Multiple input and multiple output ofdm for visible light communication

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Abstract. VLC is an important strategy that gives wireless communication by utilizing an optical source. It is the corresponding method to Radio Frequency communication since it has more extensive data transmission. In this paper, VLC utilizes MIMOOFDM. In MIMOOFDM, countless subcarriers are utilized to convey the information, at that point the required precoding strategy is utilized to wipe out the impedance. Data communication can be accomplished by utilizing LEDs that send information to the receiver side.

Keywords— Visible Light Communication(VLC), Multiple Input Multiple Output Orthogonal Frequency Division Multiplexing(MIMOOFDM), Microcontroller.

1. Introduction

VLC may be a data communication variety that uses obvious light between 400 – 800 THz. This innovation utilizes LEDs for moving information. LEDs are utilized at the transmitter section and the Li-Fi sensor is utilized at the beneficiary side. Li-Fi, as well as Wi-Fi, is very like both communicate information as electromagnetic signals. In any case, Wi-Fi can use the radio waves and Li-Fi runs on obvious light. Thusly the VLC gets the light signals and a component to change over the information into a streamable substance. A LED is a semiconductor diode that is used to convert the electrical energy into the light energy and it is used to move the information. Information is taken care of into a LED light, it at that point sends information at quick speeds to the photograph identifier (photodiode). LEDs are used as an eco-friendly light resource that is used in many types of instruments, electronic circuits, and consumer products. LEDs can be used in the process of signaling and illumination. These can be used because of their small size, long life, low cost, and high energy savings over other light resources. Beside it is an initiative and Energy-Effective System.

2. Related work

Numerous papers that use the MIMOOFDM for VLC. B. Li et al, 2015 [1], explained that LEDs are used for illumination and are invoked to support wireless services which produce multiuser interference. Hence, transceiver design is proposed to eliminate multiuser interference. T. Fath and H. Haas, 2013 [2], provides significant spectrum relief for the crowded radio frequency spectrum used by the older wireless communication systems in indoor areas. The strategy utilized in Z. Yu et al, 2013 [3], is the precoding procedure were utilized in Multiuser MISO in transmitter plan in indoor obvious light correspondence to wipe out obstruction. S. D. Dissanayake and J. Armstrong, 2013 [4], differentiate the ACO-OFDM and DCO-OFDM. In ACO-OFDM, the sent sign can be made as a positive, and cutting the first bipolar OFDM signal to zero and sending just the positive sign of signals. In DCO-OFDM, a DC bias can be added to the signal to get it as positive. Azhar et al, 2013
[5], designed and invented a highspeed MIMOOFDM VLC transmission system that can be operated at gigabit per second rate that uses the imaging receiver. M. Jiang and L.Hanzo, 2007 [6], featured the impediments of regular recognition and channel measuring procedures intended for multiple user MIMOOFDM frameworks in the line of inadequate situations. J. Zhang et al, 2004 [7], embraced between transporter impedance scrape out plan in the OFDM framework. Wu et al, 2014 [8], Mention the ideas about the most advanced research area in VLC. It can be used for the development of the 5G framework in the future. L. Zeng et al, 2009 [9], utilized the white light-emitting diode as a source that can be regularly used for the data transmission. G L Stuber, 2004 [10], investigated different physical layer research difficulties in MIMO-OFDM framework configuration, including physical channel estimations and displaying simple beamforming procedures. Q. H. Spencer et al, 2004 [11], depicted two classes in arrangements. The essential uses a sign taking care of approaches with various kinds of transmitter confirmations. The ensuing uses "dirty-paper" coding to solving the impedance a customer sees for the signals expected to various forms of clients. That we close by illustrating future regions of examination in multiple client MIMO interchanges. J. Armstrong and A. J. Lowery, 2006 [12], have found that clipped OFDM can be obtained from the bipolar OFDM by equates the negative things to zero. J. Grubor et al, 2007 [13], give the ideal similarity pre-balance configuration is additionally carried out at the LED Transmitter section and no blue channel is utilized at the Receiver section for expanding the balance data transfer capacity from 1 MHz to 30 MHz. Y. Zheng and M. Zhang, 2010 [14], merging can be done in USB 2.0 port on one board, can accomplish into 2 Mbps bit rates error-free.

3. Proposed method

Wireless modules are used to transmit the data which is very low in baud rates when compared to the Light fidelity technology. It also results in data loss which is very inconvenient and lacks reliability. Hence we need a system that is faster in data transmission and should be reliable about non-data loss. This system has very much higher baud rates when compared to the existing system. This system also used the Light-Fidelity concept to implement faster data transmission. When the user sends the data to the receiver, the receiver receives the data and displays it in the LCD at higher speeds. This system can send the data without any loss of packets. The communication system for the transfer of data consists of two sections. Li-Fi is the new technology and it is used with pic microcontroller and embedded c programming.

