Visible Light Information System For Multiuser Using Arduino

[1]Shailaja Udtewar,[2]Keone Crasto,[3]Paul Dsouza,[4]Anugrah Aghamkar,[5]Delroy Dsouza
[1]Asistant Professor,[2]Student,[3]Student,[4]Student,[5]Student
[1]Department of Electronics and Telecommunication,
[1]Xavier Institute Of Engineering, Mahim, Mumbai, India.

Abstract : Visible Light Communication (VLC) is basically a type of data communication variant in which Light which is visible to the human eye is used. It lies in the range between 400 and 800 THz (780–375 nm). VLC is a subset of optical wireless communications technologies. In this paper the application of VLC in museums has been described. Visible Light Communication is being used in the museum for conveying information about the various monuments, painting, etc. This method of conveying information is aimed at replacing the current conventional methods that are being used to convey information in museums today. In this application of VLC the main optical source for transmission of information are LED's (Light Emitting Diode) whose application is to perform two function, Illumination as well as transmission of data simultaneously, and which is placed above the monuments, paintings in the museums. Here the information about the monuments, painting is stored in receiver module which is in the mp3 format and is delivered to each visitor via Earphone/Headphones. The source LED will transmit a binary data which when received by the receiver module will decode the binary data and plays the mp3 file stored in the receiver which is the information about the monument, painting which is front of the visitor. This VLC system allows multiple uses to receive information about the monument. There can be 'n' number of users in the system as long as the users are within the illumination of the LED light source. In this way, this system conveys information seamlessly to the visitor.

Index Terms **- Multiuser, VLC, Museum, LED, Arduino.**

I. INTRODUCTION

As there has been a tremendous growth in the Technical Industry, many of the devices developed make use of Radio frequencies as its source for communication. The Radio Frequencies are divided into groups of electromagnetic spectrum groups. As the licensed electromagnetic spectrum becomes saturated the current it becomes difficult to provide services in this spectrum [1]. RF is also easily prone to hacking and can be decoded. In order to avoid hacking and loss of personal information many security algorithms are needed which makes the system very complex [5].

In order to overcome this problem Visible Light Communication (VLC) can be used. VLC offers several key advantages over traditional radio-frequency based access networks including approximately 300 THz of license free bandwidth carried on visible wavelengths, ~10,000´ larger than that available in radio, which is also substantially oversubscribed. VLC is basically a subset of optical communication. This system uses LED's or Lasers which is visible to human eye. Visible Light Communication provides a very large bandwidth, large capacity and high speed communication [8].

Using VLC we can transmit any data that can be transferred using conventional Wi-Fi network. That can be Images, Audio, Video, Internet connectivity, etc...But the advantages over the Wi-Fi Network are High speed, Increased Security, More Number of Connected Devices, and Less cost. In coming year's number of devices that support VLC will hit the Market. It is estimated that the compound annual growth of VLC market will be of 82% from 2015 to 2018 and to be worth over $6 billion per year by 2018[9]. VLC operates under the concept of transmission of data via light rays to send and receive messages in a given distance. Putting to use LED lighting, VLC can be used as a replacement for radio frequencies in areas it cannot be applied. In addition, VLC has the upper hand over radio frequencies as it offers ultra-fast data transmission and also high bandwidth transmission [10].

The cost required for VLC is less as compared to RF. The Visual Light Communication provides free licensed bandwidth in the THs which is a lot more than RF spectrum. Unlike RF, where the radio waves can interfere with other RF waves, VLC doesn't interfere [3]. VLC does not require another component to operate; basically a system can be added to any illuminating device. Due to this, we are able to implement VLC in places where the use RF if prohibited like hospitals, power plants, etc. Thus we see that VLC has many pros over RF and can be used in museums to give the users a seamless experience [7].

