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Li-Fi Based Wireless Data Transfer

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Abstract: *Li-Fi (Light Fidelity) is an advanced technology that allows transferring data using optical communication such as visible light. Li-Fi data can travel through the light and then interpreted on the receiver side using any light-sensitive device like LDR or photodiode. Li-Fi communication can be 100 times faster than Wi-Fi.Here in this project; we will be demonstrating Li-Fi communication using two Arduino. Here the text data is transmitted using LED and 4x4 keypad. And it is decoded on the receiver side using LDR. This paper introduced the concept of Li-Fi which is used for data transfer. Li-Fi is an LED based alternative that uses visible light instead of radio frequency spectrum. Simply, Li-Fi is nothing but Wi-Fi using light. In Li-Fi system we analyses its performance with respect to existing technology. With the help of light data can transmit.This is latest technology in which LED can transmit data faster as compare to Wi-Fi technology. Here we developedhardware of Li-Fi technology using Arduino in which data can be transmitted through light andreceived by using photodiode or photo detector.*

Keywords: Arduino IDE, Li-Fi data transmission, Wireless Communication, Light Fidelity

I. INTRODUCTION

Recently LiFi technology uses led‟s for transmitting data. It is derivative of optical wirelesscommunication technology using light from Led to deliver high speed communication. Visible lightcommunication works by switching the Led off and on at very high speed, it can‟t noticed by thehuman eye. The intensity of the LiFi LED emitter is kept low enough so that it cannot be seen by thehuman eye but high enough to carry out the communication easily. It is also very secure from hackingas the light cannot penetrate the walls. However, this also limits the range.This is advantageous in electromagnetic sensitive areas where electromagnetic interference isespecially avoided like hospitals, nuclear power plants and aircrafts. Although WiFi and LiFi bothemploy electromagnetic spectrum to transmit information, WiFi uses radio waves and LiFi usesvisible light. Li-Fi has almost no limitations on capacity. Visible light spectrum is 10,000 times largerthan the entire radio frequency spectrum. The light signals are transmitted via wireless channels to thereceiver. The detector in the receiver converts the optical signals to recover the message. Since lightcannot travel through the walls, hence LiFi signals can be secured in physical space.

As discussed above, Li-Fi is an advanced communication technology which can be 100 times faster than Wi-Fi communication. Using this technology, the data can be transferred using visible light sources. Imagine, if you can access to high-speed internet by just using your light source. Isn't it seem very interesting?

Li-Fi uses visible light as a communication medium for the transmission of data. A LED can act as a light source and the photodiode acts as a transceiver that receives light signals and transmits them back. By Controlling the light pulse at the transmitter side, we can send unique data patterns. This phenomenon occurs at extremely high speed and can't be seen through the human eye. Then at the receiver side, the photodiode or Light-dependent resistor (LDR) converts the data into useful information.

II. LITERATURE SURVEY

In the past few years, there has been a large amount of research tried with Li-Fi technology, and taking advantage of its many features to become an alternative transmission medium for wireless data transmission. In this section, experiences with the smartphone-based VLC communication system will be briefly discussed and analyzed. It may support us enhance the limitations of previous research and problem solving.

In [9], the authors developed a system for sending data between two smartphones based on VLC technique. This system consists of transmitter and receiver part. In the transmitter part, the flashlight of built-in smartphone camera is used to

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send binary data, by turning flash on/off, on if the binary data is 1 and off for 0, according to On-Off Keying (OOK) modulation scheme. In the receiver part, there is an ambient light sensor, which built-in smartphone sensor used to discover the flickering of flash (on/off). This system achieved a low data bit rate about 9 bps and the maximum distance between the transmitter and receiver was 15 cm.

In [10], the authors proposed a method to enable bidirectional VLC communication between smartphone and tabletops. In smartphone to tabletop stage, they utilize a flash of built-in smartphone camera to transmit data optically to the camera of tabletop. The authors developed an android application, which is used to turn the flash on/off to transmit data. The pulse width modulation (PWM) is utilized to encode binary data, 0 and 1, using different length of flash pulses. When the authors tested that system a transmission data rate was reached to 20bps. Moreover, to transmit data from tabletop to smartphone, the authors utilized a built-in camera in smartphone, and they implemented a test program on the tabletop that transmits bit sequences at different frequencies. Based on results they conclude that data is transmitted at rates of up to 33 bps.

