Audio transmission using Li-Fi

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ABSTRACT

This paper concentrates on developing a model which uses Visible Light Communication (VLC) to transfer Audio signals under various interference conditions. The proposed model will work based on the concept of Light Fidelity, which is commonly called as Li-Fi. This Li-Fi based audio transmission system is also compared to the existing systems and its performance is analyzed. Even though WiFi is great for coverage within the buildings, Li-Fi has high-density wireless data coverage in confined areas. It also relieves the major problem of radio interference along with the providence of better security, bandwidth, transmission rate and efficiency than WiFi. Since it uses low-cost LEDs, we can use this system to accomplish many innovative tasks like using it in hospital rooms, museums, car-to-car communication, smart homes, etc. This will be the technology of the future and every home, office, and shop will use this eco-friendly technology to transfer data.

Keywords: *Li-Fi, Power Amplifier, Relay, Transmitter, Receiver, Buffer, Driver, Audio Transmission, Eco-friendly system.*

1. INTRODUCTION

Over the past few years, there has been a rapid growth in the utilization of the RF region of the electromagnetic spectrum. This is because of the huge growth in the number of mobile phones subscriptions in recent times. This has been causing a rapid reduction in the free spectrum for future devices. Hence, an alternative means to wireless communication is necessary to accommodate the exponentially increasing wireless traffic demand. Visible light communication systems provide an alternative to the current standards of wireless transfer of information, using light from LEDs as the communication medium.

The term Li-Fi was Invented by the German Professor at the University of Edinburgh, Harald Haas and it refers to light based communications technology that delivers a high-speed, bidirectional networked mobile communication which is similar to WiFi. Light-fidelity (Li-Fi) operates in the visible light spectrum of the electromagnetic spectrum i.e. it uses visible light as a medium of transmission rather than the traditional radio waves. Li-Fi is the transmission of data using visible light. This is done by sending data through an LED light bulb that varies in intensity at a speed much faster than the human eye can follow. If the LED is on, the photo detector registers a binary one; otherwise, it's a binary zero that is registered.

This Li-Fi system can be used to produce data rates higher than 1 Giga bits per second which is much faster than our average broadband connection or Wi-Fi. The high speed of Li-Fi can be explained using frequency spectrum of Electromagnetic Radiations. From the electromagnetic spectrum, we can see that the frequency Band of the visible light is in between 430THz to 770THz and that of Radio Frequency Band is in between 1Hz to 3THz. Hence the Frequency Bandwidth of the visible light is about 400 times greater than the Radio Frequency Bandwidth and so, number of bits can be transferred through this Bandwidth than in the radio frequency bandwidth. Thus the Data rate will be higher in Li-Fi and higher speed can be achieved.
In this project, the audio signal is modulated and is transmitted to the light source. This signal is captured by the photo detector and demodulated to give the output.

2. EXISTING SYSTEM

WiFi and Bluetooth are the two consistent wide range sources used by multiple applications today. However, these methods use radio frequency spectrum and noise of the signal is very high. Other inconveniences of these methods are special equipment requirement, high power consumption, and high cost. Secure data transmission is not available here. WPS key encryption can be provided and hacking can also be done easily
Since it uses radio wave transmission it is harmful to health.

3. PROPOSED SYSTEM

Visible light is a new technique of data transmission method. LiFi, data is transmitted by modulating the intensity of the light, which is then received by a photo-sensitive detector, and the light signal is demodulated into electronic form. This modulation is performed in such a way that it is not perceptible to the human eye. VLC consists of a light source as a transmitter and detector as a receiver. This electrical signal is amplified by the amplifier circuits and fed into the power LED. The light signal from the LED varies according to the intensity of the voice signal. Louder the voice, the glow of the LED will be more. At the receiver side, Avalanche photo detector will receive the light signal and correspondingly generate an electrical signal proportional to it. This electrical signal is processed by a demodulator circuit, which is then fed to a speaker and it produces the audio signal which was at the input of the transmitter side.
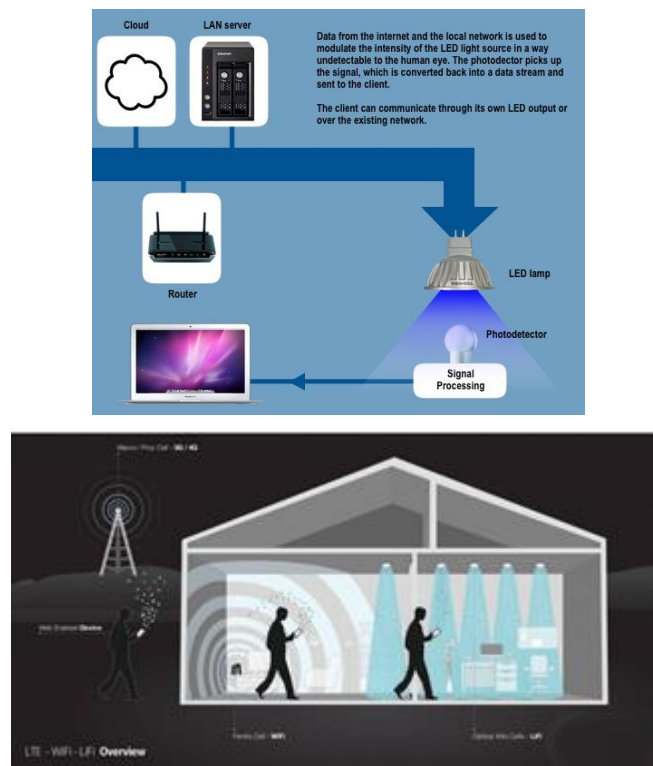

4. BLOCK DIAGRAM

Voice is recorded through a microphone and stored in the sound record and playback module. Analog audio signals are converted into digital signals using ADC. Modulation happens in the LiFi drive and a high beam light is transmitted. In the receiving side, there is a program which gives a particular range of light which is transmitted. The output is given to audio amplifier and then received by the speaker through the relay.

