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SERIAL DATA TRANSMISSION AND DEVICE CONTROL USING LIGHT FIDELITY TECHNOLOGY

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ABSTRACT

The main objective of this paper is to transmit the serial data using visible light communication system. 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 paper, a prototype of real-time data transmission and control system using inexpensive commercially available light emitting diode (LED) lamps is proposed. Experimental results show that real time data with the maximum distance of 1m 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.

For communication and control we have design our own transmission and receiver module using AVR Microcontroller based on Transistor Transistor Logic signal working with a baud rate of 9600 and 1MHz of Clock Frequency. The software design for data transmission is based on VB.Net whereas Embedded C is used for Microcontroller (ATMega16) programming

KEYWORDS: AVR microcontroller, LiFi, ATMega16, Relays, L293D, Photodiode, VB.Net, Embedded C.

I. INTRODUCTION

Li-Fi is a label for wireless-communication systems using light as a carrier instead of traditional radio Frequencies [1], as in Wi-Fi. Li-Fi has the advantage of being able to be used in sensitive areas such as in Aircraft without causing interference. However, the light waves used cannot penetrate walls. It is typically implemented using white LED light bulbs at the Downlink transmitter. These devices are normally used for illumination only by applying a constant current. However, by fast and subtle variations of the current, the optical output can be made to vary at extremely high speeds. This very property of optical current is used in Li-Fi setup. The operational procedure is very simple-, if the LED is on, you transmit a digital 1, if it's off you transmit a 0. The LEDs can be switched on and off very quickly, which gives nice opportunities for transmitting data. Hence all that is required is some LEDs and a controller that code data into those LEDs. All one has to do is to vary the rate at which the LED's flicker [2] depending upon the data we want to encode. Further enhancements can be made in this method, like using an array of LEDs for parallel data transmission, or using mixtures of red, green and blue LEDs to alter the light's frequency with each frequency encoding a different data Channel. Such advancements promise a theoretical speed of 10 Gbps – meaning one can download a full high-definition film in just 30 seconds.

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S.NO.	BASIS OF COMPARISON	WIFI	LIFI
1.	Security	Not secured (can be hacked)	Secured (cannot be hacked)
2.	Data transmission rate	Slower (uses radio waves)	Much faster (uses visible light)
3.	Range	Small	Large
4.	Traffic control	Less (signal become weaker as traffic increases)	More (due to high speed & easy availability)
5.	Where can be used	Within a range of WLAN infrastructure , usually inside a building	Anywhere , where light source is present
6.	Cost	Costly	Cheap
7.	Working concept	various topologies	direct binary data serving

Fig: 1 Comparison between LiFi and WiFi

II. LITERATURE

Using a standard white-light LED, researchers at the Heinrich Hertz Institute in Berlin, Germany, have reached data rates of over 500 megabytes per second [1]. Li-Fi Consortium was formed in October2011 by a group of companies and industry groups to promote high-speed optical wireless systems and overcome the limited amount of radio based wireless spectrum. According to the Li-Fi Consortium, it is possible to achieve more than 10 Gbps of speed, theoretically which would allow a high-definition film to be downloaded in just 30 seconds [2]. Researchers at the University of Strathclyde in Scotland have begun the task of bringing High-speed, ubiquitous, Li-Fi technology to market WANG Jia-Yuan, ZOU Nian-Yu, WANG Dong, IRIEKentaro, IHA Zensei, NAMIHIRA Yoshinori .The Journal of China Universities of Posts and Telecommunications. In this paper, the illumination of the receiving surface for different distances between the LED and photodiode receiver was tested. It was found that with the increase in communication distance, the sillumination sharply reduced [3].

