

VISIBLE LIGHT COMMUNICATION

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Abstract—With the invention of LED (Light Emitting Diode), the idea of using light as a communication medium has started again. VLC uses white Light Emitting Diodes (LED), which send data by flashing light at speeds undetectable to the human eye. One major advantage of VLC is that we can use the infrastructure around us without having to make any changes to it. LEDs' ability to transfer information signals over light (light which is between 400THz to 800THz of frequency and whose wavelength is between 400nm to 700nm) makes it a very good communication medium. Now the light we use in our daily life can not only be used for providing light but also for communication.

Upon detailed investigation of VLC research, it was found that not a lot of research has been done to develop this technology for commercial use. But because research into VLC is relatively new, the possibilities are wide open. A lot of research is being done to make this technology available for commercial use in various fields, including Internet access and vehicle-to-road communication using traffic signal lights. From our review of the literature, it became evident that work should be done to look into the possibility of designing a new model that could fit the present infrastructure for indoor applications.

Keywords—VLC (Visible Light Communication), LED (light emitting diode), OOK (On Off Keying), FSO (Free Space Optical).

I. INTRODUCTION

The idea of using light as a communication medium was implemented by Alexander Graham Bell in 1880 with his invention of the photo phone, a device that transmitted a voice signal on a beam of light. Bell focused sunlight with a mirror and then talked into a mechanism that vibrated the mirror. The vibrating beam was picked up by the detector at the receiving end and decoded back into the voice signal, the same procedure as the phone did with electrical signals. But Bell could not generate a useful carrier frequency, nor was he able to transmit the light beam from point to point. Obstacles in nature such as fog and rain which could interfere with the photo phone made Bell stop any future research into his invention. With the invention of LED (Light Emitting Diode), the idea of using light as a communication medium has started again. VLC uses white Light Emitting Diodes (LED), which send data by flashing light at speeds undetectable to the human eye. One major advantage of VLC is that we can use the infrastructure around us without having to make any changes to it. LEDs' ability to transfer information signals over light (light which is between 400THz to 800THz of frequency and whose wavelength is between 400nm to 700nm) makes it a very good communication medium. Now

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Fig. 1. VLC Technology

II. LITERATURE REVIEW

Nowadays, a lot of researchers are working on the development of light-emitting diode (LED) lighting system. The LED lighting system can achieve lower power consumption and has a longer life-time compared to the fluorescent lamp system. In this project, the characteristic of short transient time in turning the light on/off processes was further investigated. A high-speed wireless communication system, which is embedded in our LED lighting system, was built. The duplex communication system consists of both downlink and uplink media through different frequencies of lights. Several experiments were conducted in the visible light communication system. In this communication system, off-the-self components were taken part in building the driver circuit and the performance of the system was evaluated, such as, data transmission rate, data transmission distance and the field of view of the transmitter.

A. H. Elgala [2]:

In this paper, he gives differences between Radio and Visible Light Communication and declares that Optical Wireless Communications has had a long history. Wide spread deployment of solid state lighting (SSL) using LEDs is helping to drive this technology in the form of Visible Light Communication (VLC). Data from an experimental systems shows that data density's of 0.41 bits/second/Hz/m² is being achieved from a VLC implementation.

B. W.O. Popoola, S. Rajbhandari, M. Amiri, S. Hashemi [3]:

In this paper, they have been proposed a number of modulation techniques and thoroughly analyzed in literature

for optical wireless communication systems. Each modulation technique has its unique attractive features as well as its challenges. Some are very simple to implement and bandwidth efficient like the On-Off keying (OOK). Pulse interval modulation (PIM) techniques are reputed for their inherent synchronization pulse, subcarrier modulation offers increased throughput, resilience to the inter-symbol interference (ISI) and immunity against the fluorescent-light noise near DC, while pulse position modulation (PPM) provides the unparalleled power efficiency in line of sight (LOS) links but the performance degrades severely in dispersed communication channel. There has been an enormous work on the analysis of these and many more modulation techniques under different channel and environmental conditions, we however present here a concise synopsis of the mostly reported wireless infrared modulation techniques.