Transmitter
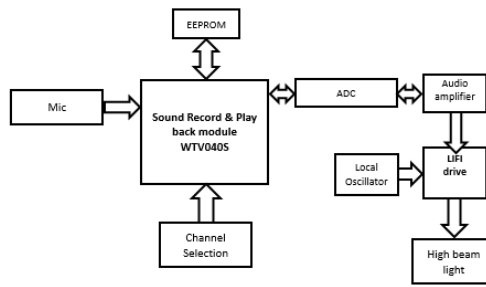
Voice Playback Module: It stores the recorded voice. It can store up to 32 channels.

Microphone: It is used to record the voice.

EEPROM: It is an electrically erasable programmable read-only memory. The voice can be overwritten or deleted using this ROM.
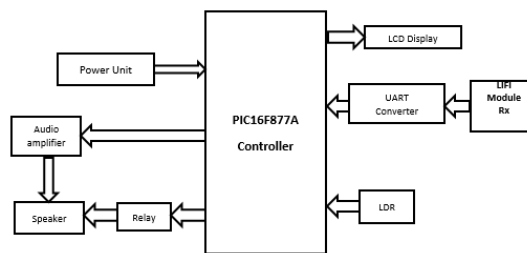
Channel Section: Different channels can be chosen.

ADC: Analog to Digital Convertor. User defined analog signals are converted to digital signals.

LiFi drive: Modulation of a message and carrier signal takes place here.

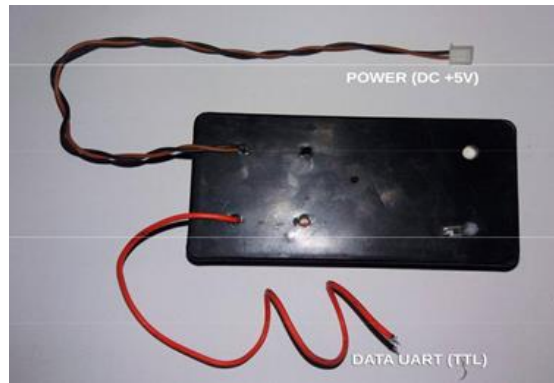
Receiver

Power Unit: Power supply of 5 V

Pic16f877A: Microcontroller used in this project.

Audio Amplifier: To amplify the receiving voice.

LDR: It differentiates between the actually transmitted light and the light in the room.

UART Converter: It uses serial communication. It converts TTL to RSL.

Relay: It shares the energy and the load.

5. COMPONENTS REQUIRED

HARDWARE REQUIREMENTS	SOFTWARE REQUIREMENTS
PIC16f877a Controller	MPLAB IDE
Li-Fi transmitter & receiver module	Embedded C
Power Amplifier	Pickit-3
LCD	
Power supply	
PC	

6. ADVANTAGES

- Low cost
- High speed
- Low Bit Error Rate
- Portability

7. APPLICATIONS

- As Wi-Fi radiates harmful signals as well as interference from cell phones and computers block the signal from monitoring equipment, Li-Fi is preferred in areas like Hospitals.

- Li-Fi can be used in petrochemical industries automation where the use of radio spectrum is very dangerous.

- Li-Fi can also be used in Power plants as Wi-Fi and many other radiation types are very bad for such sensitive areas.

- Localised advertising can be done by broadcasting through the Li-Fi channel into smaller distances.

- Underwater communication - Radio waves aren't appropriate for underwater communication as they get absorbed in water. Li-Fi is a better selection for communicating.

- Safety environments – In the hazardous environment, instead of electrical equipment Li-Fi is a safer option to transfer data. This also provides better security.

- Sensitive data - Hospitals are an environment where both EMI sensitivity and security of data are issues. Li-Fi can enable the better disposition of secure networked medical devices, patient accounts, etc.

8. FUTURE SCOPE

LiFi can be used in diverse fields. Data transmission is done through LEDs and thus all screens which illuminate light can be served as a platform for data communication.

The Screen of mobiles, televisions and tube lights itself act as a transmission device. On the other hand, the photo detector can be replaced by a camera in mobile phones for scanning and retrieve data. Transparent screen mobile phones, televisions, desktops, smartcards and smart guides are some of the future scope areas where LiFi can be used. LiFI can also be implemented in schools, colleges, museums, hotels, hospitals etc. In places like hospitals where electromagnetic rays are very harmful LiFi can be used. It can also be used in a dangerous environment like the thermal power plant and nuclear power plant without causing electromagnetic interference. Hence WiFi can be replaced by LiFi.

9. REFERENCES

[1] T.Komine and M.Nakagawa, ”Fundamental analysis of visible light communication systems using LED Lights,” IEEE Trans. Consumer Electronics, vol. 59, no.1, Feb 2004.

[2] M.Kavehrad, "Sustainable Energy-Efficient Wireless Applications Using Light," IEEE Commun. Mag., vol. 48, no. 12, Dec. 2010, pp. 66- 73.

[3] P. Amirshahi, M. Kavehrad, "Broadband Access over Medium and Low Voltage Powerlines and use of White Light Emitting Diodes for Indoor Communications," IEEE Consumer