Transmission of data, audio and text signal using Li-fi technology

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Abstract: The light fidelity technology refers to visible light communication that uses light as a medium to deliver high speed data which is much greater than that of WiFi. LiFi data is transmitted in several bit streams and the receiver side consisting an IR detector decodes the message. The transmission happens in the form of binary data where 0 means LED in ‘OFF’ state and 1 means that the LED is in the ‘ON’ state. Transmitter and receiver sections contain Arduino which is programmed using Arduino IDE. High power intensity led’s are used in the LiFi transmitter. In receiver section photodiode module is used to detect the light signal generated by the LiFi transmitter. In this we are transmitting the 2 different data using light they are Audio signal and Text signal. Hence the study of various topologies to understand the characteristics a LiFi system.

Keywords: Light fidelity, wireless fidelity, data transmission

1. INTRODUCTION

LiFi technology uses led’s for transmitting data. It is derivative of optical wireless communication technology using light from Led to deliver high speed communication. Visible light communication works by switching the Led off and on at very high speed, it can’t noticed by the human eye. The intensity of the LiFi LED emitter is kept low enough so that it cannot be seen by the human eye but high enough to carry out the communication easily. It is also very secure from hacking as the light cannot penetrate the walls. However, this also limits the range.

This is advantageous in electromagnetic sensitive areas where electromagnetic interference is especially avoided like hospitals, nuclear power plants and aircrafts. Although WiFi and LiFi both employ electromagnetic spectrum to transmit information, WiFi uses radio waves and LiFi uses visible light. Li-Fi has almost no limitations on capacity. Visible light spectrum is 10,000 times larger than the entire radio frequency spectrum. The light signals are transmitted via wireless channels to the receiver. The detector in the receiver converts the optical signals to recover the message. Since light cannot travel through the walls, hence LiFi signals can be secured in physical space.

2. RELATED WORK

The Li-Fi technology are being developed to improve the data rate, efficiency and low power consumption. LiFi is a bidirectional network system and provides a substantially similar experience as WiFi to the user. As we move toward the future, the connectivity demands are going to increase
exponentially. To cater to these demands we need higher spectral capacity network. With, LiFi we can utilize the spectrum 100000 times greater than that of radio frequency. LiFi is now providing unprecedented data and bandwidth. It is a category of optical wireless communications, includes infra-red and ultra-violet communication as well as visible light. However, Li-Fi is unique in that the same light energy used for illumination may also be used for communication.

The working of LiFi is simple but powerful. When an LED light bulb is supplied with constant current stream of photons are emitted from the bulb which is seen as illumination. LED bulbs are semiconductor devices, which means the current, and therefore the illumination can be modulated at extremely high speeds which can be detected by the photo detector. Using this technique, transmission of high-speed information can be done through a LED bulb. LiFi uses direct modulation methods that are similar to the low-cost infrared devices like remote controls. Also, LED light bulbs can have very large data rates as the LED bulbs have very high intensities.

A good data density reduces the need to share the bandwidth with other users hence, improving the user experience. The achievable data density by the LiFi is 1000 times greater than the WiFi. Hence, this provides more data per square meter. The LiFi communication system can work even under the sunlight as the modulated light rays can still be detected. Since the system works on the detection of rapid changing light intensity and not the slow varying levels which can be caused by disruptions due to the sunlight. As light waves in LiFi are heavily modulated, the sun just adds a constant light which can be easily filtered out by the receiver.

3. EXISTING MODEL

Most of the commercially used LEDs, are high brightness blue LED that has a phosphorus coating to create a yellow light. When the blue and the yellow light combine, they turn into white light. Data rate in this type of LED is up to 1Gbps

4. PROPOSED SYSTEM

Instead of using colour converting chemical, the usage of RGB LED as white light source can boost the date rate up to 5Gbps. The speed of the transmission for a single micro LED is of 8 Gbps. We are transmitting the two different data they are transmission of audio and text signal using Li-Fi. It is less cost than other. Speed of the data transmission is high compared to the existing model (Figure 1). Also fast than Wi-Fi and it is un-hackable.

