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Lifi(Light fidelity)-Efficient use of visible spectrum

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ABSTRACT : *LEDs are beginning to be used in every home and office which makes LED's light ideal for ubiquitous data transmitter 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 is a new wireless communication technology which enables a wireless data transmission through LED light. LiFi appears as a new greener, healthier and cheaper alternative to WiFi. Li-Fi is the emerging area of technology is also known as Visible Light Commu-nications (VLC) .Moreover LiFi makes possible to have a wireless Internet in specific environments (hospitals, airplanes etc.) where WiFi is not allowed due to interferences or security considerations.*

KEYWORDS: *LED(light emitting diode), wi-fi, Li-Fi, VLC.*

I. INTRODUCTION

The objective of this project is to develop small portable system for data transfer in indoor unit. Wireless communication has become utility like water and electricity. For this wireless communication we use radio and micro wave which use particular part of electromagnetic spectrum. The radio waves are limited scarce expensive and we only have certain range of it. With the increasing number of users RF spectrum is clogged due to which the capacity of electromagnetic spectrum is affected. The base stations consume more power hence the total energy consumption of entire communication system is equivalent to air traffic which results reduction in efficiency of entire communication system. One germen physic. Harald Haas has come up with a solution he calls "data through illumination" –taking the fibber out of fiber optic by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. It's the same idea band behind infrared remote controls but far more powerful. Hass says "Very simply, if the LED is on, you transmit a digital 1, if it's off you transmit a 0 and They can be switched on and off very quickly, which gives nice opportunities for transmitted data.As LED has long life, small volume, low power consumption and low heat radiation, hence it is suitable for many application. White LED is expected to replace incandescent and fluorescent lights in the future and considered to be the next generation lighting source. It is possible to encode data in the light by varying the rate at which the LED's flicker on and off to give different strings of 1s and 0s.The LED intensity is modulated so rapidly that human eye cannot notice, so the output appears constant. This technology uses visible light spectrum as a medium for data transfer through LED. By comparing the visible light with radio waves capacity of visible light is 10000 times more than radio waves. Infra structure required for this technology is already existing only the incandescent and fluorescent bulbs has to be replaced with LED. Li-FI is faster, safer and cheaper than other forms of wireless internet, advocates say -- and so could eliminate the need for costly mobile-phone radio masts. Experiments have shown that LEDs can be electronically adapted to transmit data wirelessly as well as to provide light.

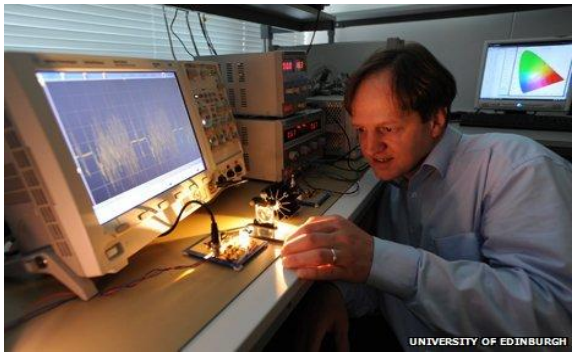

Figure1 . Harald Haas

II. WORKING OF LI-FI:

In order to know the working of Li-fi we need to know the necessity for Li-fi .With the vast development in living the use of gadgets and invention of new gadgets is increasing which lead to the technological developments. There are many situations in which people get frustrated with the dull performance signals of Wi-Fi at a place with many network connections in seminars conferences etc. Li fi fulfills these needs .this fantabulous idea first striked the mind of Harald Haas from University of Edinburgh, UK, in his TED Global talk on VLC. His idea was very simple that if the LED is "on" then the digital 1 can be transmitted and if the led is "off" then the digital 0 can be transmitted. Led's can be switched on and off very quick. For transmitting data this way all that we require is LED's and controller that code data into LED's.