II. PROPOSED BLOCK DIAGRAM

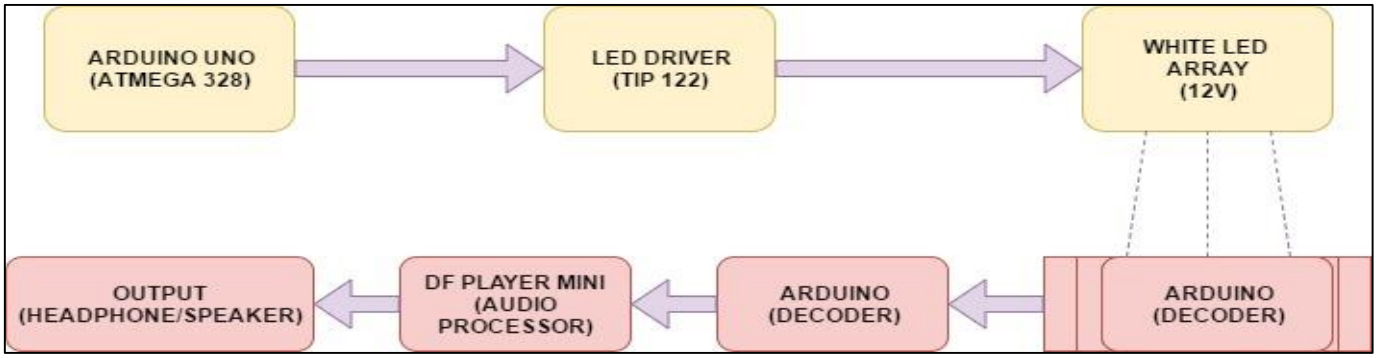

Figure 1: Block Diagram of Visible Light Information System for Multi-User Using Arduino

Hardware:

This system is divided into two parts that is the transmitter and the receiver part. The transmitter module is mounted above the monument or painting in museum. The transmitter consists of Arduino, LED Driver and array of white LED's, the transmitter will transmit a particular code via visible light which will play a particular wav file stored at the receiver end. From the code that is burned in the Arduino, the receiver gets serial binary data which taken from the pin no 5 which is the digital output pin of the Arduino. This output of Arduino is given to LED driver to drive a 12 volt LED array. The transistor tip 122 is used as a driver which works as switch, which flickers the white LED array according to the transmitted binary data at a very high rate which is not visible to human eyes.

The receiver is a portable module which is given to each visitor in museum. The receiver module consists of the following components, solar panel, Arduino Uno, DF Player Mini, headphone/speaker as end output device. As the transmitted light falls on the Solar Panel of the receiver it converts the optical signal received into analog output which is given to pin no. 2 that is analog input pin of the Arduino. The Arduino decodes the received analog input signal and converts it into digital binary data. The binary data is basically used for the selecting and playing the particular track in DF Player Mini related to the respective monument or picture in the museum. DF Player Mini works as storage device for storing tracks in form of wav file and also has an inbuilt amplifier for driving speaker or headphones. This system can have multiple users with the receiver module receiving the data from the same transmitter module without any interference of other users.

Software:

For coding the Arduino Boards, We are using Arduino IDE Software in which the codes are written in C++ Language. For the transmitter part we are sending a codeword, For example we are sending number "1". Arduino sends the codeword serially to the LED array in the form of ASCII code.
The receiver Arduino decodes this ASCII codeword and plays the track associated with the codeword. We have written a "IF Else" statement for checking the codeword and playing the matched track associated with it. For example if "1" is received, Track number 1 is played. Similarly if "2" is received, Track 2 is played and so on.

