Application of LI-FI Technology in the Transmission of Sound at the Base of PWM

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***Abstract*—**The rising regard of solid state lighting devices, Visible Light Communication (VLC) is worldwide acknowledged as an advanced and promising technology to realize short-range, high speed as well as large capacity wireless data transmission. In this method, propose a sample of real-time audio system using economical commercially available Light Emitting Diode (LED) lamps. Experimental results show that real-time high quality audio and can be achieved during proper layout of LED sources and improvement of concentration effects. Lighting model within room environment is designed and simulated which indicates close relationship between layout of light sources and delivery of luminance.

***Keywords*—**Focusing Lens; LI-FI Technology; Light Emitting Diode; Synchronized Audio Relay Model; Visible Light Communication.

***Abbreviations*—**Light Emitting Diode (LED); Light Fidelity (Li-Fi); Multiple Input Multiple-Output (MIMO); Pulse-Width Modulation (PWM); Radio Frequency (RF); Visible Light Communication (VLC).

I. INTRODUCTION

IN 2004 by Toshihiki Komine and has progressed quickly ever since with the growth of solid state light sources, particularly Light Emitting Diodes (LEDs).The great popularity of VLC owes largely to the advantages of LED such as high brightness, low cost, small size, low power consumption, long lifetime and low heat radiation. VLC explores the free-for-all visible light portion of the electromagnetic spectrum and acts as an addition rather than substitute of established RF systems. With matching strengths of both technologies, excess capability demands of RF channels can be off-loaded to VLC networks, which enable users to seamlessly access to the Internet while keeping high Qos levels and avoiding network congestions and delays. The concept of a full duplex multi-access system for LED-based wireless communications is proposed by Nakagawa laboratories. Simplex and duplex transceiver prototypes have been demonstrated in which also prove the effectiveness of replacing existing illumination systems with LED lighting devices. With 300 THz of bandwidth available for VLC, multi gigabit per second data rates could be provided over short distances, for example, using array of LEDs in a Multiple Input Multiple-Output (MIMO) system. Moreover wireless connectivity in home environment, combining the function of illumination and transmission is also attractive in specific scenarios where healthy, secured and non-interfered communication is necessary, such as hospital, underground mine, under-water, air planes etc [Jeffrey G. Andrews et al., 1].

Jamal Elmhamdi, Wireless communication is the need of the hour, so there is a huge desire for improvement of the means of communication. Motivated by the threatening crisis of Radio Frequency (RF) spectrum, light fidelity (Li-Fi) which is a technology attached to the Visible Light Communications (VLC) offers many key advantages and effective solutions to the problems posed in the last decade. Through this technology, data is transmitted by light thanks to the unique properties of white Light Emitting Diode (LED) lamps switching. In this article, we created a scheme of transmission at the base of the Pulse-Width Modulation (PWM). The information that we are going to transmit in our case is an audio signal generated by a mobile phone. We create a saw tooth signal that we compare with our audio signal in order to create a PWM signal. Then this modulated signal will be transmitted by LED in the form of a light signal that the photodiode (PD) detects and transforms it into an electrical signal. Finally, we demodulate the signal obtained

by a simple first-order low-pass filter RC to receive the demodulated in the speakers and therefore the maximum frequency of the transmission is 87 KHZ [Wei Guo et al., 2].

Akassh A. Mishra and Neelesh S. Salian, Wireless communication is the need of the hour. In the present fast paced life, there is a strong urgency for the improvement in the means of communication. A Wireless network using Visible Light Communication (VLC) is a newly rising trend that can easily pave the way for a comfortable wire-free future. The usage of light as a source of communication is an inventive and not-yet commercialized technology. Such a technology is useful to picture a smarter personal wireless network, underwater communication and also in applications that provide mobile services. This paper aims to explain the concept of VLC through its application to provide Wireless Internet. It elaborates the use of Low Power Light Emitting Diodes (LEDs) for transmission and reception along with the current and future prospects of this technology. It also deals with the technical terms for constructing such a network for real-time purposes [Jungnickel et al., 3].