3.1 Transmitter unit
3.2 Receiver unit.

3.1. Transmitter section:

In the transmitter area, data is applied to a microcontroller from the source using the clock pulse. RS232 cable is used for sending the information to the microcontroller with the source. ADC is used to convert the analog into digital data and the same can be transferred to the microcontroller. From the microcontroller, the data can be fed to the LEDs. Here, USART is made at the transmitter. The most used data format is 8 bits. The USART is sent and receive the lower significant byte and is functionally independent. The transmitter section is illustrated in fig.1
3.1.1. PIC Microcontroller:

PIC Microcontroller is an electronic programmable device that can be utilized to do various purposes. PIC is a microcontroller which likewise comprises of Ram, Rom, CPU, clocks, counter, simple to advanced converters, computerized to the simple converter. PIC Microcontroller utilizes the blaze innovation with the goal that it can ready to identify the information in any event, when the force is turned off. They are solid and failing of the pic is less. Furthermore, execution is quick a result of utilizing RISC design. Power consumption is additionally very less when put next to other microcontrollers. Interfacing is incredibly easy, also it's possible to attach analog devices directly with none extra circuitry and use them. Programming is additionally very easy in comparison to other microcontrollers.

3.1.2. Crystal Oscillator:

An oscillator may be a device that converts the mechanical resonance energy into the electrical energy to produce an exact frequency. This frequency is utilized to produce the stabilized and constant clock signals for the digital integrated circuits, receiver, and transmitter. An electronic oscillator converts the electrical signal into an electrical signal. Crystal oscillators have four pins, power, ground, and signal. The fourth pin could be a dummy or a frequency adjust pin. it's necessary to ground it and supply power, usually, they're designed to use either 3.3VDC or 5VDC power supply to form the output oscillator. The clock signal decides the operating speed level of the microcontroller.

3.1.3. Li-Fi Transmitter:

Li-fi transmitter consists of LEDs that will transmit the info from one device to a different. The transmit section consists of the information input which is then fed into a switching system. supported the info, the switching control generates a stream of 1’s and 0’s. The output of this control is given to the LEDs which activate and OFF at high speeds. Relays are attached to the transmitter part. Relays are electronically operating the switch. The microcontroller is employed to investigate the intensity of sunshine and to get a bearing signal which successively ON or OFF.

3.2. Receiver Section:

The receiver unit having the Li-Fi sensor for receiving the data. And it demodulates the original data from the coded binary information data. The send the information as photons. The receiver consists of the photodiode as a photosensor and it detects the light. The photodetector converts the light into electrical data. The data is processed by the pic microcontroller and it transfers the data through the RS-232 interface to the host computer. The Functional diagram of the Li-Fi receiver is shown in fig.2.

![Fig.2 Block Diagram of Receiver](image-url)
The Li-Fi sensor captures the light from the transmitter and generates the binary data bitstreams. The photodiode accepts photons and generates an electrical current which flows in the external circuits. Based on the presence of light intensities it produces the output and it will be applied to the microcontroller for further computations.

The software used to implement Li-Fi transmitter and receivers are given below:

3.2.1 MikroC PRO TOOL (For the programming purpose)
3.2.2 PROTEUS TOOL (For implementation purpose).

3.2.1. MikroC PRO tool:

The mikroC PRO tool can be used as a powerful PIC microcontroller development. It will be used to give the simplest possible solution for application development of an embedded system without compromising its performance. The PIC can be used with C programming for the development of embedded applications. With mikroC PRO and PIC gives the features of ANSI compiler, Advanced integrated development environment, and a large set of hardware libraries.

3.2.2. Proteus tool:

Proteus is software is used for the printed circuit board (PCB) designing, simulation of the PCB, and schematic capture. It is developed by the Lab center. Proteus is the technological software is used for creating the guidelines for decision support for the execution of software programs.

4. Result and Discussion

The Hardware demonstration of the pic16f877a microcontroller is connected with a led spotlight which forms the transmitter section. Then the receiver side Li-Fi sensor is used which is connected to the laptop in which the program is embedded. Then the data signal is detected by the Li-Fi sensor and it is communicated to the transmitter side in the form of a test and it gets displayed in the LCD. Fig.3 shows that the data is transmitted in the form of text which is displayed in LCD.

![Fig.3 Simulation results for displaying ‘a’](image)

5. Conclusion

Data Communication through VLC consists of LEDs that transmit the data signals to the receiver side. Since the light is a directional one this technology can be used for the directional applications. And the use of VLC with MIMOOFDM several users can be accommodated in the wide spectrum. And the use of precoding techniques interference across the users can be minimized. Besides, Li-fi Technology is a highly efficient and green energy-efficient, eco-friendly technology at a low cost. Further, it does not have any harmful radiations like the radio frequency spectrum.
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