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TRANSMISSION OF AUDIO AND TEXT SIGNALS USING LI-FI TECHNOLOGY

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ABSTRACT

This project is based on developing a Light Fidelity (Li-Fi) based system and analyzing its performance with respect to existing technology Wi-Fi. This is just a demonstration how Li-Fi works. Wi-Fi is great for general wireless coverage within a building, where as Li-Fi is ideal for high density wireless data coverage in confined area and for reliving radio frequency interference issues. Li-Fi provides better bandwidth, efficiency and security than Wi-Fi. By leveraging low-cost LEDs lightings units there are many opportunities to exploit this medium, for public internet access through street light to auto-piloted cars that communicate through their head lights. This technology envisions a future where data for laptops, smart phones, and tablets will be transmitted in an economic and eco-friendly medium of light in room. Here data is transmitting from one Arduino to other. Audio input which is given as input is played by the speaker.

Keywords: *Light fidelity, wireless fidelity, audio and text transmission.*

1. INTRODUCTION

Data transfer is the key to the communication. We have many ways to transmit information from one place to another. Li-Fi is the concept involving high data transfer through the highly available light sources like LEDs. Li-Fi is high speed, bidirectional, and fully networked wireless communication of data using light. Li-Fi constitutes of several light bulbs that form a wireless network. When an electrical current goes through to a LED light bulb, a stream of light (photons) emits from the lamp. LED bulbs are semiconductor devices, which mean that the brightness of the light flowing through them can change at extremely high speeds. The signal is sent by modulating the light at different rates. The signal can then be received by a detector which interprets the changes in light intensity (the signal) as data. Also when the LED is ON, you transmit a digital '1', and when it is OFF, you transmit a '0'.

Because it runs on light waves from common household LED bulbs, LiFi technology operates the way light does. Visible light has a much wider bandwidth than WiFi, meaning that LiFi-enabled devices can send and receive huge volumes at extremely high speeds - up to 224 gigabits per second. However, light can't travel through walls because the light waves are too small. Additionally, to send and receive light signals, your light source must be active for the technology to work. So if you're running your smart home on LiFi alone, you'd need to have LED bulbs throughout your house.

Yet by the same token, LiFi offers more security than WiFi because of the opportunity to introduce physical barriers. You can contain light within a space, so you can protect the messages you're sending and receiving from outside parties. LiFi signals are also immune to the electromagnetic interference that can plague radio frequency-sensitive areas. If you turn on your microwave or cordless phone near a LiFi signal, likewise, you won't disrupt an important transmission.

2. LITERATURE REVIEW

The new member of wireless data transmission family is Li-Fi which uses the concept of flickering light faster than human's eye ability for data transmission. As we know speed of light is much more than existing wireless data transmission technique, it is like to achieve speed of fiber optics in wireless communication .Another major concern is security because visible (Visible light) is more secure then invisible (radio waves).we are using light because radio/microwave/ Infrared red techniques have reached the limit same as silicon age is over and we are looking for broader range i.e. nanotechnology. The idea of Li-Fi came out from the mind of Dr. Harald Haas who has been working in this field from 2004 and finally in 2011 he demonstrated of sending video by LED light lamp at speed of 10 Mb/s [1]. Visible light communication (VLC), which uses a vast unregulated and free light spectrum, has emerged to be a viable solution to overcome the spectrum crisis of radio frequency. Light fidelity (Li-Fi) is an optical networked communication in the subset of VLC to afford the mobile data transfer which offers many advantages at indoor scenario. In this article, we survey the key technologies for realizing Li-Fi and present the sate-of-the-art on each aspect, such as: indoor optical wireless channel model, the VLC modulation techniques with user satisfaction, OFDM in VLC, optical MIMO, optical spatial modulation, multiple user access, resource allocation, interference management and hybrid Li-Fi schemes. Some challenges and future work that need to be solved in the area are also described [2].

