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A Review on Lifi based Underwater Communication

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ABSTRACT: Important research efforts have been directed over the past ten years, towards exploring alternative parts of the electromagnetic spectrum that could potentially offload a large portion of the network traffic from the overcrowded radio frequency (RF) domain. Due to the latest improvements, the optical wireless communication (OWC) proves to be a viable alternative solution to the issues of forthcoming radio frequency RF spectrum crisis, especially in certain places and situations. Currently, most mobile data traffic is consumed indoor, where light fidelity (LiFi) which is related to visible light communication (VLC) offers lots of specific advantages, and effective solutions to the many issues of wireless communication. The current paper summarizes most of the research, developments and applications achieved so far and looks at the different aspects of the strengths and weaknesses, implementations, challenges, VLC IEEE standard and data modulation techniques of the VLC and specific LiFi's new coined optical wireless communication technology.

KEYWORDS: Li-Fi, Wireless Communication, Visible Light Communication, Wi-Fi, LED ... Intensity of light is modulated to achieve this goal.

I. 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 free spectrum for future devices. 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 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. The idea of *Li-Fi* was introduced by a German physicist, Harald Hass, which he also referred to as "Data through Illumination". The term *Li-Fi* was first used by Haas in his TED Global talk on Visible Light Communication. According to Hass, the light, which he referred to as „DLight‟, can be used to produce data rates higher than 1 Giga bits per second which is much faster than our average broadband connection.

The high speed achievement 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. So more Number of bits can be transferred through this Bandwidth than in the radio frequency bandwidth. Hence Data rate will be higher in the *Li-Fi* and higher speed can be achieved. Using *Li-Fi* we can transmit any data that can be transferred using conventional *Wi-Fi* network. That can be Images, Audio, Video, Internet connectivity, etc.. but the advantages over the *Wi-Fi* Network are High speed, Increased Security, More Number of Connected Devices, and Less cost. In coming years number of devices that support *Li-Fi* will hit the Market. It is estimated that the compound annual growth of *Li-Fi* market will be of 82% from 2015 to 2018 and to be worth over $6 billion per year by 2018.

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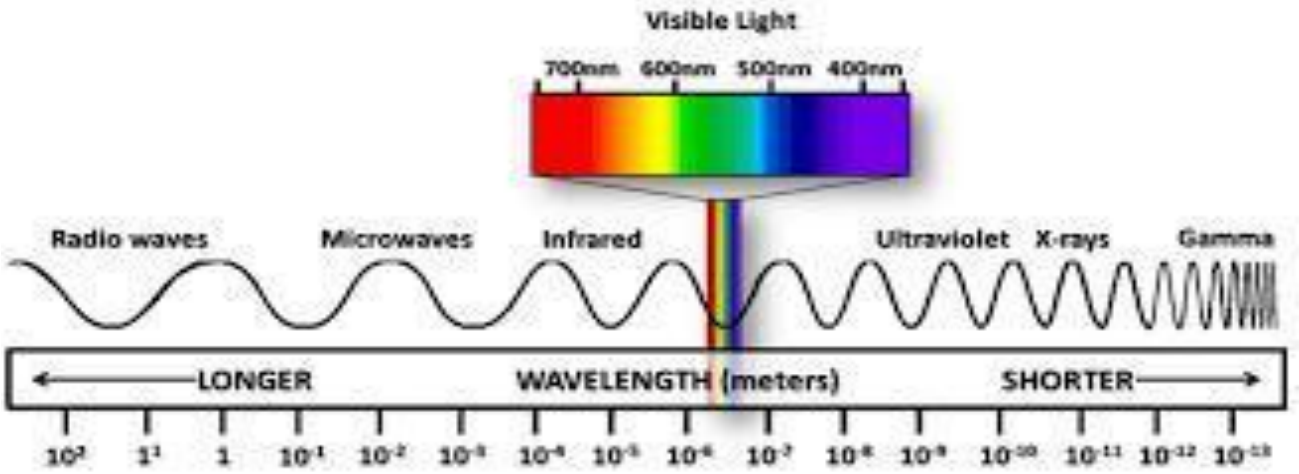
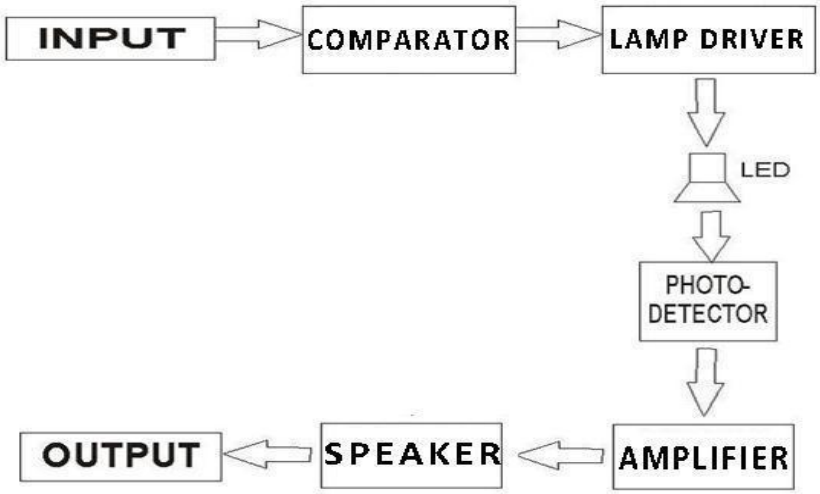
II.METHODOLOGY