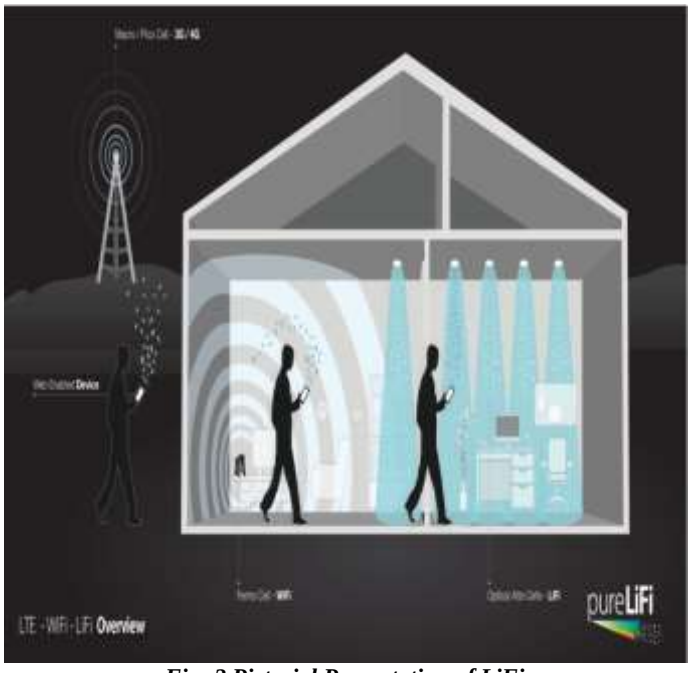

Fig: 2 Pictorial Presentation of LiFi

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III. OVERVIEWS

Li Fi is a new wireless communication technology which enables a wireless data transmission through LED light. Li Fi is based on a unique ability of solid state lighting systems to create a binary code of 1s and 0s with a LED flickering that is invisible for human eyes. Data can be received by electronic devices with photodiode within area of light visibility. This means that everywhere where LEDs are used, lighting bulbs can bring not only The light but wireless Connection at the same time. With increasing demand for wireless data, lack of radio spectrum and issues with hazardous electromagnetic pollution, LiFi appears as a new greener, healthier and cheaper alternative to WiFi. The term was first used in this context by Harald Haas in his TED [4] Global talk on Visible Light Communication. The technology was demonstrated at the 2012 Consumer Electronics Show in Las Vegas using a pair of Casio smart phones to exchange data using light of varying intensity given off from their screens, detectable at a distance of up to ten meters. In October 2011 a number of companies and industry groups formed the Li-Fi Consortium, to promote high-speed optical Wireless systems and to overcome the limited amount of radio based wireless spectrum available by exploiting a completely different part of the electromagnetic spectrum. The consortium believes it is possible to achieve more than 10 Gbps, theoretically allowing a high-definition film to be downloaded in 30 seconds. Li-Fi has the advantage of being able to be used in sensitive areas such as in aircraft without causing interference. However, the light waves used cannot penetrate walls.Later in 2012, Pure VLC, a firm set up to commercialize Li-Fi, will bring out Li-Fi products for firms installing LED-lighting systems. Moreover Li-Fi makes possible to have a wireless Internet in specific environments (hospitals, Airplanes etc.) where Wi-Fi is not allowed due to interferences or security considerations.

IV. BLOCK DIAGRAM

Justification and objective of carrying out the research work.

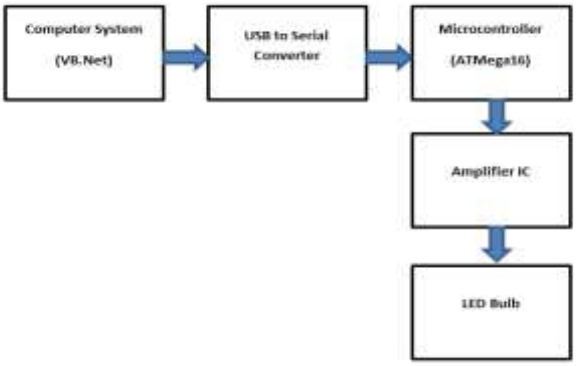

Fig. 3 Transmitter

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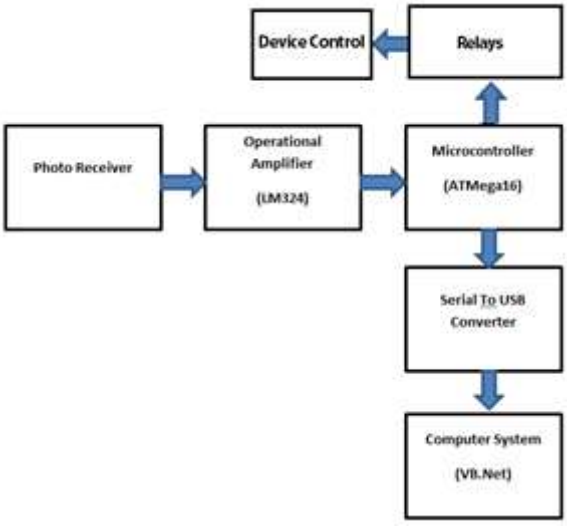