Li-Fi stands for Light-Fidelity. Li-Fi is transmission of data using visible light by sending data through an LED light bulb that varies in intensity 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. This paper deals with the implementation of the most basic Li-Fi based system to transfer data from one computer to another. The main components of this communication system are high brightness LED which acts as a communication source and silicon photodiode serving as the receiving element. The data from the sender is converted into intermediate data representation, i.e. byte format and is then converted into light signals which are then emitted by the transmitter. The light signal is received by the photodiode

at the receiver side. The reverse process takes place at the destination computer to retrieve the data back from the received light [3]. Motivated by the looming radio frequency (RF) spectrum crisis, this paper aims at demonstrating that optical wireless communication (OWC) has now reached a state where it can demonstrate that it is a viable and matured solution to this fundamental problem. In particular, for indoor communications where most mobile data traffic is consumed, light fidelity (Li-Fi) which is related to visible light communication (VLC) offers many key advantages, and effective solutions to the issues that have been posed in the last decade. This paper discusses all key component technologies required to realize optical cellular communication systems referred to here as optical attocell networks. Optical attocells are the next step in the progression towards ever smaller cells, a progression which is known to be the most significant contributor to the improvements in network spectral efficiencies in RF wireless networks [4].

Li-Fi is one of the wireless technologies which uses visible light for communication. Li-Fi has achieved remarkable success in every field of communication as it uses visible light which has high speed, more security and less interference due to which large capacity wireless data transmission is possible. The objective of this paper is to transmit text (Hexadecimal characters) and Audio information using light as carrier. The high flickering LED and LASER is used as a source to transmit text data and audio respectively. It is possible to achieve text data transmission of up to 2m by using LDR as the detector. In case of audio transmission, solar panel is used to receive the audio signals and around 15feet [5]. Over the years, the overdependence on Wireless Fidelity (Wi-Fi) for data transmission necessitated the need for an alternate and more reliable means of communication, hence, Light Fidelity (Li-Fi). It involves the use of Light Emitting Diode to transmit data by blinking (i.e. switching them On and Off) at a speed not noticeable to the eye. This paper proposed the development of the Li-Fi system using off the shelf electronic components. The proposed system utilizes an embedded system with dual-core Advanced Virtual RISC (AVR) microcontroller (ATmega16L) interfaced to input/output circuits comprising of the Light Emitting Diode (LED), LM358N Operational Amplifier and a photodiode. Also, by developing a user (Receiver PC) interface using Embedded C programming, the sample data (text, voice and image) transferred was monitored and the speed, efficiency, security and capacity of the system was examined and discovered to be top notch. This would make the system an indispensable means of communication in the nearest future. This data transmission system is different from those in existence because expensive components were not in the design, invariably reducing the overall cost of the implementation [6].

3. EXISTING MODEL

Previously we were transmitting data using WIFI. In today world communication between the devices is much common. These devices are using radio waves for short range wireless transmissions. Wi-Fi and Bluetooth are currently the two prominent short range wireless technologies. The radio wave spectrum has certain key limitations which include bandwidth consumption, efficiency, availability and security. We were transmitting data using WIFI but LIFI is more convenient and faster. It takes more time to transmit the data.

Drawbacks:

- In radio wave spectrum data transmission security is very less.
- Lot of data cannot be transferred simultaneously.
- Health issues.
- Bandwidth usage is limited.

4. PROPOSED SYSTEM

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 Wi-Fi. Here we are showing how Li-Fi works by transmitting the 2 different data using light, they are Audio signal and Text signal. For audio transmission we are using earphones, speaker, amplifier board, and solar panel, light. Here we will connect earphone to our system and it is connected to solar panel when we play the song on our system and if we place light on solar panel it will send that signal to amplifier circuit and it will amplify that signal and give it to speaker. For the transmission of text signal, we use Arduino to process the data and Li-Fi Transmitter and Li-Fi Receiver to communicate between two PCs using XCTU named Serial Software. If we will write anything on monitor it will transmit from LIFI transmitter and receiver side will receive that data and show it on monitor.

