Image and Video Transmission using LED

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ABSTRACT
The main objective of this project is to transmit the data using LED (Light Emitting Diode). With the increasing popularity of solid state lighting devices, Visible Light Communication (VLC) is globally recognized as an advanced and promising technology to realize short-range, high speed and large capacity wireless data transmission. In this report, a prototype of real-time audio and video broadcast system using inexpensive commercially available light emitting diode (LED) lamps is proposed. Experimental results show that real-time audio and video with the maximum distance of 2ft can be achieved through proper layout of LED sources and improvement of concentration effects. The design and construction of the LI-FI (Light Fidelity) light source enable efficiency, long stable life, as well as full spectrum intensity that is digitally controlled and easy to use.

General Terms
Visible Light Communication, Image and Video Transmission.

Keywords
VLC, LED, OOK, OFDM, MIMO, Phototransistor.

1. INTRODUCTION

In the 21st century, high speed data transmission is playing an important role in our daily life. Multimedia information is visualised to be available at any place and at anytime [1]. Wireless access networks constitute a key element to attain these goals. However, radio frequency bandwidth at frequency ranges which allow reasonable spatial coverage is a limiting factor. Thus, alternative wireless transmission means have to be explored [2].

Short range communication systems characterize a wide range of scenarios, technology and requirements [4]. White LEDs are currently penetrating many areas of our everyday life. They are visualised to replace high energy consuming light bulbs in private and business homes and even in street lamps. Furthermore, they can be used in headlights of planes and trains, for front and back lights in cars and trains, and for object illustration in museums, etc.

The next sections include literature survey about all the papers then methodology describing the experimental setup and finally conclusion based on literature review.

2. LITERATURE REVIEW

The data transmission using LED is a bidirectional, high speed and fully networked wireless communications, like Wi-Fi, using visible light. The following sections talk about the literature that was used and reviewed for realizing the research work.

2.1 Basics of Visible Light Communication

The visible light communication is an emerging domain where visible light is used as a medium of data transmission. The basic and background information of visible light communication is introduced by Shinichiro Haruyama in [1]. This article talks about application of VLC along with its properties. VLC is new way of wireless communication. Visible-light LEDs are used as transmitter and photodiodes as receiver. Properties of VLC communication are as follows: distance using VLC is between 1-100m, the distance is small as compared to radio wave communication and it is basically line-of-sight communication. Major concentration is been given on applications like: location based services using photodiode as receiver and location based services using image sensor as receiver. It also mentions properties of VLC, major discussion on location based application which can be included in future scope for our project and advantages and disadvantages of VLC. Dinesh Khandal*et al.* explains the advantages of visible light The visible light communication is an emerging domain where visible light is used as a medium of data transmission. The basic and background information of visible light communication is introduced by Shinichiro Haruyama in [1]. This article talks about application of VLC along with its properties. VLC is new way of wireless communication. Visible-light LEDs are used as transmitter and photodiodes as receiver. Properties of VLC communication are as follows: distance using VLC is between 1-100m, the distance is small as compared to radio wave communication and it is basically line-of-sight communication. Major concentration is been given on applications like: location based services using photodiode as receiver and location based services using image sensor as receiver. It also mentions properties of VLC, major discussion on location based application which can be included in future scope for our project and advantages and disadvantages of VLC. Dinesh Khandalet al. demonstrates the advantages of visible light communication where the article [2] talks about features of Light Fidelity. It also states that every light bulb can be converted into Li-Fi signal receptor to transfer data and we could proceed toward the cleaner, safer, greener and brighter future. As we know that the airways are getting inhibited day by day, Li-Fi can offer a genuine and very efficient alternative. Li-Fi is enabled by advanced digital transmission technologies. Optical cell networks based on Li-Fi are the link between future energy efficient illumination and cellular communications. They can also exploit unregulated, unused and vast amount of electromagnetic spectrum and can even enable ever smaller cells without the need for new infrastructure. The visible light communication

basic block diagram is explained by Ying jie He et al. in [3]. It mentions VLC prototype design with large increase in transmission distance and improvement in channel capacity. The MATLAB program is used to simulate the illuminance distribution for two practical light source deployments. VLC system descriptions are explained with general block diagram for data transmission using LED. Experimental result is presented and analyzed. Transmission on high quality video/audio images with the distance of 3 m can be achieved and improvements can be made by adding focusing lens between transmitter and receiver.

2.2 Orthogonal Frequency Division Multiplexing (OFDM)

There are various modulation techniques available. H. Elgala *et al.* mentions in article [5] that OFDM is a multiplexing technique. Therefore, in this article OFDM is considered in combination with modulation schemes.

