Wireless Data Communication Using Li-Fi Technology

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***Abstract** : Future electric lights willbecomprised of visible LEDS (light emitting diode).Visible led'swithhigh power output are expected to serve in the nextgeneration of lamps. An indoor visible data transmission system utilizing visible led lights isproposed. In the system, thesedevices are used not only for illuminatingrooms but also for an opticalwireless communication system. This system issuitable for private networks such as consumer communication networks. Howeveritremainsnecessary to investigate the properties of visible led'swhenthey are used as opticaltransmitters. Based on numerical analyses and computer simulations itcanbeused for indoor optical transmission. Infrared light isalreadyused for communication, such as wirelessremote control, IrDA(InsuranceRegulator and DevelopmentAuthority), Infraredwireless LAN, and infrared inter-building communication. However, visible light LEDs are beginning to beused in every home and office, whichmakes visible light LEDsideal for ubiquitous data transmitter.*
***Keywords** : LED, Visible Light Communication, Li-Fi, Infrared, Optical Transmitters,IrDA*

I.   Introduction

We have designed a prototype LIFI system to transfer data as well as Files. Our idea is to send data and file as serial data using UART serial communication from one PC to another PC using VLC. So we have used the visible light communication at the transmitting end and also for reception we are using photodiodes at the receiving PC.Presently, wireless communication uses radio waves. The demand for voice and mainly high end data services like VOIP, video calling, instant messaging by the users is rapidly increasing as the consumer needs better and efficient ways of transferring data which are large and often need a high level of encryption. The existing Radio Spectrum fails to cater this burgeoning need and faces various other issues like scalability and availability. It's time to

Explore the potential of other available spectrums, a new medium which can best serve our needs. An indoor visible data transmission system utilizing LED lights is proposed. This system of communication using Li-Fi can be used in critical environments, such as aircrafts or hospitals, where radio frequency (RF) based transmissions are usually prohibited or refrained to avoid interference with critical systems. Moreover, a huge amount of unregulated bandwidth is available at infra-red and visible light frequencies. Visible spectrum covers wavelength from 380nm to 750nm. This system rapidly and subtly fluctuates the intensity of LEDs to create a binary code (on=1, off=0) in a way that is imperceptible to the human eye. The light then hits a sensitive photo sensor that decodes the data. This technology is known as visible light communication (VLC).[1]

II.   Working Principle Of Li-Fi

This technology is based on the Visible Light Communication which uses the visible light for data communication. In VLC, we use a source of illumination which can not only produce illumination but also send information using the same light. So we can say that VLC is illumination along with communication.

Now imagine a torch which we might use to send some sort of a signal, maybe morse code. We can do so manually by switching the torch ON and OFF repeatedly. But in this case, we may not be able to use the torch as an efficient source of illumination, so we cannot strictly consider it as VLC as per our definition. Now suppose we switch the torch ON and OFF very quickly using a computer system. In this case, due to the rapidity of the motion of switching between ON and OFF states, the torch appears to be ON constantly, and additionally, we also cannot "see" the data being transmitted. We would, of course, need a receiver.

Literally, any form of information that can be sent using a light signal that is visible to humans could be considered to be VLC, but by our definition we should be able to see the light, but cannot "see" the data. So although there seems to be no universally agreed definition of VLC, we can at least agree what we mean by VLC. The sending of the data in the above mentioned manner has been made possible by the widespread use of the LED bulbs. These bulbs can be switched ON and OFF very rapidly thus permitting us to send the required data via light. The rapid adoption of LED light bulbs has created a massive opportunity for VLC. The problem of congestion of the **radio** spectrum utilized by Wi-Fi and cellular radio systems is also helping to create the market for VLC [2].
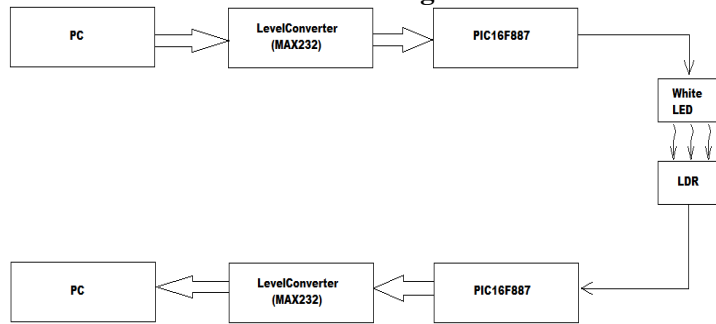
III. Block Diagram