In [11], the authors implemented a system which transmits the information of credit card that are stored on the smartphone, over a secure visible light link to a simple inexpensive receiver circuit module that is attached to the ATM machine. The authors used an embedded flashlight of smartphone as a transmitter while a receiver part consists of Arduino Mega kit and photodetector sensor, which is Light Dependent Resistor (LDR) that is used to detect light signal. Many experiments are conducted by replacing LDR with photodiode sensor and using PWM scheme instead of OOK to get data bit rate from 4.2 to 15 bps.

In [12], the authors implemented the Li-Fi data transmission system that consists of transmitter circuit and receiver circuit. The transmitter circuit comprised of Arduino UNO and LED where the data is encoded and sends via light of LED, while at receiver circuit the photodiode is utilized to sense the incoming light of transmitter circuit and decode the data back to original format. This prototype achieves a speed about 11,520 bps only that is not of a high arrangement of Gbps.

In [13], the authors developed an application of Li-Fi based wireless communication system using VLC, where the transmitter section consists of array of LEDs that connected to Arduino UNO circuit, while the receiver section consists of array of PNP diode (BPW34) that are connected to Arduino UNO. Current effective data transmission speed is 100 bits/sec, while the distance between transmitter and receiver does not exceed 1 foot because of the infiltration of ambient light.

III. PROPOSED SYSTEM

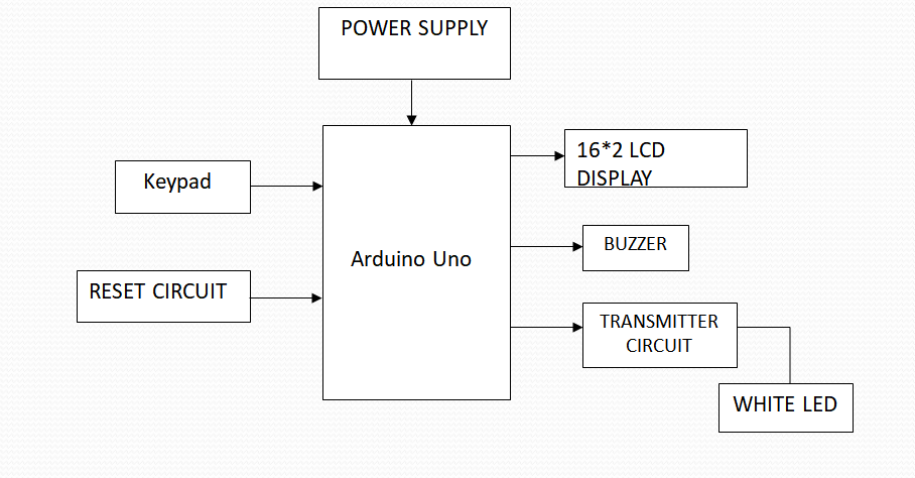

Fig.1. Block Diagram (Transmission Section)

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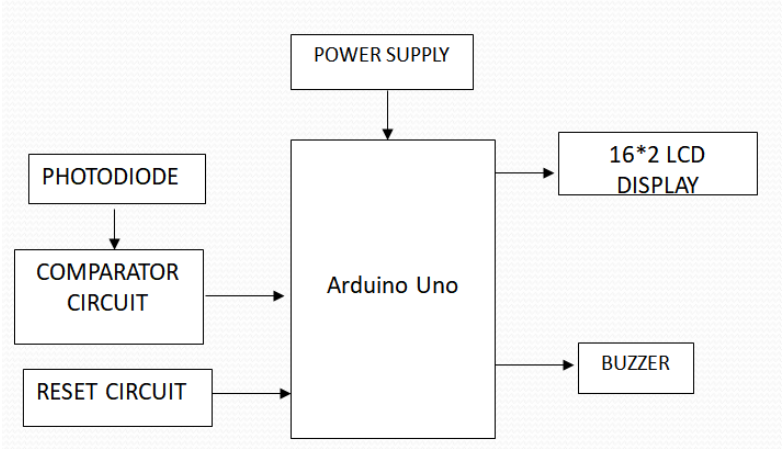

