International Journal of Trend in Scientific Research and Development (IJTSRD)
UGC Approved International Open Access Journal
ISSN No: 2456 - 6470 | www.ijtsrd.com | Volume - 1 | Issue – 5

Visible Light Communication for Visually Impaired People using Sustainable LEDs

Ms. Pradnya Kulkarni
M.E (Digital System), Dept. of Electronics and Telecommunication JSPM's JSCOE
Pune, Maharashtra, India

Prof. Mr. M. B. Tadwalkar
Dept. of Electronics and Telecommunication
JSPM's JSCOE
Pune, Maharashtra, India

ABSTRACT

We developed navigation system prototype for the visually impaired using LED lights. Where LED lights emit visible light with location data and a smart phone or blind person's stick with a visible light receiver receives the data. The controller with receiver calculates the optimal path to a designation and speaks to the visually impaired through a headphone or turns stick left or right with the help of motor. The prototype is able to navigate the visually impaired users fairly well with speech guidance. We believe that the application of visible light communication belongs to location-based services and new graphical user interfaces that combine visual imagery with visible light communication. For this application, users are able to know the information associated with a transmitter. If a transmitter is attached to a building or a fixed place, location information will be obtained. Indoor navigation is convenient for everyone, and it is especially useful for visually impaired. If a transmitter is attached to a building or a fixed place, location information will be obtained and conveyed to receiver using LED light. Indoor navigation is convenient for everyone, and it is especially useful for visually impaired.

Keywords—*Visible Light Communication, Li-Fi, Communication System, Navigation System*

I. INTRODUCTION

Communication is one of the integral parts of everybody's life for exchanging information on devices in wired or wireless networks. With the mobile devices, wireless communications have become the basic necessity of our lives. We have Wi-Fi as the wireless communication standard. Similarly, Li-Fi (Light-fidelity) is also wireless communication system based upon Visible Light Communication with higher data rate than Wireless Fidelity (Wi-Fi).Due to increasing demand for wireless communications, Wi-Fi is facing many challenges namely- capacity, availability, efficiency and security.

"Li-Fi" was introduced by Harald Hass in 2011 in TED Global talk on visible light communication, to limit these challenges faced by Wi-Fi [5]. Li-Fi uses visible light region of the electromagnetic spectrum, transmitting data through high brightness LED bulbs. This idea works very simple, if the LED is on, it transmit digital 1; and if it is off it transmit a 0. The LEDs can be switched on and off very quickly, which gives nice opportunities for transmitting data. To handle more users and more data traffic, spectrum utilization need to be improved.

Basically the goal of Li-Fi is not to replace radio frequency, but rather to complement it.

II. TECHNOLOGY USED

A. Visible Light Communication (VLC)

Sending some form of data using visible light LEDs from a transmitter, and decoding it with a receiver. Information will be converted into bits through some coding scheme by a microcontroller and will be transmitted with blinking LEDs. The blinking of these LEDs will not be visible to the human eye as they are blinking at a high frequency. Photodiodes on the receiving side will detect the fluctuation of the LEDs from the transmitter and will send signals to a microcontroller which is integrated with a computer to determine the originally transmitted message. The transmitting system will be powered from a wall outlet whereas the receiving system will be powered by batteries.

VLC systems have more flexibility and integrity than other communication systems in many regards. Since the medium for transmission in VLC systems is visible light and not RF waves that can penetrate walls, the issue of security is inherently solved because light cannot leave the room, containing data and information in one location. There is no way to retrieve and access the information unless a user is in a direct path of the light being used to transmit the data. In addition, LEDs are highly efficient and becoming more durable, adding to the integrity of these systems.