Figure 1: BLOCKDIAGRAM

3.1 PC
The data is to be transmitted is an image, text or file. Data transfer is done using Putty suite 0.66 which is a free and open source terminal emulator,serial console and network file transfer application or terminal v1.9b which is a simple serial port(COM) terminal emulation program.It can be used for communication with different devices such as modems,routers,embeddeduCsystems,GSMphones,GPS modules.

3.2 Serial Port Max 232
MAX 232 is 16 pins IC, which converts signals from an RS232 serial port to signals suitable for use in TTL compatible digital logic circuits. At the receiver it again converts back the TTL logic levels back to serial signal levels

3.3 Microcontroller Pic16F877P
It receives the signals at TTL levels at various ports and converts this data to binary form. At the receiver, it again converts the binary data to decimal data.

3.3 LED'S
This acts as a light source which transmits the binary output of the microcontroller in the form of light intensity pattern which is then transmitted.

3.4 LDR
Photoresistor is a light controlled variable resistor.The resistance of a photoresistor decreases with increasing incident light intensity
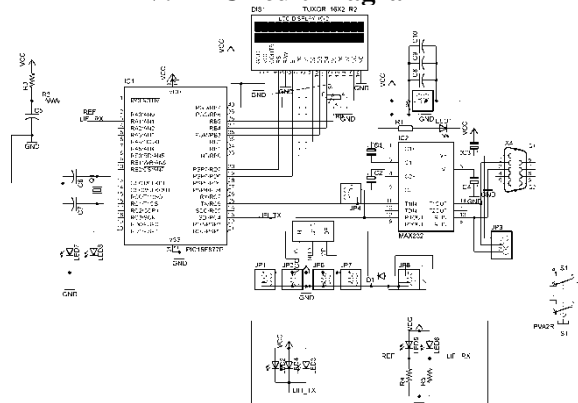
IV. Circuit Diagram

Figure 2: CIRCUITDIAGRAM

The hardware shown above shows the trans-receiver circuit. This circuit can act as a transmitter and a receiver at the same time, making it a half-duplex form of communication.
Port 3 act as a receiver port and port 23 as a transmitter port in above Pic16F877P. Analog signal is supported by port 3 i.e the receiver port.Digital Signal is supported by port 23i.e transmitter port.Port 3 and Port 23 doesnot works simultaneously. Pic16F877P is connected toMAX 232 via port 26 and port 25.

V.   Result
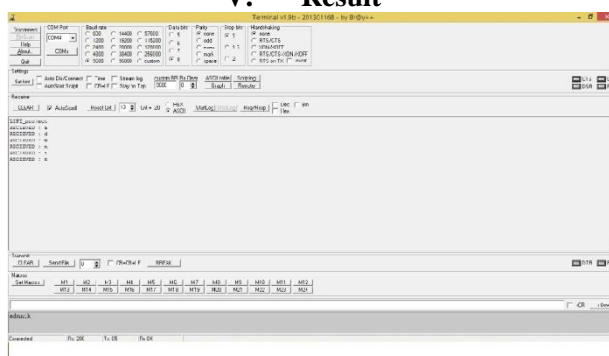
A text was transferred to the receiver terminal wirelessly by using light(LED) as the medium of transmission.

VI.   Features

6.1 It is a new source of data transmission (i.e.) VISIBLE LED LIGHTS.

6.2 Bandwidth is not limited.

6.3 It can produce data rates faster than 10 megabits per second, which is speedier than your average broadband connection.