C. HU Guo-yong^{†1}, CHEN Chang-ying^{1,2}, CHEN Zhen-qiang¹ [4]:

In this paper, they conclude the possibility of visible red light laser being used as signal light source for Free-Space Optical (FSO) communication is proposed. Based on analysis of transmission in atmospheric channel concerning 650 nm laser beams, performance of wireless laser communication link utilizing a low power red laser diode was evaluated. The proposed system can achieve a maximum range of 300 m at data rate 100 Mb/s theoretically. An experimental short-range link at data rate 10 Mb/s covering 300 m has been implemented in our university. It is feasible to enhance the system performance such as link range and data rate by increasing transmitting power and decreasing laser beam divergence angle or through other approaches.

D. Akash, A. Mishra and Neelesh, S. Salian [5] :

In this paper, they give the idea of using internet using Visible Light Communication and also said that 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 emerging trend that can easily pave the way for a comfortable wire-free future. Such a technology is useful to envision 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 specifications for constructing such a network for real-time purposes. In this experiment, we found that visible light was indeed an excellent medium to transmit data. Since we used the low cost LED as our source, we barely had incurred much expenditure to obtain the hardware components.

III. USB PROTOCOL

The USB protocol is completely different from RS-232 protocol. For using any device attached to the computer USB interface, the device has to be recognized by the computer so that it grants permission to a COM port usage for the device to process. Granting permission needs a USB ID. USB ID also called as device descriptor, is an identification or an access permission for any device to start its operation with a computer [42]. The ID is recognized through the connection, and the computer recognizes the device then it allows the devices to operate with it. UM232R is such a device it has a USB ID and can be used with any computer USB ports.

IV. BLOCK DIAGRAM

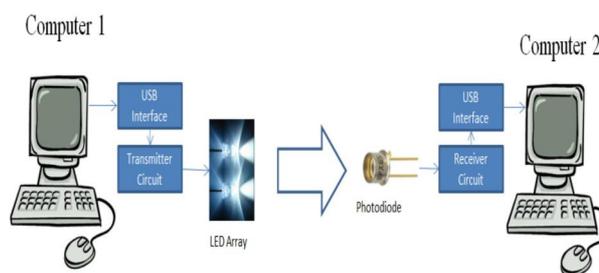


Fig. 2. Design of Prototype with USB Interface

V. AVENUE OF APPROACH

In future, LEDs are expected to replace all the incandescent and fluorescent lights. VLC technology focuses on utilizing the LEDs not only for lighting, but also for communication. Many models have been proposed using LEDs as communications means in various applications, for example, traffic lights for signalling [8], accessing the Internet in a room [7] and underwater communication using remotely operated vehicles (ROVs) [9]. Based on the literature review, several methods were considered for utilizing VLC technology when deciding how to proceed with the thesis. This thesis work concentrates on using LEDs for indoor usage. If all the lights in our houses and offices are replaced by LEDs, free space optical communications can then be achieved. Wireless optical communication between computers has been proposed for indoor applications. The proposed model is easy to implement, just like plug-in devices that require no additional hardware.

VI. CONCLUSION

This technology has a bright scope in future. This technology demonstrated a solution to the problem of integrating Visible Light Communication technology with present infrastructure, without having to make major changes to that infrastructure. Visible Light Communication is a rapidly growing segment of the field of communication. There are many advantages to using VLC. There are also many challenges. VLC will be able to solve many of the problems people have been facing for many years, mainly environmental and power usage issues.

VLC is still in its beginning stages, but improvements are being made rapidly, and soon this technology will be able to be used in our daily lives. In spite of the research problems it is our belief that the VLC system will become one of the most promising technologies for the future generation in optical wireless communication.

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