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Implementation of increasing packet delivery ratio using lifi technology

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Abstract-The fast growth in gadgets usage and application developments has prompted many researchers to look beyond Wi-Fi. The possibility of using visible light for short range communication is explored by many researchers [1]. An intuitive acronym Li-Fi is used by many in contemporary literature to describe this concept. Light reaches almost all over the place, so communication can be done through light easily. By utilizing visible light as a transmission means, Li-Fi provides wireless indoor communication. Since the switching speed of Light Emitting Diode is less than 1 µs, they can be turned on and off rapidly, so human eye cannot identify any flickering, thus the light source seems to be persistent. This imperceptible on-off action permits information transmission utilizing binary codes. Turning on LED is a binary '1', turning it off is a binary '0'. It is possible to get sequence of 1s and 0s by adjusting the LEDs flickering rate. A photo detector can be used to recover the original data. This method of wireless transmission of information using rapid pulses of light is cited as Visible Light Communication. Its ability to challenge conventional Wi-Fi has roused the interest in Li-Fi. A study to analyze the performance of visible light communication system in optical wireless communication has been made and achieved a data rate of 10 kbps over 40 cm distances.

1. INTRODUCTION

Internet video traffic is growing at compounded annual growth rate of 48%. As a result, aggressive spatial reuse and co-channel interference of RF spectrum is increased, which became a major capacity limiting factor, leading to RF spectrum shortage. Also, there are many other issues regarding electromagnetic spectrum such as capacity, security, availability, efficiency etc. To fix these problems, any of the following solution can be used.

- Identify a new spectrum or bands
- Enhance spectrum reuse (smaller cells) or
- All the above jointly.

Visible Light Communication (VLC) is the transmission of information using light source whose intensity is changed quicker than the human eye can notice. The fast and cheap wireless communication system, labelled by theterm Li-Fi, is referred to as the optical equivalent of Wi-Fi. Digital data is represented by state of the LEDs.

If it is on, a digital '1' is transmitted and on the other hand if it is off, transmit a '0' [2]. Encoding the information in the light to give distinctive sequences of 1s and 0s is feasible. LEDs can be modulated rapidly. So the human eye cannot identify flickering, making the light source to be seemingly persistent.

VLC information rate can be increased by more sophisticated methods. Instead of radio waves to transmit information, VLC uses light pulses for the data transfer. Also, rather than utilizing Wi-Fi routers, VLC would utilize LED lights fitted transceivers that can illuminate a room as well as transfer information[3].

The number of access points can be many as simple light sources are used. This technology utilizes a band of the electromagnetic spectrum, the visible spectrum, which is still not greatly utilized.

Additionally there is 10,000 times more transmission bandwidth accessible in this range and

it also multiplies to 10,000 times more accessibility as we count the sources in use [4].

2. RELATED WORKS

Table 1 details the some recent efforts by various groups in attaining greater speeds using VLC. Paper [7] uses OOK modulation and shows high data rate under desired illumination and blue filtering at the receiver.

OFDM modulation has been used in paper [8] which results in 2.1 Gbps data rate. But the range is small even though there is controlled illumination at the receiver.

In this paper, we have achieved a high data rate of 10 kbps even under normal day light condition.

Considering the fact that the illuminance at the receiver is the most relevant design parameter for transmission performance. Also, the range is increased to 40 cm.

2. Illustrations l

Reference	Distance	Modulation	Comment	Data rate
[7]	23 cm	OOK	Desired illumination, Blue filtering	280 Mb/s
[8]	10 cm	OFDM	Controlled illumination at the receiver	2.1 Gb/s
This paper	40 cm	OOK	Normal day light, No filtering mechanism .	10 kb/s

The prototype shown in Fig.1 is used to study the performance of the visible light communication system.The set up consists of transmitting and receiving sections. The experiments were carried out using two PCs with a 2.30 GHz Intel Core i3 CPU and 2 GB of memory. Algorithms were implemented using MATLAB 8.1 (R2013a).