2.3 Multiple Input Multiple Output (MIMO)

Thomas Q. Wang et al. in article [9] talks about imaging MIMO optical wireless system which uses a hemispherical lens in the receiver setup. The channel gain and power density of the new system are derived. It shows that the system provides a wide FOV and significant spatial diversity at the same time. Results are also presented for a number of typical indoor optical wireless scenarios. Consequently, significant diversity order and wide FOV can be provided by the imaging receiver which can be used for high data rate communications. Yang Hong et al. have described in article [10] about the investigated BER and SNR performances of proposed pre-coding MIMO indoor VLC system for decentralized multi-user. The multi-user obstruction is eliminated in transmitter by BD pre-coding algorithm. Under this scheme, the power consumption and complexity of user terminals are reduced. A method to enhance the system performance by utilizing different FOV is analyzed.

2.4 Modulation techniques

Table 1: Comparison of modulation technique [5][6][7].

Modulation	QPSK	OOK	OOK
BER	10^{-3}	$2x10^{-5}$	10^{-6}
Distance	1m	90cm	1.75m
Luminous Intensity	5600mcd	11000mcd	-
Photodiode	$9.8mm^2$	$9.8mm^2$	$9.8mm^2$

It is shown that for OOK modulation a BER of 2×10^{-5} was achieved at a distance of about 90cm with only a single LED. Harald Haas *et al*. in article [6] mention an overview about the technology and describe the physical layer implementation of a VLC system based on a modified version of the classical OFDM modulation technique.

Preliminary measurements showed promising optimistic with 9 LEDs producing illuminance of about 5 times below that required for work spaces.

Mostafa Z. Afgani *et al.* in article [7] talks about wireless communication using white, high brightness LEDs. In particular, the use of OFDM for intensity modulation is investigated. The prototype system has managed a distance close to one meter with an impressive bit error rate of 10^{-3} under the moderate ambient light conditions found indoors.

3. METHODOLOGY AND EXPERIMENTAL SETUP

Methodology section explains the flow of the project. In this section the experimental setup and methodology is described with the help of flow chart. The proposed system will have description of transmission of data using LED. The data will be in the form of image and video.

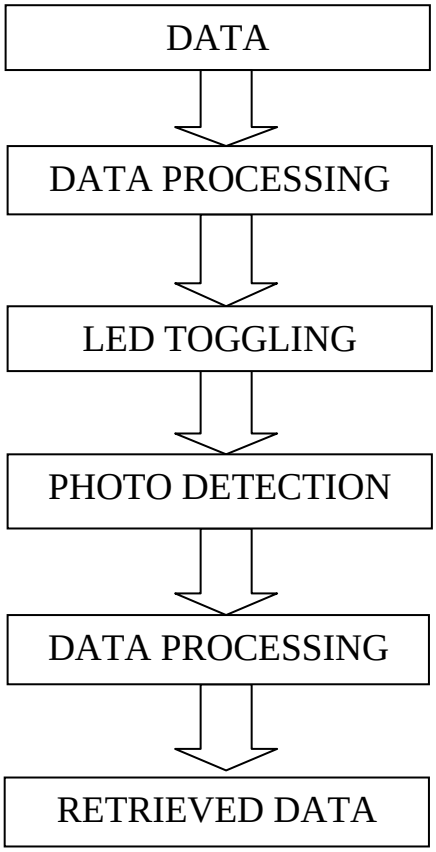

Figure1: Flowchart

The data i.e. Image/text or video is given as an input to the sender PC consisting of MATLAB (software) reserved for image processing of the input image. Image processing is done in the sender PC, the output of which is processed by the microcontroller connected to PC via a serial port using USB to TTL.

Depending upon the output of microcontroller the led's connected to one of its port gets toggled. At the receiver side photo-detection takes place using photo-diode placed at the receiver end. Then the microcontroller at the receiver side conducts the binary conversion of the input data taken from photo-diode output. This data is received by the receiver PC connected to microcontroller via serial port processed the data

in order to reconstruct the send image at the receiver side by using the MATLAB (software).

4. CONCLUSION

It has been shown that even though most existing efforts are still in a very early stage, VLC is a optimistic technology with a wide held of prospective applications. An ever rising interest in VLC throughout the world can be expected to lead to real-world applications in the future. In some fields of usage it poses a favorable alternative to conventional solutions (infrared, WLAN). The transmission is based on the assumptions of direct LOS (line-of-sight) channels and simplex channel conditions. The encoding and decoding could be used in the transmitter part and receiver part to reduce the error in transmission. In extension, the data transmission rate could be enhanced by using fast switching LED. The driving velocity of the circuit could also be enhanced if fast switching transistors were used. The tests were carried out under moderate indoor ambient light conditions. It is envisaged larger coverage can be obtained by using LED arrays. Finally, the wireless communication technology could be embedded into the visible light source which is the ultimate goal of the project.

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