Block Diagram for Audio Transmission

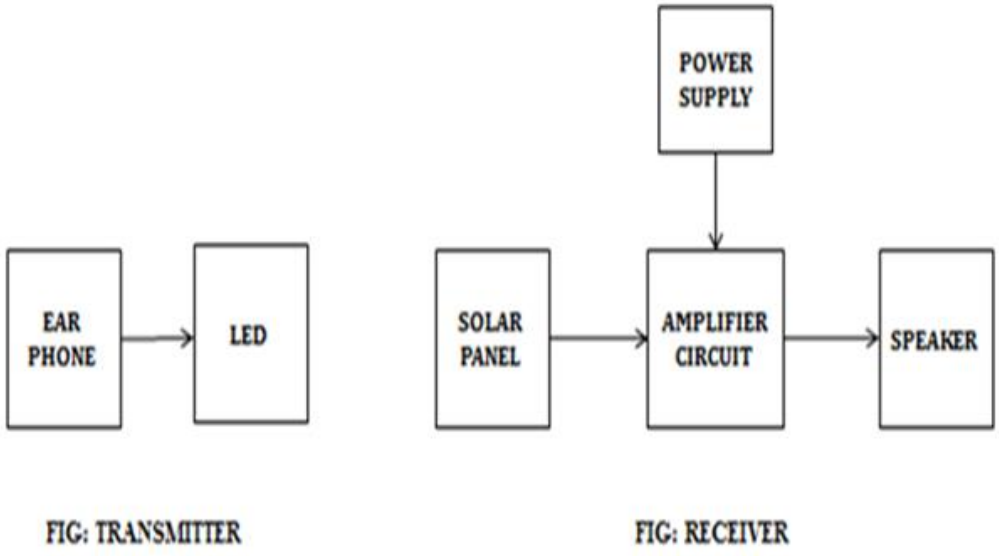


Fig. 4.1: Block diagram of Audio Transmission

The Fig. 4.1 represents the block diagram for the audio transmission. The transmission of audio signal was done through a Smartphone at the transmitter end, providing the audio signal through the 3.5 mm jack. The 3.5mm audio jack and the input audio from the phone is converted from digital to Analog. It is connected to a laser along

with a 9V battery to supply the power required and the laser converts the audio signal to light signal. This variation in the intensity of light, however, is captured on a solar panel that acts as a photo detector. It captures all the variations and sends the received signal to an amplifier circuit and then the speaker. The Analog signal that was transmitted through the fluctuating Laser to the solar panel gets amplified in the amplifier circuit and then emits the sound waves to be heard from the speaker.