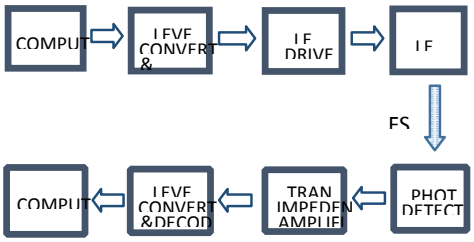

Fig.1. Block diagram of a VLC system

3.1.Transmitter

The transmitter consists of a computer from which data will be transmitted. Data can be a character or a text file or image stored on the computer. In this work, RS 232 ports are used to transmit the data from the computer. RS 232 ports can be programmed using MATLAB environment and will be used to transmit the data serially. The LED used is a white LED, emitting wavelength in visible spectrum. The modulation technique used is on-off keying (OOK) [5] [6].

3.2.Receiver

Photo detectors are used for detecting the white light, which contains the transmitted data. Photo diodes are used as detectors.

The detected signal is then amplified using transimpedance amplifier. Decoding the received data is done at the receiver computer using MATLAB programme. The RX pin of the Serial to USB Converter transmits data to the PC [6].

4. Experiment and Results

A noise free 32 × 32 image of 1 KB was transmitted. The experiments were carried out in a 3m × 3m × 3m room under normal day light condition. The transmitted image is shown in Fig. 2. The obtained images at various distances are shown in Table. 2.

Fig.2.Transmitted image

Image quality measures

The quality of received images was analysed to quantify the effect of channel variation on data transmission. An image signal whose quality is being assessed can be considered as a total of a non-distorted reference signal and distorted signal. Different image quality measures such as PSNR, MSE and BER were used in this analysis.

4.1.Mean square error and PSNR

A general assumption is that the loss of perceptual quality and visibility of the error signal are directly related. Mean squared error (MSE) is the simplest implementation of this idea, which objectively measures the quality of the lapse signal. MSE measures fidelity of the signal. The objective of a signal fidelity measure is to analyse two signals by giving a quantitative score that depicts the level of similarity/fidelity or, conversely, the level of error/distortion between them. I is the error-free m× n monochrome image and K is the erroneous image.

Peak Signal-to-Noise Ratio (PSNR), is the ratio of maximum possible power of a signal to the power of distorting noise that affects the fidelity of its representation. Since many signals have a very wide dynamic range, logarithmic decibel scale is usually used to express PSNR.

4.2.BER

The number of bit errors per unit time is measured using Bit Error rate (BER). BER is the ratio between number of bits in error to the total number of transferred bits over the studied time period. BER is a unit less quantity, often expressed as a percentage.

Coding and modulation techniques are related to the BER performance. The simple and power efficient On-Off Keying (OOK) is adopted in this prototype. It is a binary level modulation scheme consisting of two symbols. Considering ones and zeros are equally likely, the BER can be determined as the values of various image quality measure calculated for different outputs are listed in Table 2.

Received image PSNR(dB) MSE BER

Fig. 3 Plot of BER versus distance

Fig. 3 indicates the plot of BER versus distance. It denoted that a proportional increase in BER with increasing distance. This is due to the interference of light waves with the ambient light and multipath distortions at the receiver.

The transmitter and receiver aperture area and propogation delay also play a major role in distorting the signal. The illuminance at the receiver is the most relevant design parameter for transmission performance.

5. CONCLUSION

The performance analysis of visible light communication in free space communication link is done and it is performed in varying distances. Under normal day light and without any filtering mechanism we have achieved high data rate of 10 kbps for distances up to 40 cm. The conceivable outcomes are numerous and can be investigated further. VLC can be utilized as dual function as light and data connectivity. Thus for future short range applications, VLC present a reasonable and promising area. However, reliable communication methods for free space optical systems are needed to further expand the field of bi-directional as well as multipoint communication. The field of free space optical communication systems is a largely unexplored topic of research and offer promising advantages over current methods of high speed data communication. When this technology is implemented practically, each Wi-Fi router can be replaced by light sources. This guarantees a cleaner, more secure and brighter future. This may help to overcome issues such as bandwidth shortage of radio spectrum furthermore permit web

where existing radio based wireless connectivity is limited, for example, airplane or hospitals.

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