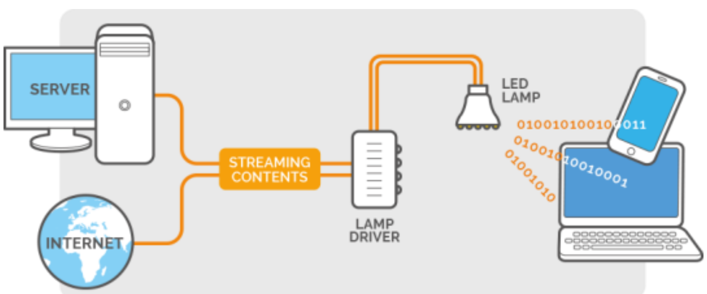

Fig. 1 Basic working of VLC

Visible Light Communication can be used for indoor applications very effectively. Such as

1. Navigation system using VLC as a communication medium.
2. For IOT applications.
3. Internet sharing for multiple users using VLC instead using Wi-Fi.
4. Vehicle to vehicle communication.
5. Traffic light to vehicle communication.
6. Under water communication.
7. Wireless communication applications where radio frequency is restricted such as chemical, petroleum plants and in aircrafts.

III. LITERATURE REVIEW

LED lights are becoming widely used for homes and offices for their luminous efficacy improvement. Visible light communication (VLC) is a new way of wireless communication using visible light. Transmitters used for visible light communication are visible light LEDs and receivers are photodiodes. Location-based services are considered to be especially suitable for visible light communication applications [1].

Visible Light Communication (VLC) Technology is the short range optical wireless communication technology using LEDs for communication. To increase the distance between transmitter side and receiver side by implementing the repeater for VLC [2].

Recent advancements have triggered research in Visible Light Communication (VLC) which enables us to use Light Emitting Diodes (LEDs) for illumination as well as low cost, high speed, power efficient and secure data communication. VLC technology is considered to be a green technology which helps in the reduction of hazardous gases emission.

VLC is a promising technology not only to increase not only the capacity of indoor wireless communication but also the security. Market penetration of white LEDs is very rapid and they can be used both for lighting and communication. VLC provides a cost effective technique of duplex communication not only for home users but can also satisfy the requirements of a small LAN. No doubt, there are many challenges which are being faced by the researchers such as ambient noise etc. yet VLC presents a realistic and promising supplement technology to radio communication [3].

If this technology is put into full-fledged practical use, every LED can be used like a Wi-Fi hotspot to transmit wireless data.

IV. SYSTEM OVERVIEW

This is a navigation system prototype for the visually impaired as shown in Figure 2. LED lights emit visible light with location data and a smartphone or blind person’s stick with a visible light receiver receives the data. The controller with receiver calculates the optimal path to a designation and speaks to the visually impaired through a headphone.

