Visible Light Information System for Museums

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Abstract- Visible Light Communication (VLC) system employ visible light for wireless communication that occupy the spectrum ranging from 380 nanometer to 750 nanometer. The paper describes an application of the Visible Light Communication (VLC) in museums. VLC technology is used for giving information about different monuments in the museum. This approach to convey information aims to replace current methods of delivering information using a MP3 player and other wireless technologies such as Bluetooth or RF. The optical source, LED's perform two functions, illumination and transmission, simultaneously and is connected over the monuments. An audio information signal is used as a modulation signal to vary the intensity of light emitted by the optical sources. This audio signal contains the factual information related to the monuments. The receiver modules are connected to headphones. The modulated optical signal is sensed at photosensitive target and is demodulated at the receiver end. In this way, the factual information related to the monument is conveyed to the visitors.

Index Terms- Visible Light Communication, information system, museum, audio, transmission**.**

I. INTRODUCTION

In the recent years there has been an ongoing growth in the usage of the radio frequency region (10^4Hz to 10^12Hz) of the electromagnetic spectrum. This is the result of rapid increase in the number of mobile phones subscriptions, in recent times [1]. This has led to reduction in free spectrum which would be inadequate to serve the needs of future devices. This is where a need for a better, efficient and a system with larger capacity comes into picture. In this context, Visible Light Communication can be one of the candidate technologies to meet the requirement of current as well as future communication needs. Visible light communication (VLC) is preferred because of its bandwidth which is higher than that of the existing RF systems and high immunity to interference from electromagnetic rays. VLC offers high-speed communication at a low cost, making it an alternative and efficient method that can cope with the high-speed demands of the wireless services. In museums, there have been a lot of methods used to convey information related to the artifacts. Besides conventional and simple ideas, electronic means have also been developed and experimented as tool for communication. Some of these methods have been mentioned in the section below. However, taking all the features into consideration, the Visible Light Communication technique may provide us with a better option and help in improving the experience of the visitors to the museums.

II. LITERATURE REVIEW

A. *Near Field Communication Technology in Delivering Information in Museums*

In this proposed system the authors make use of NEAR FIELD COMMUNICATION (NFC) for the transfer of data in museums. NFC wireless technology is used for close range data transfer of between two integrated devices. The Communication between two devices through magnetic field induction, where two devices are located in adjacent areas that effectively form a transformer with an air core [2]. For the Communication to take place between two devices that support NFC technology, the devices are required to be within 4 cm or closer to each other . NFC operates in 13.56MHz radio frequency licensed ISM band [3]. NFC can be used in museums for giving information to the visitors, but have some limitations. They have a small transfer distance i.e. the visitors have to be in the range of the NFC field, Secondly not all devices have NFC only most of the high end phones have NFC integrated in them.

B. *Effects of RF/ MW Radiations on Human.*

The RF communication technology is being used in most of our major communication systems today. Although widely used, this technology has several constrains. RF spectrum is limited and providing for the increasing demands is becoming difficult, leading to problems such as network congestions. Other than that a separate setup is required for transmission and reception of RF waves. RF communication is also prone to electromagnetic interferences and Health Hazards.

The exposure to RF to extreme extents may have have extreme biological effects. These effects depend on the frequency and intensity of RF fields, exposure period, distance from source and other factors [4]. The biological effects of RF can be caused by RF radiation, radiation from TV, radio, mobile base station and exceeding exposure limits. The organs with poor temperature control, such as the lens of the eye, are more prone to incur damage due to RF. Exposure to strong RF on a continuous basis may cause rise in the body temperature and may also lead to cause heat strokes. The internal tissues suffer from burns. The Base station in the mobile or cellular network

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can be considered as relative low power systems. Therefore, as far as the human health is concerned, focus should be more on hand held mobile phones rather than the base stations. This is because the mobile phone antennas deliver much of their RF energy to very small portions of the user's body. Keeping that in mind, exposure limits are designed to keep RF energy absorbed by the body well below the lowest level than the harmful limits.The 1992 ANSI/IEEE exposure standard for the general public is 1.2mW/cm^2 for antennas operating in the range of 1800-2000 MHZ [5]. Antennas operating in 900 MHz range have limit range of 0.57 mow/cm^2. In the presence of more than one antenna, the total power produced by each individual antenna is taken into consideration

C. Visible Light Communication

Visible Light Communication is a technology which uses Light as a medium for communication. The light from the optical source acts as a carrier signal and the information to be transmitted acts as the modulating signal. The communication is possible by varying the intensity of the light in accordance with the information signal. The VLC uses visible light that occupy the spectrum from 400 nano meter to 700 nano meter corresponding to the frequency spectrum of 400THz to 800 THz [6]. Thus large bandwidth is available. Communication through light is a high speed wireless technique.
The VLC technology can be used in different applications as a substitute to the RF, where the factors such as electromagnetic radiation and security need to be taken into consideration. The RF signal tends to interfere with other RF signals. Such interferences are undesirable in applications such as navigation of aircrafts. Therefore in fields of application which are sensitive to electromagnetic radiation, the Light fidelity is a better option. Also, Li Fi supports Internet of Thing (IoT). Another application of VLC is in vehicle to vehicle communication. VLC can be a useful tool where the RF communication cannot be used such as mines and excavations.

D. Transmission of data, audio signal and text using VLC

In this study, they make use of the technology called light fidelity which is more commonly known as Li-Fi. The data is transmitted in several bit-streams through high-speed flickering of the LED bulb and decoded on the receiver side which consists of a photo detector. This happens in the form of a binary transmission of data, where '0' is the LED in its 'off state' and '1' is the LED in its 'on-state'. The important component on the transmitter side is the Voltage Controlled Oscillator (VCO) which varies the switching frequency of light.
The data to be transmitted modulates the VCO and generates the FM signal at the output. VCO generates Square wave as there are only two states of the LED's i.e ON state and OFF state. Transmission of high quality audio with the distance of upto 1m can be achieved and improvements can be made by adding focusing lens between the transmitter and the receiver [7].