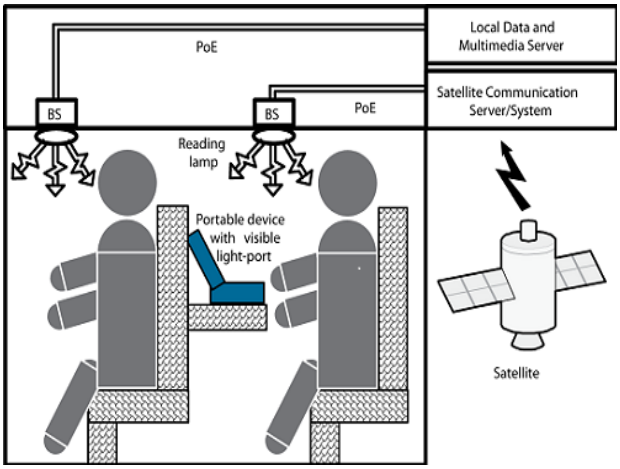

Figure2. Construction of li-fi technology

Parallel data transmission can be done by using array of LED's or by using red, green, blue LED's to alter light frequency with the frequency of different data channel. Advancements and enhancements in this field generate a speed of 10 gbps! But amazingly fast data rates and lowering band widths are not the only reasons that enhance this technology. Lifi usually is based on light and so it can be probably implemented in articrafts and hospitals that are prone to inference from radio waves. Unlike Wi-Fi Li-Fi can work even under-water which makes it more advantageous for military operations. Radio waves are replaced by light waves in data transmission called Li- Fi. Light emitting diodes can be switched on and off very much faster than the human eye allowing the light source to appear continuously. The data transmission is done through binary codes which involve switching on LED can be done by logic 1 and switch off using logic 0.The encoding of information in light can therefore be identified by varying the rate at which the LED's flicker on and off to give strings of 0's and 1's.visible light communication is this method of using rapid pulses of light to transmit information wirelessly.[1]

A. Visible Light Communication

VLC is a data communication Medium, which uses visible light between 400 THz (780 nm) and 800 THz (375 nm) as optical carrier for data transmission and illumination. Fast pulses are used for wireless transmission. Communication system components are:

1. A high brightness white LED which acts as a communication source
2. Silicon photo diode which shows good response to visible wavelength region.

LED illumination can be used as a communication source by modulating the LED light with the data signal. The LED light appears constant to the human eye due to the fast flickering rate. The high data rate can be achieved by using high speed LED's and appropriate multiplexing tech-niques. Each LED transmits at a different data rate which can be in-creased by parallel data transmission using LED arrays. Many different reasons exist for the usage of LED light in spite of fluorescent lamp, incandescent bulb etc which are available.[1]