Vikash, Li-Fi is using visible light instead of radio waves for communication. This new wireless technology can save a large amount of electricity by transmitting data through the light bulbs. In an age where we face a challenge of data jamming in the free air medium, where we struggle hard to press in all the data in the allocated spectrum. Something we generally use every day, there is not any area where we do not use light. With this rising technology we can use all the light around us that we produce to transmit data. Let us consider the amount of need that we have in the present world on the use of cell phones or laptops or the internet it is a need of the present world that we check alternate ways to transmit all this enormous amount of data we generally use. By flickering the light from a single LED, any change a human eye can detect, they can transmit far more data than a cellular tower using SIM OFDM technique-- and do it in a way that's more competent, secure and common. In this paper we are going to compare the existing Wi-Fi technology and newly adopted Li-fi wireless technology [Kim & Lee, 4].

II. PROPOSED WORK

The non-linearity of the LED is reduced. The proposed system can be used in situations where a household has many appliances with audio output. Good audible quality PCM streaming. Installation cost and environmental hazards are less in proposed system.

Advantages

- Audio, video, internet, text are easily transmitted over wireless medium.
- Cost effective measures.
- The band can be easily broken
- Wireless communication sees no physical obstacle
- Portable device.
- High speed of transmission.

III. SYSTEM MODEL

3.1. Transmitter

3.1.1. Li-Fi Transmitter

The transmitter circuit consists of a PCB that controls the electrical inputs and outputs of the LED and houses the microcontroller used to manage different LED functions. The PCB consists of an opto-isolator and an open-collector hex inverter and some other components. The transmitter is powered by a 9V battery. The circuit uses an opto-isolator to couple a standard RS-232 signal from a computer to the driver section of the circuit. The resistor/diode construction at the input to the opto -isolator converts the voltage difference of a RS-232 signal into a signal appropriate for the LED in the opto-isolator [Rahaim et al., 5].