III. PROPOSED METHOD

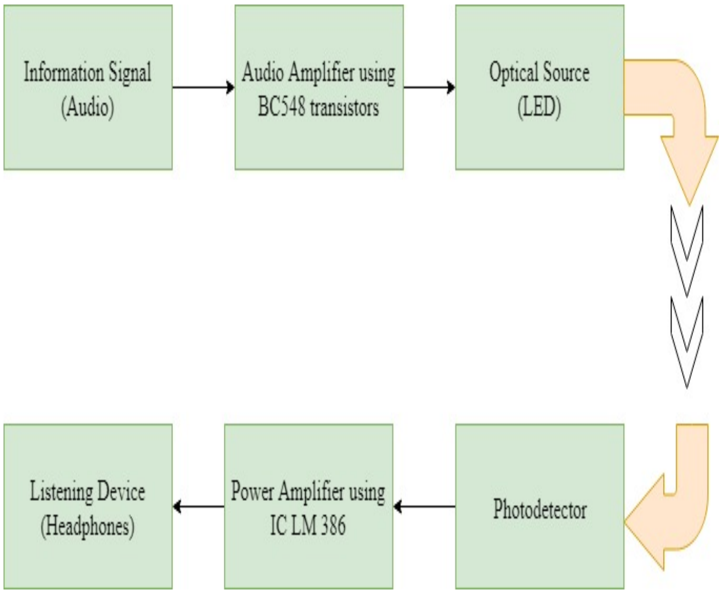

Figure:1 Proposed Block Diagram

The proposed design for implementation of the information system using visible light can be divided into two sections, the transmitter design and the receiver design. The transmitter module is supposed to be installed over or in the vicinity of the monuments. The transmitter is basically a transistor amplifier with LED as an optical source at the output. In this way, the information signal which is the input to the amplifier modulates the light intensities emitted by the optical source. The amplifier used in the design is based on transistor BC548, operating in common emitter configuration. R-C coupled stages have been introduced in order to improve the amplifier gain. This will, in return, increase the range of communication of the information system. Gain of 110 to 800 can achieved using this amplifier. The receiver module consist of a photo detector at the input to receive the modulated light intensities. As in the case transmitter, the receiver also, is merely an amplifier to detect and amplify the received light. However , in contrast with the transmitter, the amplification here is done using IC 386. Basically an audio power amplifier, IC 386 is capable of providing voltage gain from 20 to 200. The IC has gain control pins (pin 1 and 8) to vary the gain of the amplifier. The detected and amplified output is driven by either a speaker or headphones and is conveyed to the visitors of the museum.

IV. RESULT AND CONCLUSION

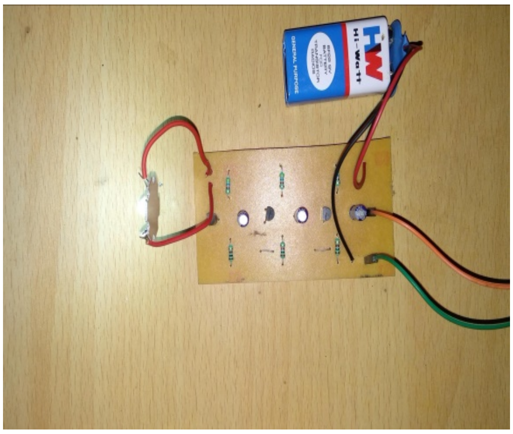

Figure:2 Transmitter

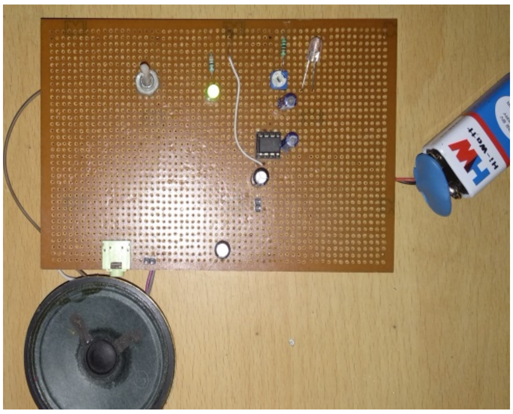

Figure:3 Reciever

The pictures above show the implementation of the information system for a single user. The performance of the system has been observed for the use of red (3mm) and white LED(1W) respectively, as an optical source at the transmitter. It is seen that the distance covered by using white LED at the transmitter is significantly greater than that using a red LED(3mm). Also, red LED(3mm) cannot withstand higher magnitude currents which are produces by multiple transistor stages. Moreover, the performance of the white LED(1W) in day light as well as in dark is far better than that of the red LED(3mm) in these conditions. The detection of the optical information signal can be performed by using either photodetector or a solar panel. However the solar panel is advantageous in the sense that it has having more area for the detection of the optical signal.

REFERENCES

[1] Latif Ullah Khan, "Visible light communication: Applications, architecture, standardization and research challenges".

[2] Djoni Haryadi Setiabudi et.al "Near Field Communication Technology in Delivering Information in Museums".

[3] "Android Developers Near Field Communication". https://developer.android.com/guide/topics/connectivity/nfc/index.html

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

[5] K.R. fosterJE. Moulder. "Are mobile phones safe, IEEE Spectrum", August 2000

[6] Muhamamd Zubair Khattak et.al "Design And Implementation of Visible Light Communication".

[7] A.Vinnarasi, S.T.Aarthy, "Transmission of Data, Audio Signal and Text Using Li-Fi".

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