In audio segment signal transmission was taken place through the phone which is placed at the transmitter end, covert digital to analog signals this converted signal into analog is now amplified and transmitted in the form of beam of led’s which were connected in the bread board. LED is provided with power supply.

These fluctuations in the light intensity were caught on the solar panel that behaves as a photo detector it captures all the LED fluctuations and transmits the signal to pre amplified speaker.

In the same manner instead of giving an analog signal through mobile, text to speech software is used text is given through software and thus the software converts and reads out the given text. These audio signals produced while going through the text is transmitted through the variations caused in the LED array as said above then the audio signals were heard through a pre amplified speaker.

LiFi is a Visible Light Communications system that can be used for Visible Communications system (VLC) for data transmission. VLC system has two main components:
One light source equipped with a signal processing unit and a device with a photodiode which is able to send and receive light signals. The VLS light source can be a fluorescent lamp or an LED bulb. However, LEDs are considered to be the ideal in these situations as the system needs a robust and extremely high rate of light emission. LED being a semiconductor based light source, it can amplify the light intensity and switch between illumination levels rapidly. Because of this, LEDs are capable of modulating thousands of signals and the human eye cannot see. The electronic signals are demodulated, then it is converted into stream of binary data that can be used for transmitting audio, video, web application information to be consumed by any internet enabled device.

The room for innovation in the LI FI technology is very much. LiFi can be also used as a bidirectional communication system just like WiFi and broadband.

By changing Infrared light to visible light in a photo detector, the connected mobile device and send data back. Also, multi-colored RGB (Red/ Green/Blue) LED's at retina size could be engineered to send and receive a wider range of signals than single coloured phosphor-coated white LED's. In transmitter side we have connected three input devices like laptop, temperature sensor and voice recorder. These input devices send the data to the micro controller and it will transfer the data through led light. At the other side photodiode absorbs the light and decoding the signal it will pass to micro controller. Micro controller will identify the signals and send the signal to receiving devices.
like LED, micro controller, and LED driver circuit. There are different possible light sources used for illumination. However, Laser Diodes (LD) and LEDs are the two most popular ones among these especially preferred for optical data communication. This study is about the VLC, which deals with the concept of maintaining a continuous illumination and simultaneous transfer. In an LED structure, there is a spontaneous emission of photons which emit in different phases. However, in LEDs, a phenomenon called coherent radiation happens. This happens when an emitted photon stimulates an emitting photon resulting the emitting photon to be of the same phase as the emitted photon. The transmitter section primarily consists of the light emitting source. To transmit the data in a serial communication technique of the computer, LASER is selected as the light source. The serial port communication is carried to and from by the RS232 pin. To have an easy and proper analysis, the transmission of data from one PC to another was carried out. LASER light is the main component of the transmission section. The computer output is taken using a serial communication port. Similar to the modern serial port converters and computers, the output of the computers is made to a constant using an Arduino. It’s considered as a 1 when the LASER is on and 0 otherwise in the receiving end. In this study, the data transfer is done using the serial communication. This circuit is mainly consisting of Max 232 IC. DB9 Pin receives the data towards the Max 232 IC. TTL logic output is converted from RS232 logic using the MAX 232 IC which is used to drive the LASER diode. The data is transferred as binary data. Here the LASER is made ON and OFF simultaneously as per the received input using switching circuit.

![Figure 3. Receiver Block diagram](image)

Photo-detectors(Figure 3) are the receiving end of the OWC system. It absorbs the photons impinging on its front surface and over against generates electrical signal. The conversion of photonics energy to the electrical energy can be achieved in alternative way. Examples such as vacuum photodiodes or photomultipliers undergo the absorption of photons that created photoelectric effects and hence, free electrons emerge as a result that are used as carriers. Another way is that, by the falling of the photons into the junction area of a semiconductor photodiode which leads to the release of an electron-hole pair. The examples of photo diode being p or a pin diode. Flowingly, the released carriers release the excessive energies by moving to the corresponding regions such as conductance and valence bands.

