



DATA TRANSMISSION USING MULTIPLE TRANSCEIVER IN INDOOR OPTICAL WIRELESS COMMUNICATION

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Abstract- Optical communication is a data communication medium, uses the light spectrum between 390nm-700nm. LEDs are used for data transmission along with illumination purpose in optical communication. LEDs can easily switch ON and OFF with logical '1' & '0' and data can be sent serially. Because of the restriction of Radio Frequency (RF) in some places like hospitals, airplane, petrol stations etc. optical communication can be used as an alternative solution for those. Optical communication reduces the complexity of wired and RF links between two or more nodes.

The main aim of this project is to design and analyse the optical wireless data transfer between two or more nodes by using optical transceiver that contain LED and phototransistor.

Index Term- Light emitting diode, phototransistor, optical communication.

1. INTRODUCTION

Optical wireless communication is a form of optical communication in which unguided visible, infrared or visible light is used to carry the signal. Optical wireless communication system operating in the visible band(390-750nm) and infrared band are commonly referred to as optical communication. Optical communication systems takes advantage of light emitting diodes(LED) which can be pulsed at very high speeds without noticeable effect on the lighting output and human eye. Optical communication can be possibly used in wide range of application including wireless local area networks, wireless personal area network and vehicular networks among others. Data transfer between two or more nodes are generally transferred by using wires or RF frequency. Since RF spectrum becomes more and more crowded like

Wi-Fi and Bluetooth there is a need for new communication technologies that are not using RF. Instead of radio frequency we can use visible light for indoor communication purpose. In optical communication we use light emitting diode (LED) for data transfer.

Some advantages over the radio frequency counterpart, such as high bandwidth density, license-free spectrum, security, cost-effectiveness, low energy consumption and dual use (i.e. they simultaneously allow for both data communication and illumination). LED is having a special characteristic, LEDs can easily switch ON and OFF with logical '1' & '0' and data can be sent serially. This technology is still in its infant stage, the usefulness of this Light Fidelity (Li-Fi) technology has implications for a great amount of good. Optical communication takes place by modulating

the intensity of the LED light in such a way that it is undetectable to the human eyes. A photo sensitive detector which demodulates the light energy into electrical signal.

2. SYSTEM MODEL

In our model, optical spectrum are used to transfer data between two or more nodes. The transmission between two nodes are bidirectional(Full Duplex).each nodes contains a multiple optical transceiver that can able to transmit and receive data from any direction. This feature enables a nodes to be mobile during transmission.

In our model, the data from nodes (PC) are taken from Ethernet port by using RJ45 cable, these data are given to the UART port of the microcontroller, but the connection between UART port and Ethernet cable is impossible because the output and input voltage for a PC is 5V for microcontroller it is 3.3V. So there is a need of a FT231X that synchronize a speed between PC and UART input port.

The data from the UART output port is directly connected to multiple transceiver circuit. In each node there will be a two more transceiver circuit so that the node can able to receive or transmit data from any direction. Since each node has a multidirectional transceiver antenna that minimize the line of sight (LOS) problem.

BLOCK DIAGRAM:

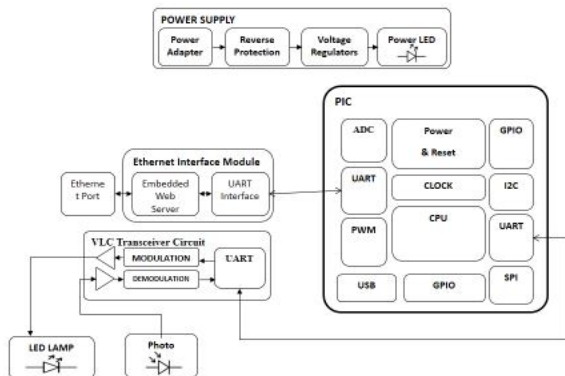


Figure.2.1 Block Diagram Of Proposed Model

Figure.2.1 represents the single optical transceiver that is connected to a PC. The number of transceiver per node (PC) is increased by increasing LED and phototransistor numbers. Microcontroller is used to provide a UART interface between a PC and transceiver.

3. OPTICAL ANTENNA DESIGN

The optical antenna consists of a optical transceiver that transceivers are placed at different angles so that the transceiver can able to transmit and receive data from any direction. In this project, we proposed a optical transceiver circuit that contain both LED transmitter and phototransistor receiver. Since LED have relatively high divergence angle and phototransistors have a comparable angular field of view, the LED and phototransistor pair forms a transceiver cone. The data that has to be transmit is amplified by the transistor and then transmit. The amplifier circuit is shown below.,

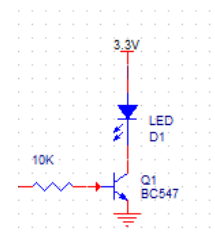


Figure.3.1 LED Transmitter

When light is emitting from an LED it disperses conically. And at any cross section of this cone the power of the emitted light can be calculated as :

$$SA_R / (SA_T + (\theta R)^2)$$

Where SA_R is the surface area of the receiver, SA_T is the surface area of the transceiver is the divergence angle, and R is the range in meters.

The data from the UART port is given to the base of the transistor, LED is connected in series with collector of the transistor. The LED blinks according to the data signal applied at the base of the transistor. Now the data is transmitted to another node through LED in light spectrum. The channel between the two nodes is free space, so the coverage of LED depends on the light intensity in the room. As the range increases the loss due to geometrical spreading increases, and we simply subtract this loss off from our average power. The loss of power due to atmospheric attenuation is described by Beer's law:

Where (R) is the transmittance at the range R , $P(R)$ is the power at R , $P(0)$ is the power at source, and is the attenuation or total extinction coefficient. The attenuation coefficient is given by:

$$= (3.91 / V) (/ 550nm)^{-q}$$

where V is visibility in kilometers, is the wavelength in nanometers, and q is the size distribution of any scattering particles. Since our experiments are for indoor scenarios the attenuation coefficients are negligible. The receiver consists of a phototransistor which converts the light energy in to electrical signal.

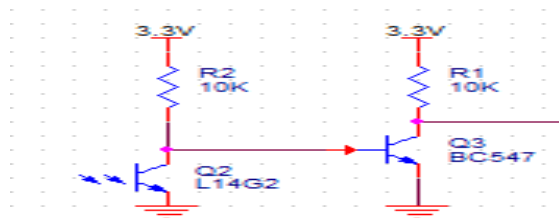


Figure.3.2 Receiver

The optical signal is allow to fall on the base of the phototransistor. The electrical signal at the collector of the phototransistor is amplified by the transistor. The amplified output at the collector of the transistor is given to UART port of the receiving node.



Figure.4.3 Transceiver Circuit

Figure.4.3 shows the single transceiver circuit in which LED and phototransistor are mounted to transmit and receive data .

4. RESULT AND DESCRIPTION

Data is successfully transmitted between two or more nodes by using optical transceivers as shown in Fig. 4.1. The range of coverage of LED is 0.6 meter in normal light intensity in a room is achieved.



Figure:4.1 Experimental Setup

[5] M. Bilgi, A. Sevincer, M. Yuksel, and N. Pala, Optical Wireless Localisation , ACM/ Springer.

5.CONCLUSION

This paper gives an idea of how we can use optical spectrum as a medium of the transmission of information. The design of the system includes optical transmitter and optical receiver. These optical transceivers avoids the complexity of the wired and RF links between the nodes. Since there are multiple transceiver, each node has capacity to transmit and receive data from any direction. With dense packaging of hundreds of transceivers on these node structures it will be possible to establish several simultaneous on going data transmissions with each neighbor separately.

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