This Project discusses the implementation of the most basic *Li-Fi* based system to transmit Sound signal from one device to another through visible light. The purpose is to demonstrate only the working of the simplest model of *Li-Fi* with no major consideration about the data transfer speed. This model will demonstrate how the notion of one-way communication via visible light works, in which Light emitting diodes (LEDs) are employed as the light sources or Transmitter antennas. The model will transmit digital signal via direct modulation of the light. The emitted light will be



detected by an optical receiver. In addition to the demonstration purpose, the model enables investigation into the features of the visible light and LEDs incorporated in the communication model.

Block Diagram



OBJECTIVE :

The main objective of the project is to provide an efficient, low cost, secure, digitally controlled and fast data transfer technique which can be used as an alternative for conventional data transfer technique Wi- Fi. At the same time the project also lets us to use more efficient light source i.e., LED.

1) INPUT:

It consists of analog signal, which is usually taken from the Audio output of the Mobile Phone, Laptop or any other Musical Instruments. The signal will be at low voltage level which is not enough to drive an LED, So in order to drive the LEDs we have to amplify the signal using amplifiers.

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2) COMPARATOR:

The input signal from an audio device will be at low voltage level, so in order to modulate the signal using visible light, we have to convert the signal in to a Pulse wave format (signal representing 0 & 1). to accomplish this task we use an Op-Amp Comparator which uses **µA 741** Op-Amp IC. The comparator compares the input signal with a reference voltage and produces an output which will be in Pulse wave form. The pulse wave so formed is amplified and modulated at the Lamp Driver.

3) LAMP DRIVER:

The pulse wave from the comparator has to be amplified to drive the LEDs. And Modulation of the input signal and Carrier Light signal is also taking place at the Lamp driver using a Transistor called **BC 548**, which is general purpose Silicon Transistor uses as Amplification transistor as well as Modulation transistor.The amplified and modulated pulse signal is used to drive the LEDs. These LEDs transmit the modulated signals to the receiver.

4) LEDs:

In *Li-Fi* Transmission, the most important requirement of light source is its ability to turn ON and OFF Repeatedly in very short intervals (in ns range). So we use LEDs which have very low switching time. These LEDs turn ON and OFF in Nano second based on the Pulse signal. Since the switching taking at a faster rate, it cannot be detected by Human eye. So itwill appear as illuminating even though they are blinking. Thus modulated signal is transmitted to receiver via Visible Light.

5) PHOTO DETECTOR:

The transmitted signal from the LEDs has to be detected, demodulated and acknowledged. So in order to detect the message signal from the blinking LED light, we use a photo cell or a Solar Cell (which comprises large no of photo cells connected in series). The solar cell detects only the variation of the light, since the blinking can be easily detected and output of the solar cell will be the message signal in the analog form. So using solar we could detect and demodulate the message signal transmitted.

6) AMPLIFIER AND SPEAKER :

The demodulated signal will be at low voltage range. So it is Amplified to the arbitrary voltage level using an amplifier. This amplifier will be same type of amplifier which we used in transmitter side. This is due to the fact that if any phase errors occurred, it will be cleared at this stage. The speaker will convert the electrical signal to the audible form using electro magnets present in the speaker.

7) OUTPUT:

The demodulated audible signal is transmitted from speaker to its final destination. So that the audience can listen to the message that has been transmitted from the source

Atmega328p Controller or Arduino UNO

Arduino is a popular open-source single-board microcontroller, descendant of the open-source Wiring platform, designed to make the process of using electronics in multidisciplinary projects more accessible. The hardware consists of a simple open hardware design for the Arduino board with an Atmel AVR processor and on-board input/output support. The software consists of a standard programming language compiler and the boot loader that runs on the board. Arduino hardware is programmed using a Wiring-based language (syntax and libraries), similar to C++ with some slight simplifications and modifications, and a Processing-based integrated development environment. Current versions can be purchased pre-assembled; Additionally, variations of the Italian-made Arduinowith varying levels of compatibilityhave been released by third parties; some of them are programmed using the Arduino software. The Arduino project received an honorary mention in the Digital Communities category at the 2006