However, due to their small size, high sensitivity and fast response. Photodiodes are the most preferred ones. The favored types of photodiodes are P-I-N (PIN) and Avalanche Photo Diode (APD) as photodiodes are used as receiver.
4.1. Transfer of text
At first the text will be typed to the source like computer/laptop/palmtop/mobile, etc in order to keep the thing to be transmitted ready. Then the transmitting side will work in accordance with the text that is needed to be transferred. The text will be sent to the micro controller of the transmitter side in the above figure 4.

The text will be coded in a form to proceed for the further processing. Once the code is ready, it will be transferred to the converter where the text that is in coded form is converted to the light form. Then the data’s are transferred to the receiver side when it is being placed within the range of the light. From there the coded text is decoded and then sent to the receiver output. And then the output is obtained on the source present on the receiver side.

4.2. Transfer of audio
At first the voice will be recorded by the help of a voice recorder in order to keep the thing to be transmitted ready. Then the transmitting side will work in accordance with the recorded voice that is needed to be transferred. The voice will be sent to the micro controller of the transmitter side. There the voice will be coded in a form to proceed for the further processing. Once the code is ready, it will be transferred to the converter where the voice that is in coded form is converted to the light form. Then the data’s are transferred to the receiver side when it is being placed within the range of the light. From there the coded voice is decoded and then sent to the receiver output. And then the output is obtained on the speaker present on the receiver side.

4.3. Transfer of detected temperature
At first the temperature that is detected will be recorded by the help of a temperature detector in order to keep the thing to be transmitted ready. Then the transmitting side will work in accordance with the recorded temperature that is needed to be transferred. The temperature will be sent to the micro controller of the transmitter side and the temperature will be coded.
The text data which is optical signal transmitted from the LED is fall on the photodiode, it detects the optical signal and detects the flickering led which represents the data in binary code. The data will be send into the micro controller of the receiver module(Figure 5). It will transferred to the converter where the light form to text form. Then the data gets decoded shows in the display or computer. The recorded voice is coded into the light in the transmission side and it is transmitter in the form of light, it falls on the receiver called photodiode. Here the light is decoded into the voice and the sound is heard from the speaker, which is been displayed in the.

![Figure 6. Results of input screen](image)

The arduino is connected to the computer we use visual basic run time software for simulation. We to check the port number which arduino is connected, the port number is entered in the comm port box and start. The temperature is shown, Enter the text message to be send to receiver and click send. For the audio signal transmission the voice is already recorded that can be send by clicking voice — > send. Then the audio signal is also transmitted through led which is been displayed in the above figure 6.

![Figure 7. Results of output screen](image)

Arduino of the receiver side is connected to the another computer and check the port number. Enter the port number in the common port and click start. Then the data is displayed on the screen in the above figure 7. Here we use the visual basic run time software.
5. CONCLUSION

We have been able to transfer the text, temperature recorded voice on the receiver side through the help of light source which is present on the transmitter side. A proper audible sound is heard on the speaker, the temperature is detected accurately and the text is displayed exactly. The future scope of this technology is very bright. The solution of the problem dealing with the integration of visible light with a communication system is demonstrated here. This system can be used with the present infrastructure, without undergoing major changes. Visible Light Communication is a rapidly growing technology in the field of wireless communications. As there are many challenges in this fields but there are equal or more advantages with it as well. With the introduction and usage of VLC, many of our long-faced problems such as power and environmental issues can potentially be solved. The VLC is still in its beginning stage, but with the rapid improvements being made in this technology stage by stage, it will be used in our daily life soon. In spite of the research problems, it is our belief that VLC system will become one of the most promising and prominent technologies in the field of wireless communication for the future generations.

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