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# Li-Fi Technology: A Real Time Data Transmission Using Visible Light Communication

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**ABSTRACT:** Li-fi Technology is one of the Developing fields that improves the sharing of information between systems. Li-Fi innovation, proposed by the German physicist—Harald Haas, Researched about that transmission of information through illumination by sending information through a LED light. As LED light changes in frequency quicker than the human eye can see, it likewise have higher recurrence than Radio wave which brings about considerably higher speed than Wi-Fi. Driven builds the effectiveness, toughness and Data rate, along these lines enabling the development of Li-Fi frameworks and Visible Light Communication (VLC) framework. The Speed of about 10 Gbps can be accomplished by utilizing LED Bulbs as opposed to utilizing all conventional glowing knobs or smaller fluorescent gadgets. The extent of the Development is to utilize a LED Bulbs as a medium of information transmission and Communication in such a way that can be implemented in Home, office, Organization and Industries. These days, with the fast development of remote interchanges the issue of utilizing range effectively has turned out to be more imperative. Numerous arrangements have been proposed to fathom this issue; one of these arrangements is the use of noticeable light frequencies to send information. These frequencies are as of now free and unused. Light loyalty (Li-Fi) is another short range optical remote correspondence innovation which gives the availability inside a nearby system, by utilizing Light-Emitting Diodes (LEDs) to transmit information relying upon light brightening properties.

**KEYWORDS:** Bandwidth, Light-Fidelity (Li-Fi), Light Emitting Diode (LED), Wireless-Fidelity (Wi-Fi), Visible Light Communication (VLC). ,Transmission, Photo Detector.

### I. INTRODUCTION

In the data communication system there is a need of higher data rate and secure mean of accessibility. So to deal with this requirement the technology is exploring day by day to overcome the need of stream less communication. In this development the researchers have come with many technologies like Bluetooth, infrared, wireless fidelity and many more .This development leads *the German physicist—Harald Haas* to found new data transmission technique named as Li-Fi i.e Light Fidelity which uses the visible light as a medium for data transmission. As there is no side effects of using the visible light as data transmission medium, so visible light communication spectrum which has 10,000 times more space than Radio spectrum. As the light is part of our day to day life, light is easily available to us in our homes, streets, working area, etc. so it can be used efficiently both as a light source and as a data transmitting medium.

In order to overcome this problem in the future, Professor Harald Haas, an expert in optical wireless communications, proposes in 2011 a brilliant and applicable solution by using light to transmit data, he demonstrated how an Light-Emitting Diodes (LED) bulb equipped with signal processing technology could stream a high-definition video to a computer and he showed that one watt LED light bulb would be enough to provide net connectivity to four computers.



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This new technology is known as Light-Fidelity (Li-Fi). It is a short range wireless communication system based on light illumination from LED, and use the visible light as a signal carrier instead of traditional RF carrier as in Wi-Fi. Professor Harald Haas coined the term "Light-Fidelity" and set up a private company, called "Pure Visible Light Communication", to exploit that technology. He envisions a future where data for laptops and smart phones are transmitted through the light in a room in a secure way.

## II. OBJECTIVE

Objective of project is to transmit data using visible light as a medium for data transmission. In this the uprising technology Li-Fi, also known as Light Fidelity is to be implemented using the LED bulb or LED Panel as Data Transmitter and Photodiode as Receiver. In this researcher wants to transmit data on long range more than 2 to 3 meters using a LED panel which transmit data using light, and data is then received by a photo diode on receiving side. Using this data is to be transmitted data through multiple devices as the light used here is in form of Scattered Light and not a Unidirectional light sources. With this author is also trying to explore the research field in Li-Fi technology in data transmission using a microcontroller in Serial-communication. This project can be specially used for implementation at industries where continuous data transmission is used.

## III. LITERATURE REVIEW

Prof. Haas was an invited speaker at TED Global 2011, and his talk: "Wireless Data from Every Light Bulb" has been watched online more than 2.2 million times. He gave a second TED Global lecture in 2015 on the use of solar cells as LiFi data detectors and energy harvesters. This has been viewed online more than 1 million times. Professor Haas holds 31 patents and has more than 30 pending patent applications. He has published 300 conference and journal papers including a paper in Science. His co-authors a book entitled: "Principles of LED Light Communications towards Networked Li-Fi" published with Cambridge University Press in 2015. Prof. Haas is editor of IEEE Transactions on Communications and IEEE Journal of Light wave Technologies. He was co-recipient of recent best paper awards at the IEEE Vehicular Technology Conference (VTC-Fall) in Las Vegas in 2013, and VTC-Spring in Glasgow in 2015. He was co-recipient of the EURASIP Best Paper Award for the Journal on Wireless Communications and Networking in 2015, and co-recipient of the Jack Neubauer Memorial Award of the IEEE Vehicular Technology Society. In 2012, he was the recipient of the prestigious Established Career Fellowship from the EPSRC (Engineering and Physical Sciences Research Council) within Information and Communications Technology in the UK. Prof. Haas is recipient of the Tam Dalyell Prize 2013 awarded by the University of Edinburgh for excellence in engaging the public with science. In 2014, he was selected by EPSRC as one of ten RISE (Recognising Inspirational Scientists and Engineers) Leaders in the UK.