B. System Architecture

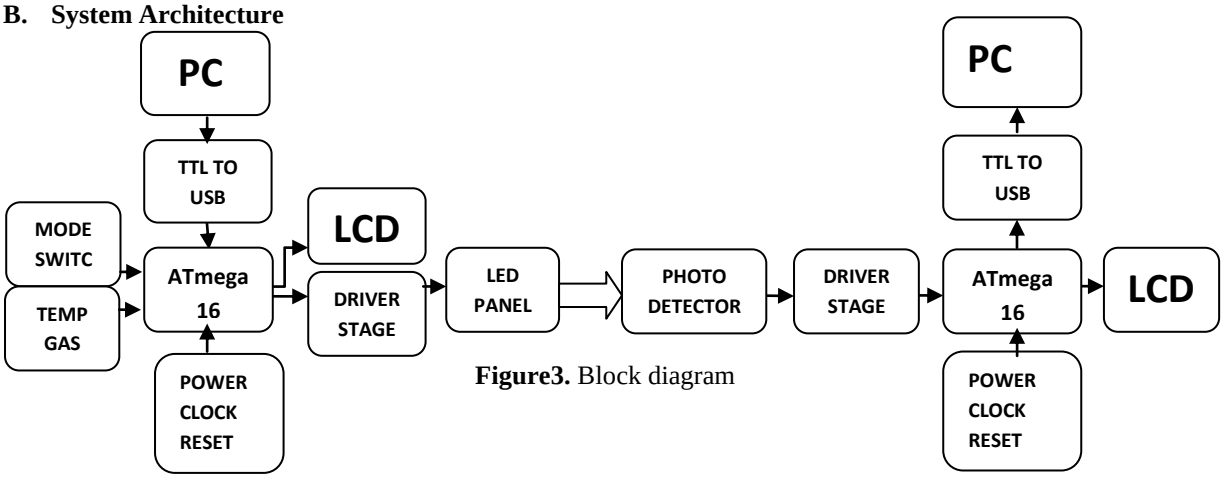

Figure3. Block diagram

The system is consist of transmitter section and receiver section. The data from transmitting personal computer PC is fed to Microcontroller unit through interface circuit. Microcontroller unit will code this input data into an eight bit binary code. This coded data is in form of string of input electrical signal. The pulse electrical signal drives LED source through LED driver circuit with which electrical to optical conversion is achieved. The heart of this technology is LED which flicker i.e. turns on and off at a rate so fast that an human eye cannot even detect. If we transmit "1", LED is "ON", if we transmit "0", LED is "OFF". The generated optical signal carrying original information is delivered to photodiode in receiving section. At receiving section the photodiode will detect optical signal and the optical to electrical conversion is achieved. The output data from receiver circuit will arrive at Microcontroller unit and be decoded into primary signal and then send to the personal computer PC receiver through interface circuit.

