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Automatic Lambent Audio Transmission Using LI-FI

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Abstract: **- Light Fidelity (Li-Fi) is an emerging technology that is expected to be one of the fastest wireless accesses in future and is used for establishing wireless communication at a very high speed. In this paper, basic LED is used for the purpose of data transfer. The main objective is to use the LED for illumination as well as for the transmission of data automatically in a room by sensing the presence of humans using piezoelectric sensor. Here, the data to be transmitted is audio signal. Since it is used for both the purposes, energy is conserved which is important in the current century. A Piezoelectric sensor is used to detect the person when they enter into a room. So it can be used in waiting halls to make the person entertained by playing an audio when they enter the hall.**

Keywords: **- Light Fidelity; Light emitting diode; Visible Light Communication; Audio transmission.**

I. INTRODUCTION

Advancement in telecommunication technologies is increasing rapidly each and every year. So the high speed data communication is considered to be one of the major aspects in the current century. This communication is also possible through Visible Light Communication. Visible Light Communication is a wireless technology that facilitates communication of voice, images and data [11]. It is found that the demand for wireless access of data doubles each year. Li-Fi technology is found to be one of the fastest wireless accesses in future [12]. Li-Fi supports the transmission of data through illumination of the light that varies the intensity which cannot be noticed by the human eye. LED is used to send the audio signal or to transmit the data in a wireless medium. Li-Fi technology comes under the Free Space Optics because the signal is transmitted in the air medium [1]. It is preferred because it can replace radio waves for wireless communication. Comparing to Wi-Fi, the main advantage is that Li-Fi uses LED bulbs that light the room as well as transmits the data.

II. LI-FI TECHNOLOGY

Li-Fi is a wireless optical communication technology that uses LED as a transmitter and photo detector as a receiver. Data is transmitted form source to destination via light medium. Li-Fi uses light bulbs and light spectrum to transfer data with the speed of above 200 GB per second. Li-Fi technology can provide illumination to a larger work space and is also well suited for providing internet access to the areas under the range of light spectrum. Li-Fi is preferred as an alternative to Wi-Fi because of the secure transfer of data.

III. METHODOLOGY

In this section, the experimental setup and methodology is described with the help of block diagram. The audio signal is given as an input. The signal is amplified and given to an optical source. The illumination of the optical source is passed through the optical fiber. The fiber is used to connect the optical source with multiple rooms. A piezoelectric sensor is connected to the arduino and attached to the front and back side of the entrance. When a person enters the room, the sensor attached to the front side of the entrance is detected first followed by the sensor attached to the back side of the entrance. The output of the arduino is connected to a switch which makes the LED in the Li-Fi module to glow only in the presence of humans. So when a person enters the hall, the LED glows and music gets played automatically. On the other hand, when the sensor attached to the back side of the door is detected first, it implies that the person is leaving the room. So the LED stops glowing and there is no transfer of music. Thus, depending on the sensor detection, entry and exit of the person is determined. Li-Fi module is a combination of the LED and photo detector and is present in every room. The light from the LED is captured by a photo detector. The output of the photo detector is amplified, and the resultant signal is given to the speaker. Thus, we can hear a pleasant audio signal.

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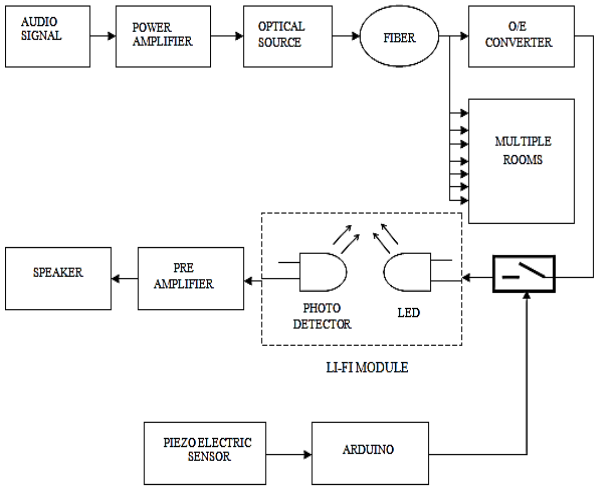