Block Diagram for Text Transmission

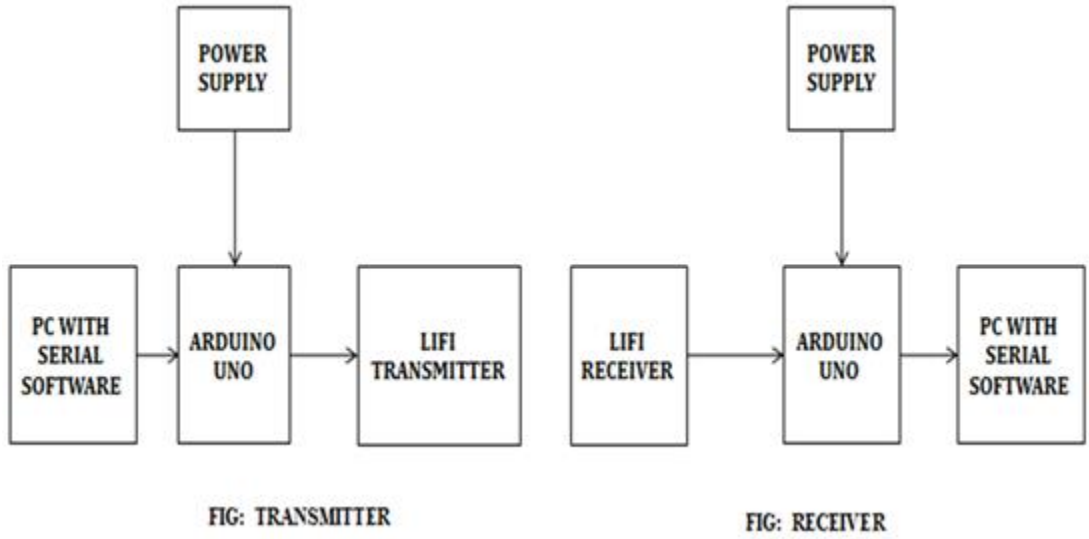


Fig. 4.2: Block diagram of Text Transmission

The Fig. 4.2 represents the block diagram for the data transmission i.e., text. In the Text transmission process, the transmitter and receiver sections contain Arduino boards which is programmed using Arduino IDE. High power intensities LEDs are used in the LIFI transmitter and LDR module is used in the receiver section to receive the incoming data. The data can be sent and received through the serial software XCTU which is interfaced with the Arduino boards by the COM ports with which the serial data can be transmitted and received accurately.

5. METHODS OR TECHNIQUES USED

For Audio Transmission:

The light technology that converts audio to light signal and vice-versa is applied to transmit the audio signal from the smartphone through the 3.5mm headphone jack to the speaker in the receiver section. Here we are using normal LED or we can use LED array also for better results.

For Text Transmission:

Arduino IDE: Arduino Integrated Development Environment (IDE) is the open-source Arduino Software makes it easy to write code and upload it to the board. This software can be used with any Arduino board. It contains

a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

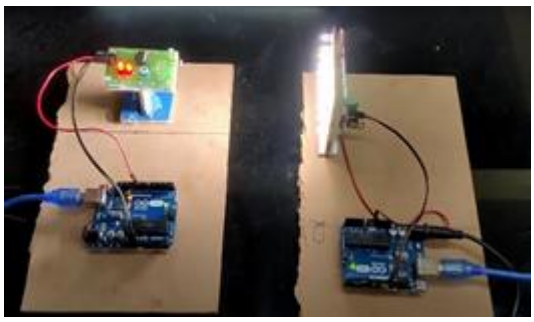
XCTU: XCTU is a free multi-platform application designed to enable developers to interact with Digi RF modules through a simple-to-use graphical interface. It includes new tools that make it easy to set-up, configure and test XBee RF modules.

XCTU software consists of a Serial Console. Interfacing XCTU with the Arduino IDE can be done by connecting the COM ports in this Serial Console which are same as in the Arduino IDE software with which the serial data can be transmitted.

6. RESULT

Audio Transmission:

Fig. 6.1: Audio Transmission using light



Text Transmission:

Fig. 6.2: Transmitter and Receiver

Fig. 6.3: Input Text from Transmitter PC

Fig. 6.4: Output displayed on another PC

- As a result, we can be able to transmit both audio and text data signals from transmitter to receiver.
- The Li-Fi system proposed in this paper is capable of transmitting data such as text, audio between two devices at the speed of a few kbps.
- The main requirement is line of sight between the sender and the receiver and hence it can be used to transmit data within a room.
- The main and basic component used is LED which is available almost everywhere.

7. ADVANTAGES

- More security and vulnerable to unauthorized access.

- Provides faster communication up to 224 Gb per second.
- Easy accessibility of LEDs
- Less power is required.
- No harm to humans.

8. APPLICATIONS

- Data transferring at very high speed
- Under water communication
- Road safety
- Medical applications

9. CONCLUSION

We have been able to transfer the audio signal to the receiver side through the help of laser light source which is present on the transmitter side. A proper audible sound is heard on the speaker. We have successfully transmitted the text signal with Arduino and XCTU Software and the output 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.

10. FUTURE SCOPE

Li Fi is a fast and cheap wireless-communication system. The increasing demand for higher bandwidths, faster and more secure data transmission as well as environmental and undoubtedly human friendly technology heralds the start of a major shift in wireless technology, a shift from RF to optical wireless technologies. The possibilities are numerous and research can provide us with many solutions. This technology can be used to make every LED bulb into a Li-Fi hotspot to transmit data wirelessly and will proceed to give us a safer, faster and a greener network.

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