C. Experimental Circuit

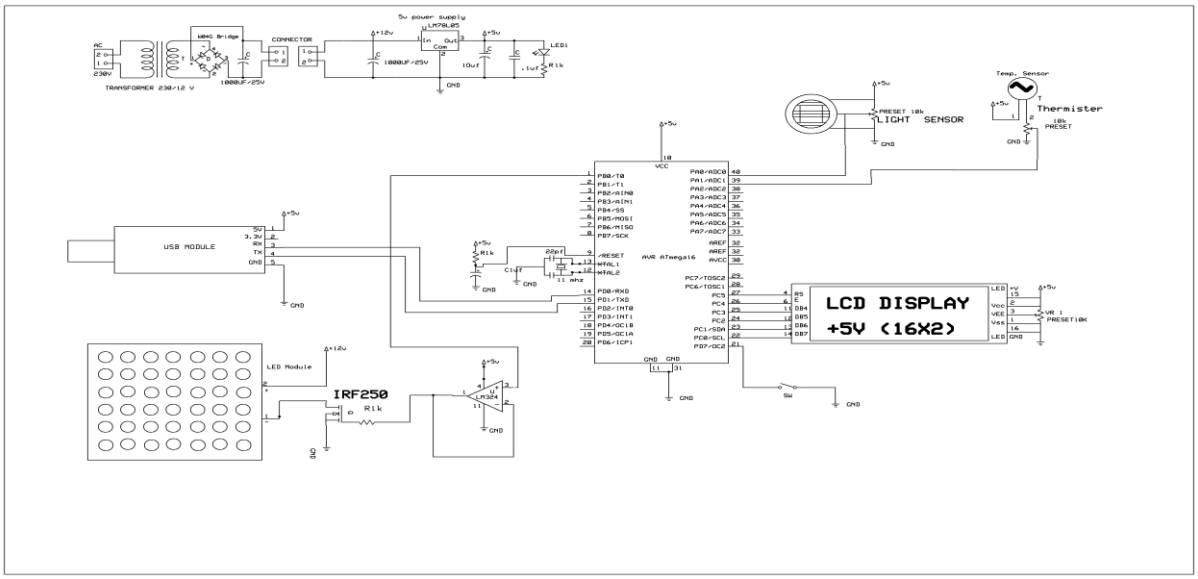

Figure4. Circuit diagram of transmitter section

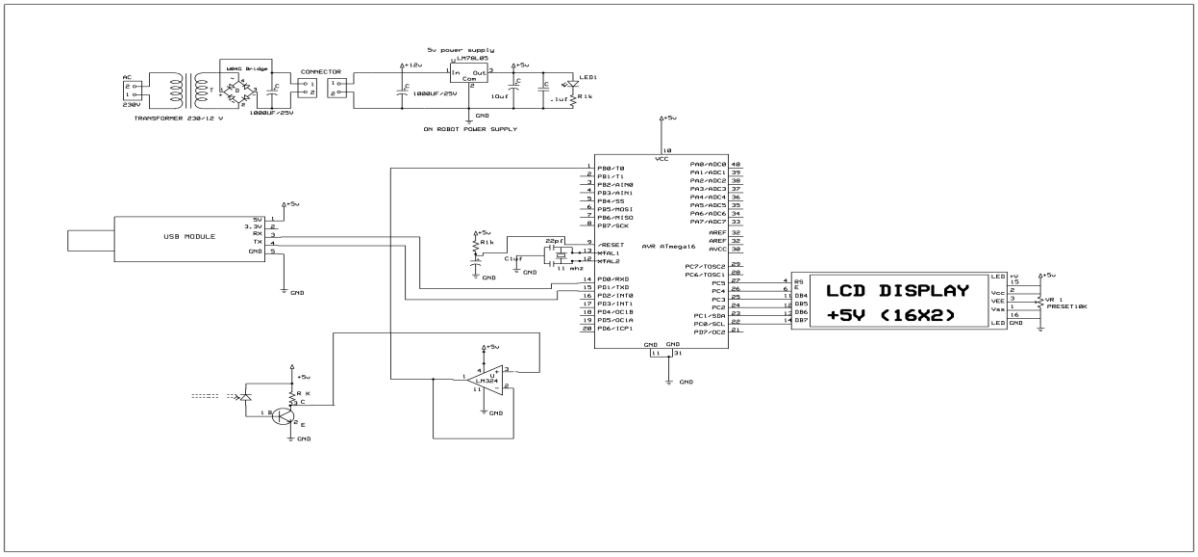

Figure5. Circuit diagram of receiver section

Experimental circuit is shown in figure. 2.2.1 and figure 2.2.2 Transmitting personal computer PC is connected to USB module PL23023. The receiving Rx and transmitting Tx pin of USB module PL23023 is connected to Port D i.e, PD.0/Rx and PD.1/Tx respectively of Microcontroller unit ATmega16. The Microcontroller unit ATmega16 will code the input data into eight bit binary code. This coded data is fed to driver stage which will drive the LED source. The driver stage consist of MOSFET IRFZ44 as it has high switching rate. The Port B i.e, PB.0 of Microcontroller unit ATmega16 is connected to gate terminal of the MOSFET IRFZ44 and drain terminal is connected to LED module. The LED module is provided with 12v constant supply. At receiving section photodiode will detect transmitted optical signal carrying original information which is fed to driver stage. The driver stage consist of BJT NPN BC549. Anode of photodiode is connected at the base of BJT NPN BC549 and cathode is connected to 5v dc biasing. The output of BJT NPN BC549 at collector is fed to Port B i.e, PB.0 of Microcontroller unit ATmega16. Microcontroller unit ATmega16 will decode the received data into original data and send to receiving personal computer PC through USB module PL23023.

III. APPLICATION:

1. Smart lighting: Any private or public lighting including street lamps can be used to provide Li-Fi hotspots and the same communications and sensor infrastructure can be used to monitor and control lighting and data.
2. Mobile Connectivity: Laptops, smart phones, tablets and other mobile devices can interconnect directly using Li-Fi. Short range links give very high data rates and also provides security.
3. Hazardous Environments: Li-Fi provides a safe alternative to electromagnetic interference from radio frequency communications in environments such as mines and petrochemical plants.
4. Hospital & Healthcare: Li-Fi emits no electromagnetic interference and so does not interfere with medical instruments, nor is it interfered with by MRI scanners.
5. Aviation: Li-Fi can be used to reduce weight and cabling and add flexibility to seating layouts in aircraft passenger cabins where LED lights are already deployed. In-flight entertainment (IFE) systems can also be supported and integrated with passengers' own mobile devices.
6. Underwater Communications: Due to strong signal absorption in water, RF use is impractical. Acoustic waves have extremely low bandwidth and disturb marine life. Li-Fi provides a solution for short-range communications.
7. Vehicles & Transportation: LED headlights and tail-lights are being introduced. Street lamps, signage and traffic signals are also moving to LED. This can be used for vehicle-to-vehicle and vehicle-to-roadside communications. This can be applied for road safety and traffic management.
8. Toys: Many toys incorporate LED lights and these can be used to enable extremely low-cost communication between interactive toys. [5]

IV. CONCLUSION

As there are issues regarding radio wave this technology proves to be a boom as it uses visible light for all good reasons mention above. Li-Fi is the upcoming and on growing technology acting as competent for various other developing and already invented technologies. Since light is the major source for transmission in this technology it is very advantageous and implementable in various fields that can't be done with the Wi-Fi and other technologies. Hence the future applications of the Li-Fi can be predicted and extended to different plat-forms like education fields, medical field, industrial areas and many other fields. And the results show that our system has a good performance that the communication distance can be get 5-6ft with bit rate up to115.607 kbit/s.

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