Fig 1. Block Diagram of the proposed system

Fig.1 represents the block diagram of proposed system. The input was an analog signal which is an audio. The audio signal is not capable of driving a LED. So the signal should be amplified. The amplification is achieved by power amplifier. The light from the optical source such as LED or LASER can be passed to multiple rooms via fiber. After optical to electrical conversion is done, the resulting signal makes the LED to glow. The LED and photo detector along with the receiver circuit is kept in every room. A piezoelectric sensor which was fitted at the front and back side of the entrance is used to detect the entry and exit of a person. Once the human presence is detected, the output is given to an arduino which is then given to a switch. The switch controls the LED. The light from the LED is made to fall on the photo detector. A photo detector is a device that responds to the incident light by using the electrical effect of individual photons. The voltage produced by the photo detector is given to a pre amplifier. A preamplifier converts a weak electrical signal into an output signal that is considered to be strong enough for noise tolerant and further processing and the resultant output is passed through a speaker. Thus, we can hear the audio which was transmitted at the initial stage. In case of noisy output, suitable noise reduction circuits such as filters are used to reduce the noise.

IV. RESULTS AND DISCUSSION

In Li-Fi transmission, the most important requirement is the blinking rate of the light source which indicates the repeated ON and OFF behavior of the light. LED switches at a faster rate in which normal human can't notice the difference. The blinking rate of the LED depends on the data transmitted. That is, if a high frequency data is transmitted, it blinks at a faster rate and if a low frequency data is transmitted, it blinks at a lower rate. LED is capable of producing lower amount of heat. LED is considered to be one of the best optical sources since it is cost effective. With limited amount of cost, illumination can be obtained. Laser beams can cause several health hazards but it is not considered as a problem in case of LED lights. Data transfer rate is high in Li-Fi. It cannot penetrate through walls. So the private information cannot be accessed by unauthorized users. It is easy to install and it is of low cost. In order to transmit the data, both LED and photo detector must be in the line of sight (LOS). Other sources of light may interfere with the signal which may cause improper transfer of data. The circuit is designed and simulated in the multisim software. Fig.2 represents the simulation of transmitter. The voice was given as an input via microphone which was available in the multisim software.

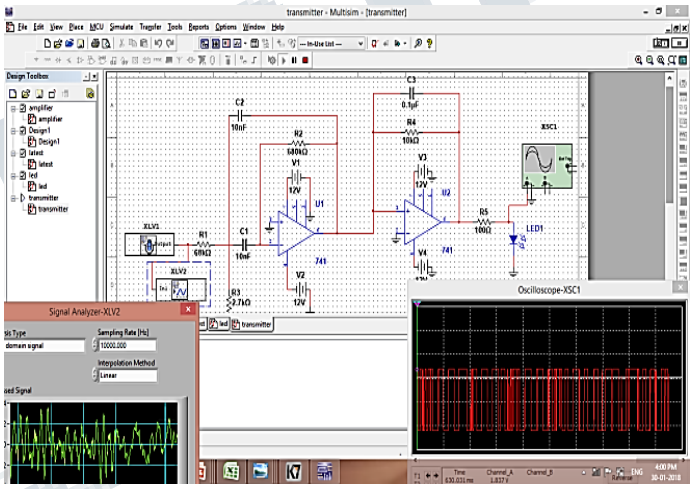

Fig.2-Simulation of transmitter

The voice was recorded for duration of 2s and the sampling frequency is set to 11025.00. Since the input was given for 2s, the LED glows only for 2s and then it stops blinking.

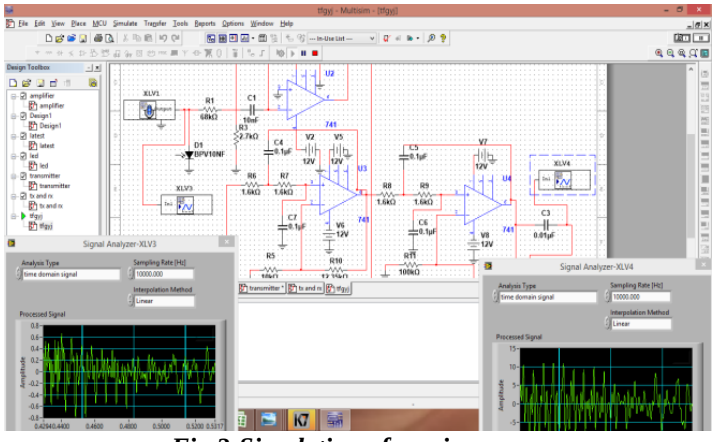

Fig.3-Simulation of receiver

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Fig 3 represents the simulation of the receiver circuit along with the higher order filter. The duration and sampling rate of the receiver circuit should be the same as that of the transmitter circuit. After simulation, the audio was played via the speaker and filters are used to reduce the noise so that a clear audio is produced from the speaker.