Fig. 4 Receiver

V. WORKING

It is clear from the Fig: 3 that the date in the form of character will be written in the application which will be serially transmit using USB to Serial converter to the microcontroller for further processing. The data will converted it into PWM signal by the microcontroller and send it to the LED driver for its amplification whereas LCD Connected with the Controller will display the status of the data transmission.

From the Fig.3 it is clear that the receiver end consisting of Photoreceiver, will detect the digital data and amplified into higher 5v TTL by the operational amplifier LM324 and will be sent to the microcontroller for data processing and Control of the device via USB to Serial converter to the computer user interface

VI. DEVICES USED

In the above model, we have used USB TO TTL converter, Photo Receiver , Microcontroller, Amplifier IC, LCD Screen, LED Bulb. Components Details are given below:

1) ATMega16 Micrcontroller
2) L293D (Driver IC)
3) Capacitors
4) USB to TTL Converter (FT232)
5) LM324 (Operational Amplifier)
6) Single Pole Electromechanical Relay
7) LCD (16x2)
8) Voltage Regulator (7805)
9) DC Battery
10) PCB

Microcontroller

The purpose of using AVR AT Mega microcontroller is its advantage of having inbuilt analog to digital converter (ADC) which are required to obtain feedback from the sensors.

The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock

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Fig:5 Microcontroller

VII. FUTURE SCOPE

- **Underwater communications:** Since radio waves cannot be used under water because these waves are strongly absorbed by sea water within feet of their transmission and this renders it unusable underwater but LIFI is suitable for underwater communication
- **Health sector:** Since WIFI is not safe to be used in hospitals and other various health care sectors because it penetrates human body. LIFI can be implemented and well suit in this sector.
- **Internet anywhere:** street lamps, light of vehicles can be used to access internet anywhere in footpaths, roads, malls, anywhere where light source is available
- .**Safety and management**: it can be used to update traffic information at almost every instant and it will be easy for traffic police to deal with traffic and catch the one who breaks the rule.

VIII. IDEAS AND APPLICATIONS

- **Underwater Applications** : the LEDs can be embedded in the water bed to reveal the various impurities underwater. The various leds will communicate with each other to give the overall amount of impurity in that particular area.
- **Instant data transfer** between the devices : the high speed transfer of the leds can be used to transfer the data between the devices.
- The disadvantage of the Lifi is uplink is difficult. So we can have the photodiodes embedded near to the people on the pillars for eg. Or we can have the same led behaving as a photodiode as well as an led.

IX. CONCLUSION

The possibilities are numerous and can be explored further. If his technology can be put into practical use, every bulb can be used something like a Wi-Fi hotspot to transmit wireless data and we will proceed toward the cleaner, greener, safer and brighter future. The concept of Li-Fi is currently attracting a great deal of interest, not least because it may offer a genuine and very efficient alternative to radio-based wireless. As a growing number of people and their many devices Access wireless internet, the airwaves are becoming increasingly clogged, making it more and more difficult to get a reliable, high-speed signal. This may solve issues such as the shortage of radio-frequency bandwidth and also allow internet where traditional radio based wireless isn't allowed such as aircraft or hospitals. One of the shortcomings however is that it only work in direct line of sight.

X. REFERENCES

[1] Hacking Exposed Linux: Linux Security Secrets & Solutions (third ed.). McGraw-Hill Osborne Media. 2008. p. 298. ISBN 978-0-07-226257-5. S.No. Parameters Wireless Technologies Light Fidelity Wireless Fidelity 1. Speed for data transfer Faster transfer speed (>1 Gbps) Data Transfer speed (150 Mbps) 2. Medium through which data transfers occurs Used Light as a carrier Used Radio spectrum 3. Network topology Point to point Point to point 4. Operating frequency Hundreds of Tera Hz 2.4 GHz 290

[2] Full-spectrum Fluorescent lighting: A review of its effects on physiology and health". Retrieved 2008-04-23.

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