6.4 Transmitters and receivers devices are cheap, and there is no need for expensive RF units.

6.5 As light waves do not penetrated opaque objects, they cannot be eavesdropped. It is very difficult for an intruder to (covertly) pick up the signal from outside the room. i.e. .There can be no theft of data. 6.6 Visible light radiations are undoubtedly free of any health concerns. Therefore, these systems will receive acceptance for use in hospitals, private homes, etc. Furthermore, no interference with RF based systems exists, so that the use in airplanes is uncritical.

6.7 Visible LEDs can offer very high brightness, very low power consumptions and long lifetime. They can serve two purposes at the same time: lighting and high speed wireless data transmission.

6.8 Visible light communication could be used in conjunction with Power line communication (PLC). 6.9VLC is a natural broadcast medium; it is sometimes desired to send information back to the transmitter.

6.10 VLC can be used as a communications medium for ubiquitous computing, because light-producing devices (such as indoor/outdoor lamps, TVs, traffic signs, commercial displays, car headlights/taillights) are used everywhere.

VII.   Advantages

7.1 Li-Fi technology is based on LEDs or other light source for the transfer of data. The transfer of the data can be with the help of all kinds of light, no matter the part of the spectrum that they belong. That is, the light can belong to the invisible, ultraviolet or the visible part of the spectrum.[3]

7.2 Li- Fi uses light rather than radio frequency signals so are intolerant to disturbances.

7.3 VLC could be used safely in aircraft without affecting airlines signals.

 7.4 Integrated into medical devices and in hospitals as this technology doesn't deal with radio waves, so it can easily be used in all such places where Bluetooth, infrared, Wi-Fi and internet are broadly in use.

 7.5 Under water in sea Wi-Fi does not work at all but light can be used and hence undersea explorations are good to go now with much ease.

7.6 There are billions of bulbs worldwide which just need to be replaced with LED's to transmit data.

7.7 Security is a side benefit of using light for data transfer as it does not penetrate through walls.

7.8 On highways for traffic control applications like where Cars can have LED based headlights, LED based backlights, and they can communicate with each other and prevent accidents.

7.9 Using this Technology worldwide every street lamp would be a free data access point.

7.10 The issues of the shortage of radio frequency bandwidth may be sorted out by Li-Fi.[2]

VIII.   Scope And Challenges

Although there are a lot of advantages of LI-FI, there are still certain challenges which need to be overcome.

8.1 LI-FI requires Line of Sight.

8.2 If the apparatus is set up outdoors, it would need to deal with changing weather conditions.

8.3 If the apparatus is set up indoors, one would not be able to shift the receiver.

8.4 The problem of how the receiver will transmit back to the transmitter still persists. □ Light waves can easily be blocked and cannot penetrate thick walls like the radio waves can.

8.5 We become dependent on the light source for internet access. If the light source malfunctions, we lose access to the internet.

IX. Applications

9.1 It can be used in petroleum or chemical plants where other transmission or frequencies could be hazardous.

9.2 Can be used in the places where it is difficult to lay the optical fiber like hospitals.

9.3 Thistechnology could be used in conjunction with Power line Communication (PLC). The idea is that voltage changes in an electrical wire, which serves as PLC carrier, are reflected by the flickering of a light source.

9.4 Vehicle to Vehicle communication. A full-duplex vehicular system which was tested in large-scale experiments resulting in interesting endings such as how multipath effects can be advantageous. 9.5 On a larger scale, lasers can be used to transmit high rates of data between satellites in space or to dishes on the ground. Such systems can allow military or telecoms information to pass between two towers or from space to the earth.[1]

References

[1]. JiteshNagdev, DipeshSher, RohitNathani, GauravKalwani, "Wireless Data Transfer Using Light Fidelity,"International Journal of Science and Research (IJSR), India Online ISSN: 2319-7064,Volume 2 Issue 6, June 2013.

[2]. ShubhamChatterjee,ShalabhAgarwal,AsokeNath, "Scope and Challenges in Light Fidelity(LiFi) Technology in Wireless Data Communication ,"International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163,   Issue 6 Volume 2 ,June 2015.

[3]. R.Karthika, S.Balakrishnan, "Wireless Communication using Li-Fi Technology,"SSRG International Journal of Electronics and Communication Engineering (SSRG-IJECE) ,Volume 2 Issue 3, March 2015.

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