashier counter the user has to press the button to transfer the data to the PC. The data transfer is done through a LED bulb. Data gets transferred as the LED turns on and off multiple times.

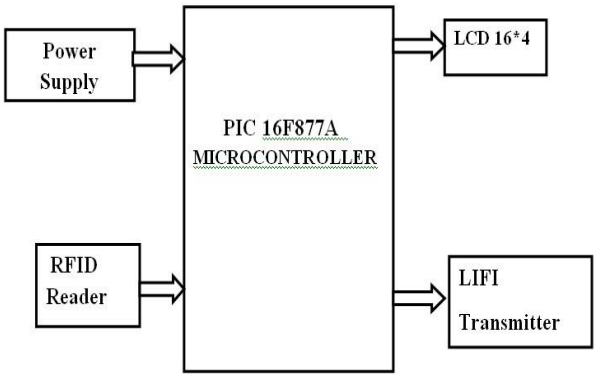


**Fig. 1 Transmitter Block Diagram**

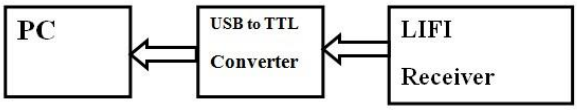


**Fig. 2 Receiver Block Diagram**

Photodiode receives the transmitted data from the LED and gives the signal to ampLI-FIer circuit. The ampLI-FIer circuit then ampLI-FIes the data and transfers the data to the TTL to CMOS converter. The data is then fed to the computer later which is stored in the hard drive using a python script.

## V. IMPLEMENTATION

Light Fidelity gives the fastest rate for data transmission from transmitter to receiver.As mention in the fig. 3, Sender circuit is connected with the RFID Module and Microcontroller with LED. Receiver is placed on the bill desk. Receiver process the data and is transferred for ampLI-FIcation to the ampLI-FIer circuit.Finally the data is converted to TTL to CMOS to send the data to bill desk. According to traditional method customers have to stand in a long queue to pay the bill. The circuit diagram to send data at transmitter side.Circuit diagram is having 5V to power up the circuit with optimum current and having four LED's connected to the four output digital pin of the microcontroller. At the time of sending the information from user the data will move to microcontroller and then directly pass to LED via Driver circuit. LED works on the range of 2.2-4.5V

At receiver side (Fig. 6), the photo-receiver is there to sense the change in LED and it will detect low voltages. As the voltage is very less and is in Milli Volts, it will get ampLI-FIed using a transimpedance ampLI-FIer so that controller can read the information. As the controller is working in the range from 0V to 5V so that information also should be in the range from 0V to 5V.

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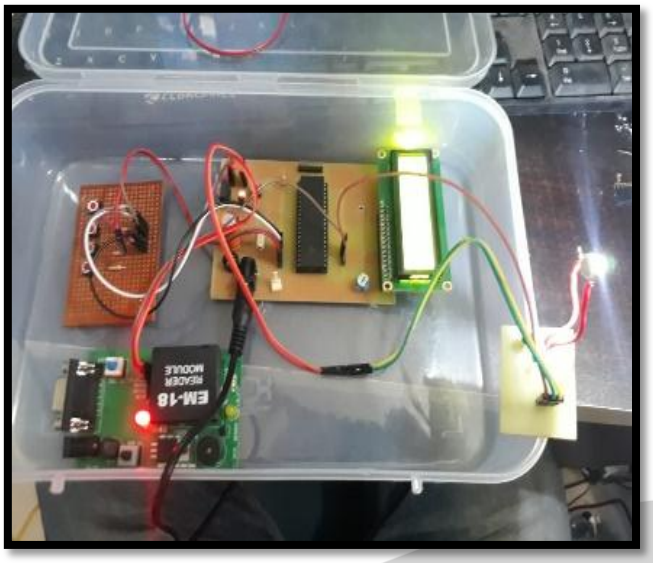
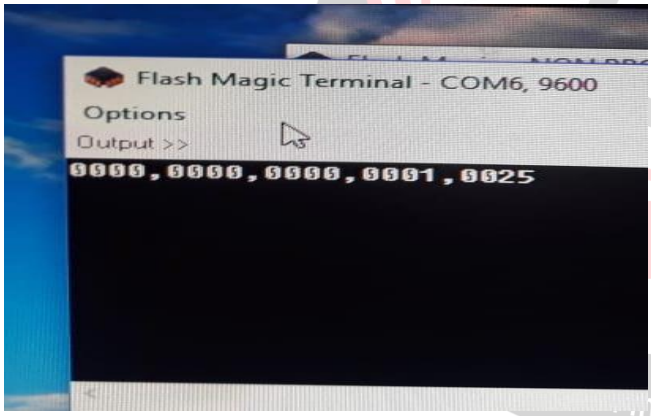
After receiving, the information is shown on to the 2x16 LCD.




## VI. RESULT

The results show the transmission of data string on the serial port monitor. After ensuring the successful transmission of data string, video frames were transmitted and received successfully. Now, when the receiver module is brought in line of sight of the transmitter, photodiode receives the audio files and sends to the speaker with the help of PIC microcontroller.




The ouput shown on desk of the billing counter.


## VII. CONCLUSION AND FUTURE WORK

The paper is successfully able to implement the Wireless communication system using LI-FI technology. The Bill is transferred from trolley to the bill desk. The practical results are in accordance with output results. But the only drawback of this technology is that it works on line of sight.

In future, work on data transmission rate can be done.

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