High-Speed Visible Light Communication: LiFi

Joy Das[1]| Kushal Ghosh[1]| Atanu Chowdhury[1]| Arijit Bhukta[1]| Anurima Majumdar[1]| Antara Ghosal[1]| Palasri Dhar[1]|Suparna Biswas[1]| Sunipa Roy[1]

[1]Department of Electronics & Communication Engineering, Guru Nanak Institute of Technology, JIS Group, Kolkata, West Bengal, India.

Abstract: Li-Fi, short for light fidelity, is a technology for wireless communication between devices using light to transmit data. The paper describes a Li-Fi system. In technical terms, Li-Fi is a visible light communications system that is capable of transmitting data at high speeds over the visible light spectrum, ultraviolet and infrared radiation. The technology is actively being developed by several organizations across the globe. Using light to transmit data allows Li-Fi to offer several advantages like working across higher bandwidth, working in areas susceptible to electromagnetic interference (e.g. aircraft cabins, hospitals) and offering higher transmission speeds.The paper explored such demonstration of Li-Fi. Just to get a clear idea: imagine if the light above your head could also give out internet for your phone? That is, in essence, what Li-Fi is all about.

KEYWORDS: Li-Fi, High speed data, ARDUINO -Nano

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INTRODUCTION

Li-Fi uses 802.11 protocols where it uses ultraviolet, infrared and visible light communication which has much bigger bandwidth(instead of radio frequency waves in Wi-Fi). It is better than Wi-Fi in terms of speed, security and usability.

In 2014, a record was established by Sisoft (a Mexican company) that was able to transfer data at speeds of up to 10 GB/s across a light spectrum emitted by LED lamps. In July 2015, IEEE has operated the APD in Geiger-mode as a single photon avalanche diode (SPAD) to increase the efficiency of energy-usage and makes the receiver more sensitive. Many authors have reported Li-fi Technology in their work. An overview of the research, developments and applications of Li-fi is described by Leba et al [1]. Usage of Li-fi is described for 5G communication [2]. Application of Li-Fi for smart communication is also reported by Mahendran et al[3]. Different advanced researches on Li-fi is reported [4-6]. Our project is inspired by the fact that Li-Fi is so much better but less feasible due to higher costs. We designed the transmitter part with transistor circuit, the noise in the process was reduced, the audio DAC of device producing audio output was made robust against current fluctuations and all of this was done under □35.

MODEL COMPONENTS AND DESIGN

Our model is a practical demonstration of how Li-Fi works and the transmission side was especially modified to show that Li-Fi is very economically viable.The first model transmits audio through light,whereas the second model transmits text data through light.

Model 1: The transmitter circuit of the model 1 is shown in Figure1.The light output of this transmitter circuit is received on a solar panel.

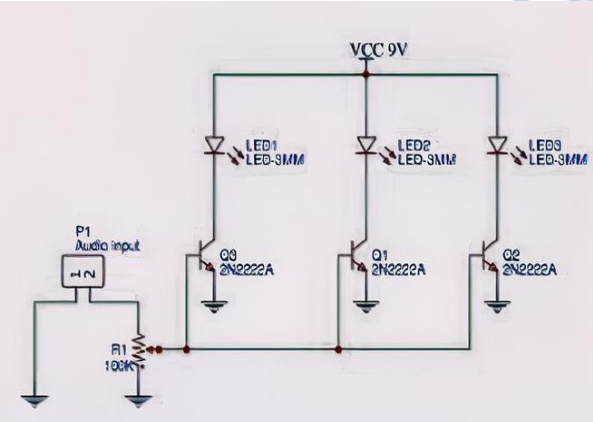

Figure 1: Transmitter Circuit of the proposed model

The output of the solar panel is fed to an audio amplifier. The transmitter circuit works on the principle that the intensity of the LED modulates according to the amplitude of the audio input to the
Transmitter