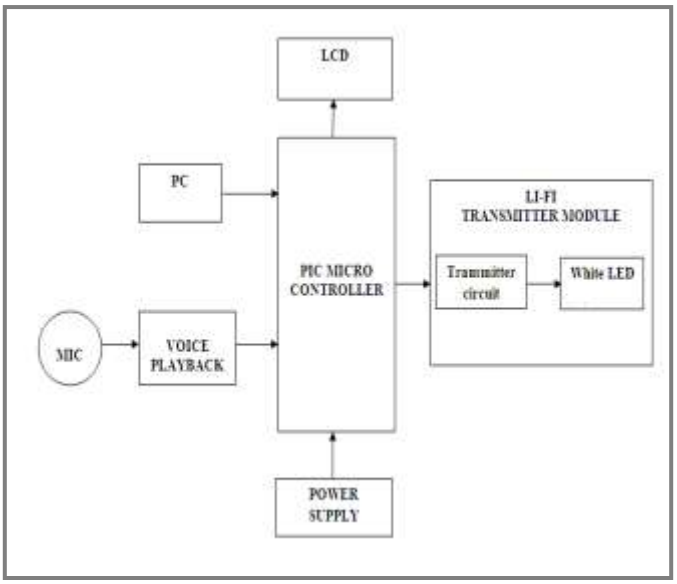

Figure 1: Li-Fi Transmitter

3.2. Receiver

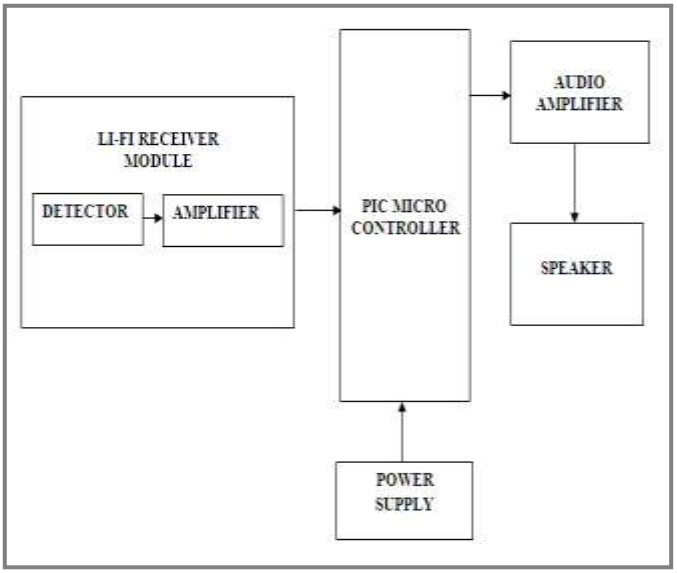

Figure 2: Receiver

3.2.1. Li-Fi Receiver

The receiving antenna is an NPN photo-transistor. Although the light wavelength is in the visible field (~670nm) the photo-transistor's broad response band (550nm to 1050nm) is wide enough to sense the powerful light beam. The signal from the photo-transistor is buffered via a pair of Schmitt trigger buffers to clean up and square the signal. The output of the second buffer is then directly converted to a RS-232 standard signal [Wu et al., 6].

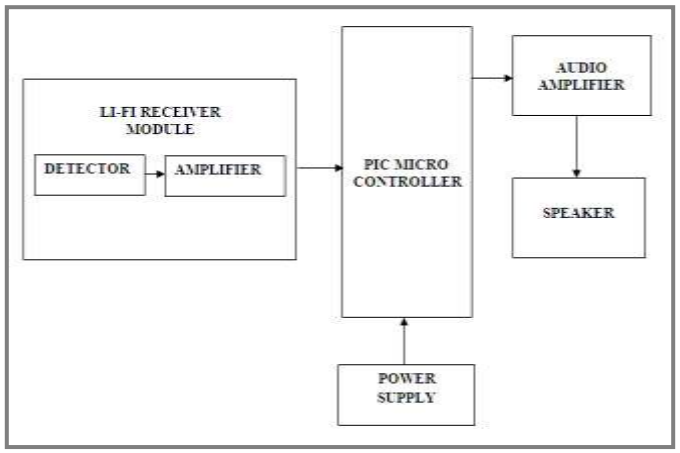

Figure 3: Li-Fi Receiver

3.2.2. Modulation Techniques in Li-Fi

Since LI-FI uses visible light for sending data, it necessary to modulate the data into a signal which can be transmitted. These signals consist of light pulses. Some of the common modulation techniques used in LI-FI are discussed below:

OFDM: Orthogonal frequency division multiplexing (OFDM) is a method of encoding digital data on multiple carrier frequencies. OFDM is a frequency-division multiplexing (FDM) scheme used as a digital multi-carrier modulation method. A large number of closely spaced orthogonal sub-carrier signals are used to carry data on several parallel data streams or channels. Each sub-carrier is modulated with a predictable modulation scheme (such as quadrature amplitude modulation or phase shift keying) at a low symbol rate, maintaining total data rates comparable to conventional single-carrier modulation schemes in the same bandwidth [Li et al., 7].

OOK: On-off keying (OOK) denotes the simplest form of amplitude-shift keying (ASK) modulation that represents digital data as the presence or absence of a carrier wave. In its simplest form, the presence of a carrier for a specific duration represents a binary one, while its absence for the same duration represents a binary zero. Some more complicated schemes vary these durations to convey additional information. It is similar to unipolar encoding line code. It is very easy to generate and decode but is not very best in terms of illumination control and data throughput.

PWM: Pulse-width modulation (PWM) is a technique used to instruct a message into a pulsing signal. Even though this modulation technique can be used to encode information for transmission, its main use is to permit the control of the power supplied to electrical devices, especially to inertial masses such as motors

IV. Implementation and Results

The Li-Fi system projected in this paper is competent of transmitting data such as wording, audio between two devices at the speed of a few kbps. The main condition is line of sight between the sender and the receiver and hence it can be used to transmit data within a room [Wonhyung Lee et al., 8].

Figure 4: Li-Fi Transmitter and Receiver Circuits

V. Conclusion and Future Scope

In this paper, proposed a synchronized audio relay model using profitable LED lamps. System design is illustrated are presented. It is shown that transmission of high value audio with the space of 5 m can be achieved and improvements can be made by adding focusing lens between the transmitter and the receiver.

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