Fig.2. Block Diagram (Receiver Section)

As shown in the figure above, in the transmitter part of Li-Fi communication, the keypad is used as input here. That means we'll be selecting the text to be transmitted using the keypad. Then the information is processed by the control unit which is nothing but Arduino in our case. Arduino converts the information into binary pulses which can be fed to an LED source for transmission. Then these data are fed to LED light which sends the visible light pulses to the receiver side.

In the receiver section, the LDR sensor receives the visible light pulses from the transmitter side and converts it into interpretable electrical pulses, which is fed to the Arduino (Control unit). Arduino receives this pulse and converts it into actual data and displays it on a 16x2 LCD display.

Arduinouno Microcontroller

It is an Arduino is one of the platform used for this project. It is a software feature which enables experienced programming designers to utilize the Arduino code to converge with the current programming language libraries can be broadened and changed. It is an awesome tool for individuals with all ability levels. Both physical programmable circuit board and programming is in Arduino. It continues running on PC which is utilized to compose and exchange PC code to the physical. Arduino has capacity such as interacting with light on a sensor, a finger on a button, running a motor, switching on an LED and distributing something online. In addition, Arduino doesn't need a separate piece of hardware, to load a new code onto the board since it can utilize it with a USB cable. The most utilized ones are Arduino Uno and ArduinoMega. Arduino IDE is utilized to program an Arduino and it utilizes a straightforward version of C++. This makes the program to be learnt less demanding. Rajan et al. proposed the product which is good with a wide range of working frameworks like Windows, Linux, and Macintosh and so on indistinct vague unclear vague

Fig.3. Arduino IDE

LIFI trans receiver Module

A **LiFi Visible Light Technology** is a very innovative technology known as **'LiFi' or 'Light Fidelity'** or **VLC** (visible light communication), which transfer the data through the **light** as a medium. Li-Fi stands for Light Fidelity .Li-Fi

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technology provides transmission of data through illumination by sending data through LED that varies in intensity faster than the human eye can follow. This product focus on developing a Li-Fi based system and analyze its performance with respect to existing technology. The heart of this technology is a new generation of high brightness LEDs. The product consisting of a transmitter which includes a light source and the receiver circuit which receives the data transmitted via light waves. The same system can be employed in industries making industrial automation using the existing light source a reality. A biomedical sensor is also introduced herewith which helps in diagnosis of a patient's medical conditions and is quickly made available to all the emergency points through light.

- It can transmit data 38400 baud rate serially.
- 5-15 feet distance, distance can be increased by changing the LED wattage.
- High intensity LED Light.

Domestic Ceiling / wall mounting focus LED light can be used for communication

Fig. 3.FingerprintSensor

LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD

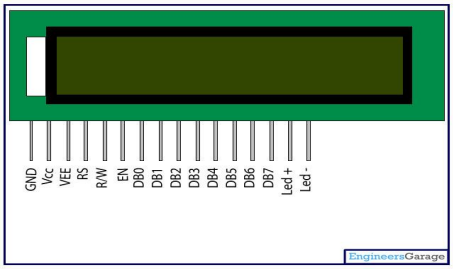

Fig. LCD Display

IV. CONCLUSION

The proposed system has accomplished the transfer of text data between two computers. As internet is not required for any of its software the bandwidth is also conserved, hence reducing the network complexity. With the Development of the technology, and its application for the industrial use. If this technology can be put in to practical application, every bulb/LED can be used something like Wi-Fi hotspot to transmit wireless data. Instead of using a single LED we will make use array of LED or Laser light to avoid interference and also to boost accuracy of transmission. By the

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implementation of this technology, we will proceed towards the cleaner,greener, safer and brighter future. The possibilities are numerous and can be explored further. This technologycan be explored further in the future and if it is approved for the practical use, then every light source anddetectors can be used to transmit and receive data.

V. ACKNOWLEDGEMENT

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