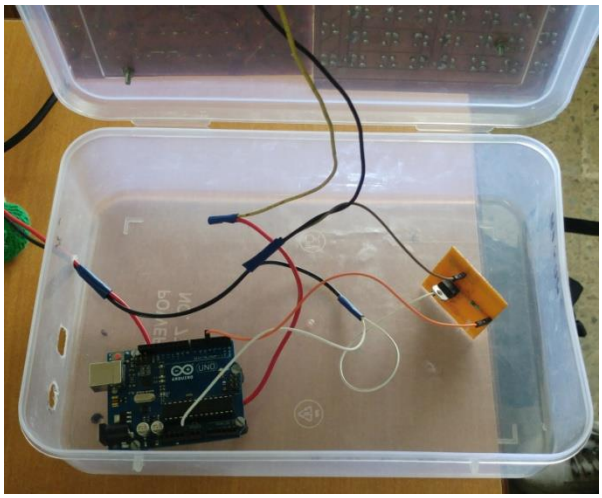

Figure 2: VLC Transmitter Module

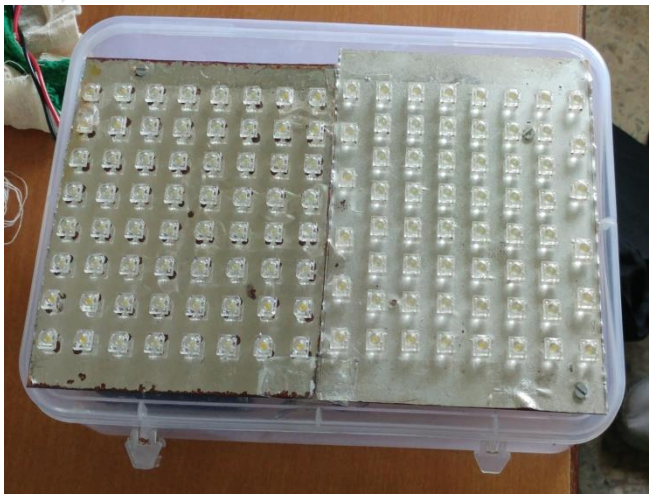

Figure 3: LED array at the transmitter

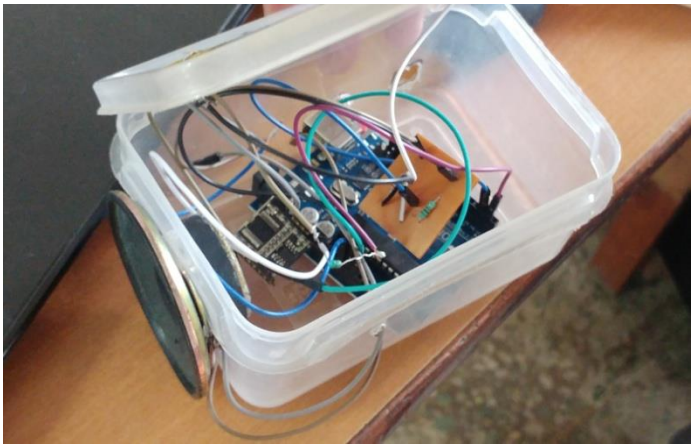

Figure 4: VLC Receiver Module

Figure 5: Solar panel at the receiver

III. Results

This system was able to successfully transmit the codeword via optical signal from the transmitter end to the receiver end. Upon receiving the binary data the mp3 file stored on the DF Player Mini was played through the speaker. The range was successfully increased to 1 meter with the help of array of LED's. Multiple users could receive the data simultaneously without any interference of each other. Far better results in the detection of optical signal were obtained by using solar panel instead of photo detector.

IV. Conclusion and Future Scope

This multiuser information system provides information about different monuments in museum without any interference between multiple users. It provides seamless connection to each user even while moving one monument to another, i.e. as soon as user switches from one monument to another the information is instantly transmitted to user module without delay. It doesn't matter how many user are present in the coverage area in the white LED array. This system can be used in many more application other than museums.

This system can be further improvised by adding sensors to detect the presence of visitor in front of the monument and only then the information would be transmitted. This would make the system more power efficient. Further the receiver module can be interfaced with the smart phone itself. Along with Audio, Image and Text will also be displayed using an application install LED on the smart phone.

V. References

[1] Indoor Visible Light Communications: challenges and prospects Dominic O'Brien1a Hoa Le Minha , LubinZenga and Grahame Faulknera , KyungwooLeeb , DaekwangJungb , YunJeOhb , Eun Tae Wonb a Department of Engineering Science, University of Oxford, Oxford OX1 3PJ, United Kingdom b Telecommunications R&D Center, Samsung Electronics Co. Ltd , Suwon, South Korea

[2] Real-time Audio & Video Transmission System Based on Visible Light Communication Yingjie He, Liwei Ding, Yuxian Gong, Yongjin Wang* Institute of Communication Technology, Nanjing University of Posts and Telecommunications, Nanjing, China

[3] Implementation of Downlink Visible Light Communication using LED and Photodiode Havisha Kalwad1 , Poornima B.K.2 P.G. Student, Department of Electronics and Communication, DayanandaSagarUniversity, Bangalore, India1 Assistant Professor, Department of Electronics and Communication, DayanandaSagar University, Bangalore, India

[4] Design of a Li-Fi Transceiver PavasGoswami, Manoj Kumar Shukla# Department of Electronics, School of Engineering, HBTU, Kanpur, India

[5] Yafang Wang, Chenglei Yang, Shijun Liu, Rui Wang, Xiangxu Meng, RFID & Handheld Device-Based Museum Guide System

[6] Djoni Haryadi Setiabudi, Ryan Christian Wiguno, Henry Novianus Palit, Near Field Communication Technology in Delivering Information in Museums.

[7] Sridhar Pattanaik, Biological effects of RF/ MW radiations on human.

[8] Ludovic Chevalier, Stephanie Sahuguede, Anne Julien Vergonjanne, Optical Wireless Links As An Alternative To Radio-Frequency For Medical Body Area Network.

[9] Sarkar, Anurag & Agarwal, Shalabh & Nath, Asoke. (2015). Li-Fi Technology: Data Transmission through Visible Light. IJARCSMS. 3. 1-10.

[10] www.circuitstoday.com/visible-light-communication