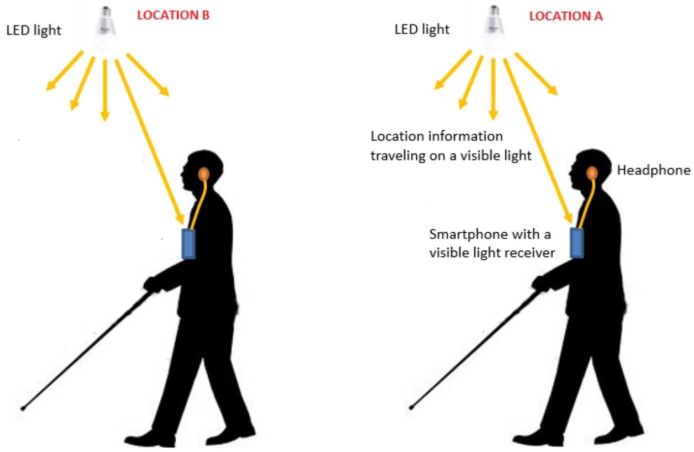

Fig. 2 Indoor Navigation system for Visually Impaired using VLC

V. ARCHITECTURE OVERVIEW

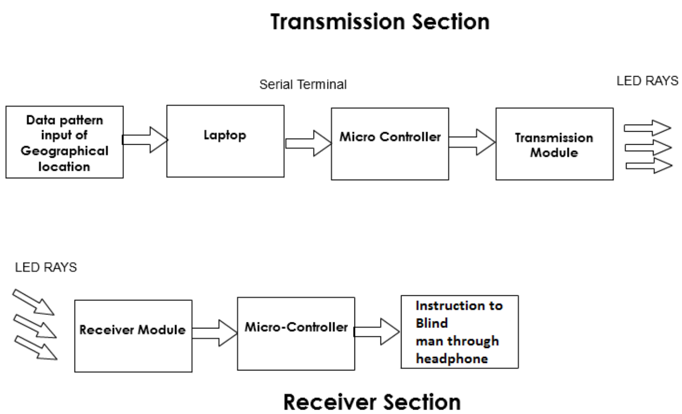

Fig. 3 Functional Block of Navigation System

Figure 3 shows the overall functional block diagram of our system. Our prototype composes one transmitter and one receiver as shown. The transmitter section consists of a user interface, a microcontroller, and analog circuitry of transmitter module incorporating LEDs, all of which are powered in some fashion. The receiver section is similar, containing analog circuitry of receiver module incorporating phototransistors, a microcontroller and a display device capable of receiving and interpreting the output, all of which are also being powered in some fashion.

The microcontroller is used as the signal source for our design by utilizing a binary system to transmit text. Each voltage maximum corresponds to a single binary 'high' digit and each voltage minimum corresponds to a single 'low' digit. This scheme is used in conjunction with the ASCII binary values, to encode a text message which is sent to the receiver side of the design utilizing LED flashes.

The microcontroller of the transmitter section receives data from user's computer through the USB port and sends data out using RS-232 serial communication interface. The byte data type is converted into light signal data type by using the on-off keying modulation (OOK) technique and is transmitted via LED. Then phototransistor at the receiver section receives light from the LED of the transmitter through air and send light signal to the microcontroller. The micro controller then converts this signal into byte data and sends it to user's computer through USB port. Software at the receiver side receives byte data and combines each set of bytes together then the file can be saved.

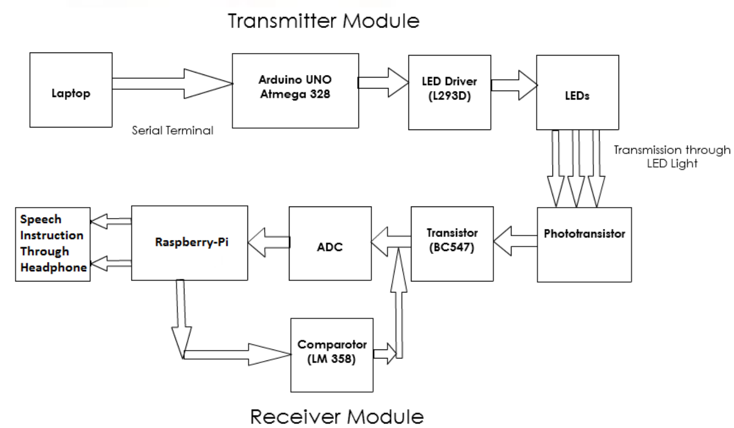

Fig. 4 Experimental Setup

Our system prototype comprises transmitter and receiver circuit where Arduino UNO ATMEGA328 microcontroller and Raspberry-Pi is used. The transmitter comprises components LED driver L293D, array of white LEDs to transmit the data, receiver comprises phototransistor, transistor BC547, comparator LM358 to receive data and converted from text to speech for directing visually impaired through headphone.