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III.TRANSMITTER CIRCUIT

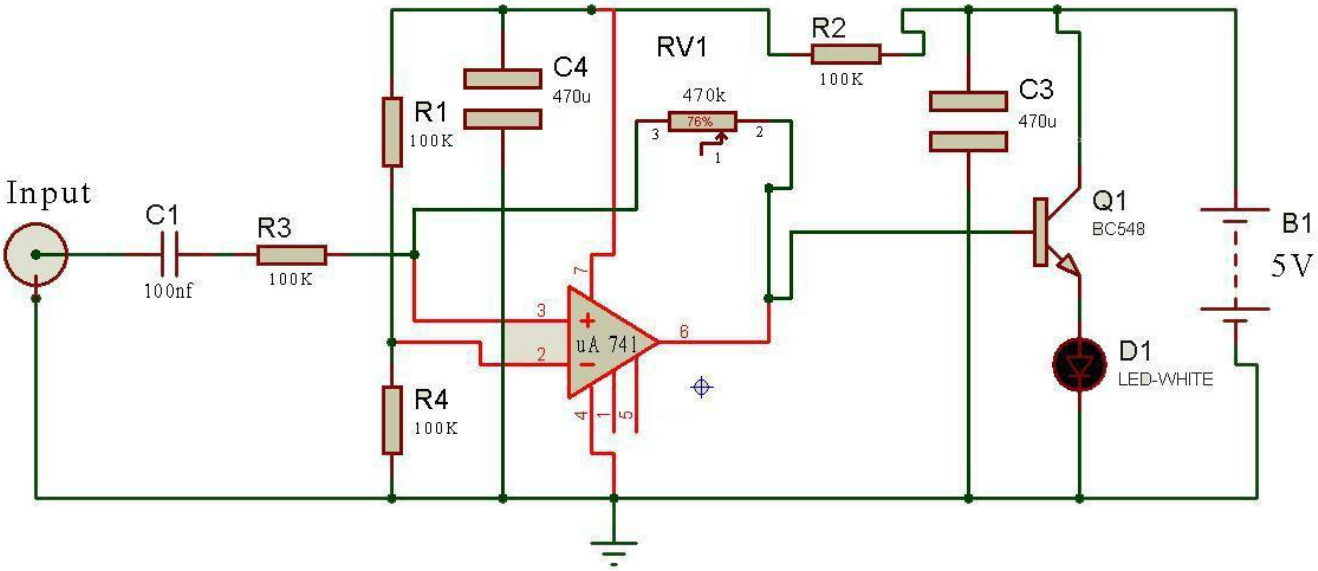

Fig.3.1.1 *Li-Fi* Audio Transmitter Circuit

IV.CIRCUIT WORKING

The above figure depicts the transmitter circuit of the *Li-Fi* circuit. We know that carrier waves can take signals along destinations, so this is simple concept when we put photons with speed of light by source to destination it can also carry signals of low frequency to destination. so we build a circuit which can modulate light with low frequency signals.

Take input from an audio device, the input will be very low audio signals of 20Hz to 20KHz. These signals paces through C1 (100nf) where DC (Direct Current) components are filtered and removed. Through R3 100kΩ which is a current limit for comparator µA741 (Op-Amp) to protect it from the high current which cause destruction of the Op-Amp. Through R1 100kΩ and R4 100kΩ, voltage at the inverting terminal of the Op-Amp limit to 5v/2 = 2.5v. Input signal at pin 3 of op-amp and compare with pin 2 of Op-Amp and output will be present at the Pin No 6 of the Op-Amp IC. 470kΩ pot or feedback gain controller to control volume at output of the Op-Amp If there is no input is fed to the Comparator, a Positive DC wave will present at pin 6 of Op-Amp, which make transistor Q1 keep alive and LED starts to glow continuously. The Capacitors C3, C4 (Both are 470µF) are filters to reduce AC components spike in circuit.

Whenever signals interrupt through pin 3 of op-amp (input from Audio device). The Comparator compares the input signal with the Reference Voltage and produce an Pulse wave output at the Pin 6. The width of the pulse wave is controlled by the Input signal Frequency. The Pulse signal is equivalent to the ON/OFF Signal which control the intensity of the Light Source aka LED (D1). The Pulse wave is further Amplified and Modulated using Transistor BC548 (T1), which is an Amplifier Modulator having high current gain. The transistor will act as a Lamp Driver and drives the LED. LED emits light according to the pulse wave form and make VLC (Visible light communication) alive. Since the blinking of the LED is controlled by the input signal, it will take place in Nano Seconds (ns) it cannot detect by Human eyes.

V.CONCLUSION

The possibilities are numerous and can be explored further. If his technology can be put into practical use, every bulb can be used something like a *Wi-Fi* hotspot to transmit wireless data and we will proceed toward the cleaner, greener, safer and brighter future. The concept of *Li-Fi* is currently attracting a great deal of interest, not least because it may offer a genuine and very efficient alternative to radio-based wireless. As a growing number of people and their many devices access wireless internet, the airwaves are becoming increasingly clogged, making it more and more

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difficult to get a reliable, high-speed signal. This may solve issues such as the shortage of radio-frequency bandwidth and also allow internet where traditional radio based wireless isn‟t allowed such as aircraft or hospitals. The main shortcoming however is that it only work in direct line of sight.

VI. FUTURE SCOPE

By using *Li-Fi* we can have Energy saving Parallelism. With growing number of people and their many devices access wireless internet, on one way data transfer at high speed and at cheap cost. In future we can have LED array beside a motorway helping to light the road, displaying the latest traffic updates and transmitting internet information to wirelessly to passengers Laptops, Notebooks and Smart phones. This is the kind of extra ordinary, energy saving parallelism that is believed to deliver by this pioneering technology

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