V. HARDWARE IMPLEMENTATION

Fig.4 **Fig.5**

Fig.4 & Fig.5- Audio Amplifier input

Fig.4 represents the hardware implementation of the transmitter circuit. The audio signal is given as the input. The signal is amplified and it makes the LED to glow. The wave form is observed by means of an oscilloscope. The waveform is produced in the CRO according to the frequency of the given audio signal. Fig.5 represents the transmitter circuit when the audio signal is paused. Since the music is paused, LED does not glow and a straight line is observed in the oscilloscope.

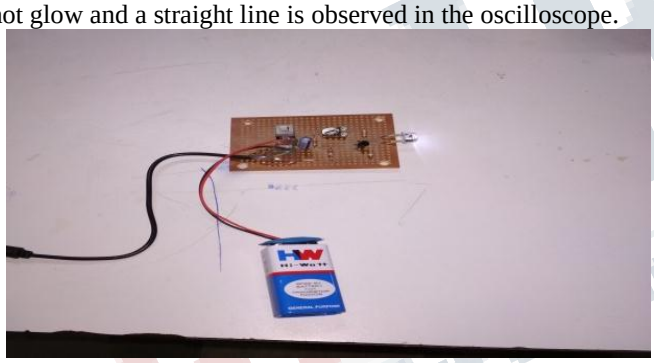

Fig.6- PCB designs of transmitter circuit.

Fig.6 represents the PCB design of transmitted circuit. It is given with a supply of 9V. The input is given from an mp3 player via audio jack. Once the signal is amplified, it makes the LED to glow only when the music is played. The LED stops glowing if the music is paused.

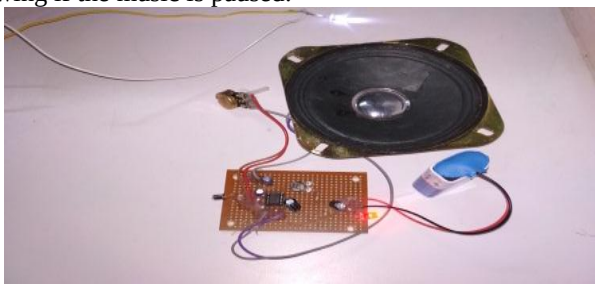

Fig.7- PCB design of receiver circuit

Fig 7 represents the PCB design of the receiver circuit. It consists of a photo transistor which captures the light from the LED. The output of the photo transistor is amplified and it is used to drive the speaker. Thus the music is transmitted using light as the carrier.

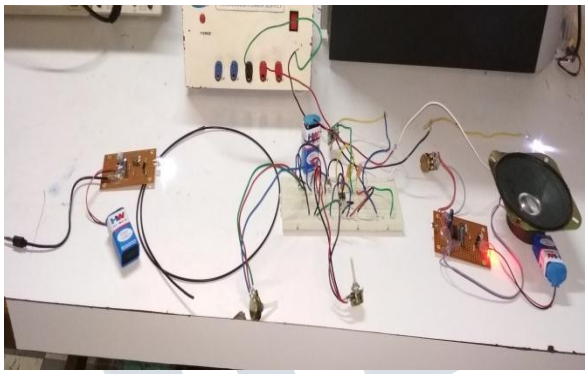

Fig.8-Prototype

In the prototype as shown in Fig.8, the audio signal is amplified and given to an optical source. Then the light from the optical source was made to pass through the fiber. The optical energy is converted into electrical energy in order to make the LED to glow. Photo detector captures the light from the LED and it is amplified and given to the speaker.

VI. CONCLUSION

Light is used as the carrier to transmit the audio signal. With the help of piezoelectric sensor, whenever a person enters the room, automatically the LED is made to glow and a pleasant music can be heard. Single LED can be replaced with array of LEDs, so that the distance between the LED and photo detector at the Li-Fi module can be increased. Thus, using Li-Fi technology, LED can be used to light the room as well as to transmit the data.

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