Analog circuits for transmitter and receiver will be as shown in fig. 5

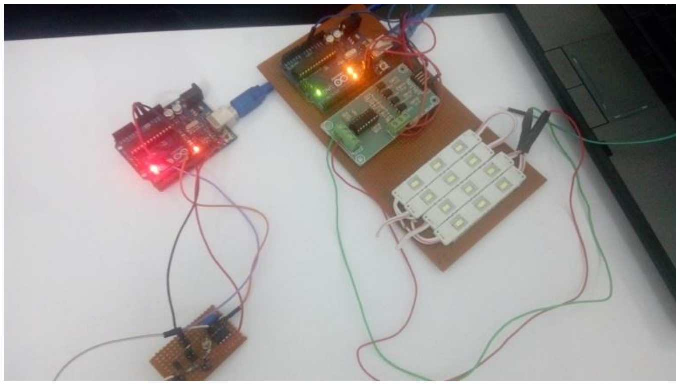

Fig. 5 Analog circuit of Transmitter (right) and Receiver circuit

VI. RESULTS

The receiver is able to receive the data that the transmitter sent. The distance measured between transmitter and receiver is of around 15cm for the prototype. One way to increase the distance would be to increase the number of LEDs at the transmitter or many photodiodes were placed in parallel at the receiver end. On top of adding more photodiodes, the amount of gain was adjusted from the amplifier to determine the best design.

Fig. 6 Functional testing of the transmitter and receiver module

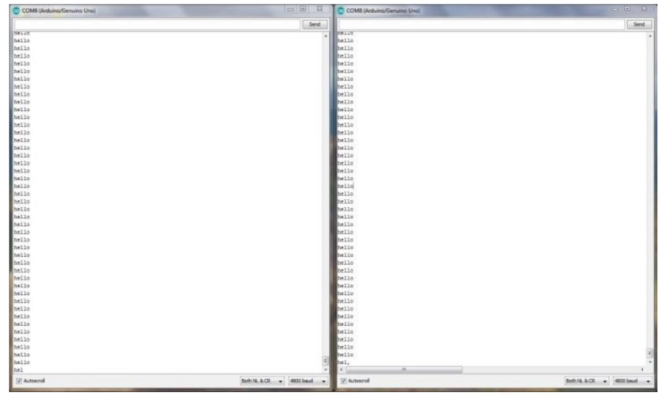

Fig. 7 Results of transmitted and received data

Fig. 8 Functional working of the prototype

VII. CONCLUSION AND FUTURE SCOPE

The method of transmitting location data using visible light and successful reception and conversion of data into speech has been shown, thereby, presenting a feasible method of using visible light for safe and cheap data transfer. Though, this technology is still in its early stages, with further studies and development its applications will get better. The VLC technology is all about using LED light bulbs meant for illumination to also send data simultaneously. It is best suited as an additional option for data transfer where radio transmission networks are not desired or not possible. In future, we can transmit an image, audio and even a high definition video using an LED light bulb.

ACKNOLEDGEMENT

We sincerely thankful to all teaching staff for their kind support. We thankful to HOD E&TC, Principal and campus director of JSPM's JSCOE, for providing us all necessary facilities

REFERENCES

1) Visible Light communication using sustainable LED lights. 978-92-61-14061-8/CFP1338E-ART © 2013 ITU Kaleidoscope

2) The Improvement of Repeater System for Visible Light Communication. 978-1-4673-9749-0/16/$31.00 ©2016 IEEE

3) Visible Light Communication: Opportunities, Challenges and Channel Models. 18 February, 2013 Vol. 2, No. 1, 2013

4) LI-FI Design For High Speed Data Transmission ARPN Journal of Engineering and Applied Sciences VOL. 10, NO. 14, AUGUST 2015 ISSN 1819-6608

5) LI-FI Technology – A Visible Light Communication ISSN: 2321-9939

6) Design and Development of an LED-based Optical Communication System with Active Alignment Control. 2016 IEEE International Conference on Advanced Intelligent Mechatronics (AIM) Banff, Alberta, Canada, July 12–15, 201

7) Design and Implementation of a Vehicle to Vehicle Communication System Using Li-Fi Technology. 978-1-4799-8966-9/15@2015IEEE

8) Application of Li-Fi Technology in the Transmission of the Sound at the Base of the PWM. 978-1-4673-8469-8/16/$31.00 ©2016 IEEE

9) Cognitive Impairments in Human Brain Due to Wireless Signals and Systems: An Experimental Study Using EEG Signal Analysis.

10) World health organization fact sheet: electromagnetic fields and public health: mobile phones, http://www.who.int/mediacentre/factsheets/fs193/en/index.html, 2011, Online; accessed Jun. 1, 2013