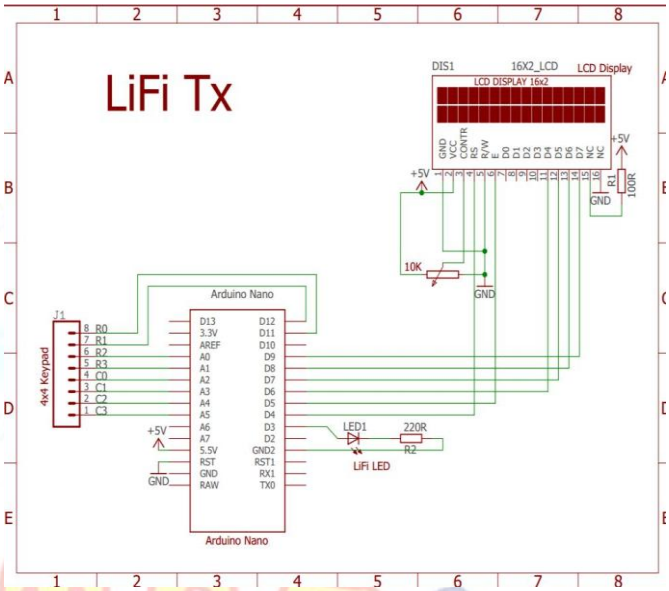

Figure 2: Connection of Li-Fi transmitter circuit

When this modulated light is incident on a solar panel then the output voltage changes according to the light intensity, i.e., we are getting the audio signal at the output. This audio signal is then fed to an audio amplifier. The output of amplifier is connected to loud speakers.

Model 2 : This model demonstrates transfer of text. The total unit is divided into receiver module and transmitter module.

Transmitter Module: The transmitter module consists of an arduino nano, a matrix keypad, a 9x2 display and a led along with necessary passive components. The text data is fetched from the keyboard and processed to calculate the 'off' time of the LED. The text is also displayed on the screen. The ASCII value of the input text determines the 'off' time of the LED. Whenever any text is input then the LED is off for a small duration of time.

Receiver Module: The receiver module consists of an Arduino Nano, a 9x2 display and an op-amp

comparator circuit. The op-amp comparator circuit uses an LDR as sensor. The light output of the transmitter circuit is fed to the comparator. Whenever the leg of the transmitter is off the output of the comparator is high. The text data is reconstructed by calculating the time of high output of the op-amp. Thus, we are able to communicate using visible light.

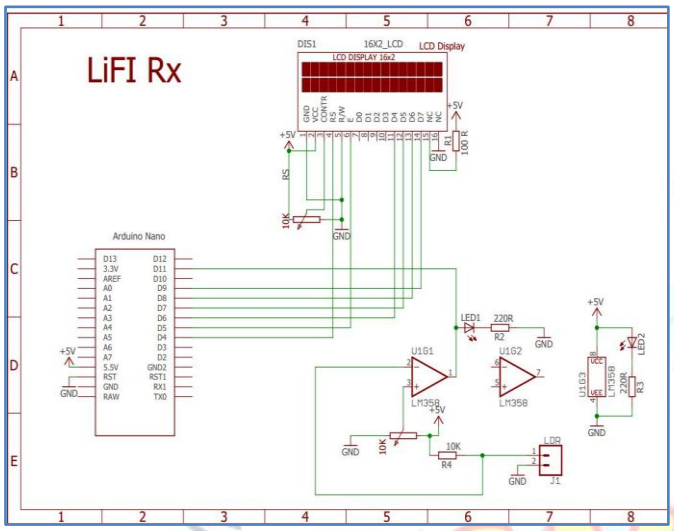

Figure 3 : Connection of Li-Fi receiver circuit

CIRCUIT DESIGN

The circuit of the proposed model is shown in Figure 4.Model 1 is on the right side of the image. The audio input is taken from a mobile device(or any other device having a 3.5mm headphone jack) and the output is received from the loud speaker.

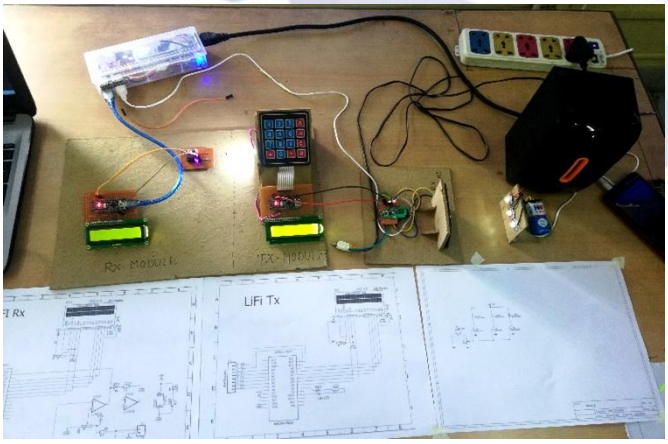

Figure 4: Circuit of the proposed model

Model 2 is on the left side of the image. The text input is taken from a matrix keypad and the output is displayed on a 9x2 display. A 9x2 display is attached to the transmission side for reference.

Power is supplied through an AC to DC adapter.

CONCLUSION

In contrast to radio frequency waves used by Wi-Fi, lights cannot penetrate through walls and doors. This makes it more secure and makes it easier to control access to a network. Since light can travel through water, Li-Fi based communications could offer much greater mobility to Remote Operated Underwater Vehicles (ROVs). Road Vehicles could communicate with one another via front and back lights to increase road safety. There are many more such applications to Li-Fi which we will see in future and our project is a step towards that future.

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