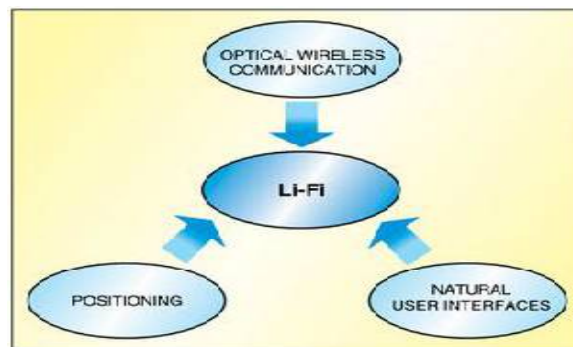


Fig. 1: Li-Fi as a superset of different optical wireless technologies involving communication, positioning, natural user interfaces and many more.

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## IV. WORKING PRINCIPAL

In a Li-Fi System the LED Bulb is used as a medium which is used as a data transmitter with high data rate. LED Bulb is cheap and fast optical devices which can be used as light source as well as data transmitter. The working Principle of LED is depended on Visible Light Spectrum which have optical carrier range between 400 THz (780nm) to 800 THz (375nm) for visible light transmission. Pulse Rate used by LEDs is high for fast data transmission.

Transmission of data bits is done by single LED or multi LED through a visible light with a constant current rating. Although speed of data transmission can be vary up to high and low by varying the intensity of light to control data flow.

The operation of LED defined as if data transmit is 1 its shows that LED is ON and if data transmitted is 0 it shows that LED is switched OFF. The rate with which LED Turn ON and OFF is very high .So the data rate of Li-Fi is very high. As the data is transmitted by LED bulb the Photo detector detects on receptor and amplified, then this data is fed to device .Data is encoded and decoded by encoding and decoding modules with help of different techniques.

The data to be transmitted can be encoded in the light by varying frequency of the flickering rate at which the LEDs flicker ON and OFF to create many strings of 1s and 0s.The LED intensity or brightness is modulated so rapidly at high speed that human eye cannot notice, so the illumination of the LED appears constant to humans.

## V. BLOCK DIAGRAM

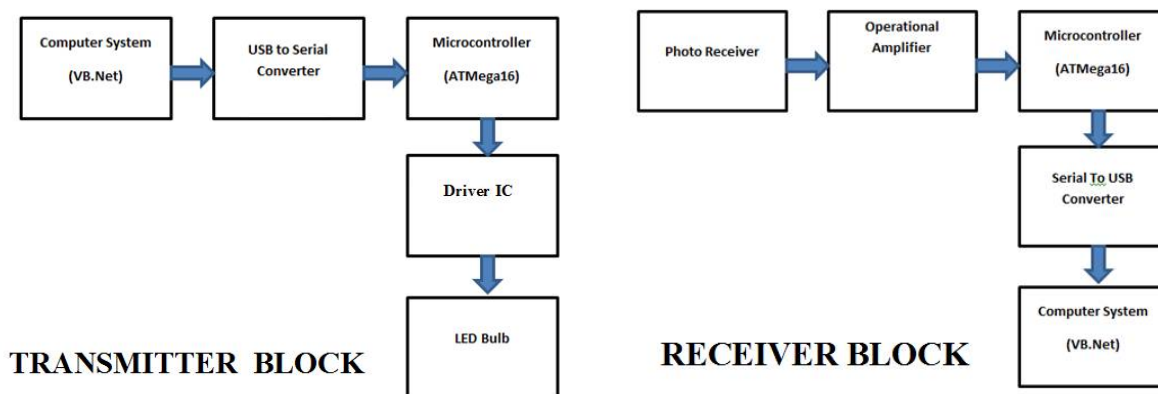


Fig 2: Transmitter Module

Fig 3: Receiver Module

The Block Diagram of the Li-Fi Transmitter and Receiver Module is as shown in above figures. This Modules works in specific way which is explained below:

### Transmitter Module:

From Transmitter module, the Data Signal or Information form the Computer system is Serially send by USB-to-Serial Converter Which is interfaced to Microcontroller ATMega16 which Processes and send 8-bit Data signal to Driver IC L293D which encode and transmit the Data Signal through LED panel using visible Light as a medium.

### Receiver Module:

At Receiver side the encoded data signal through LED panel is received by Photodiode which first given to Driver IC LM324. Driver IC then compare and decode the incoming 8-bit data signal and output of driver IC is interfaced to Microcontroller ATMega16. At microcontroller the received Data signal is then compared and related output data signal is displayed on other computer system through Serial-to-USB converter interfaced with Microcontroller.

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## VI. CONSTRUCTION OF LI-FI SYSTEM

The main components of Li-Fi system are as follows:

- a. High brightness white LED which acts as transmission source.
- b. A silicon photodiode with good response to visible light as the receiving element.

LEDs can be switched on and off to generate digital strings of different combination of 1s and 0s. To generate a new data stream, data can be encoded in the light by varying the flickering rate of the LED. The LEDs can be used as a sender or source, by modulating the LED light with the data signal. The LED output appears constant to the human eye by virtue of the fast flickering rate of the LED. Communication rate greater than 100 Mbps is possible by using high speed LEDs with the help of various multiplexing techniques. VLC data rate can be increased by parallel data transmission using an array of LEDs where each LED transmits a different data stream. The Li-Fi emitter system consists of primary subassemblies as listed below:

- a) LED Bulb/Panel
- b) Driver IC's
- c) Printed circuit board (PCB)
- d) Enclosure or BASE Holder
- e) Driver IC
- f) USB to TTL

## VII. EXPERIMENTAL RESULTS

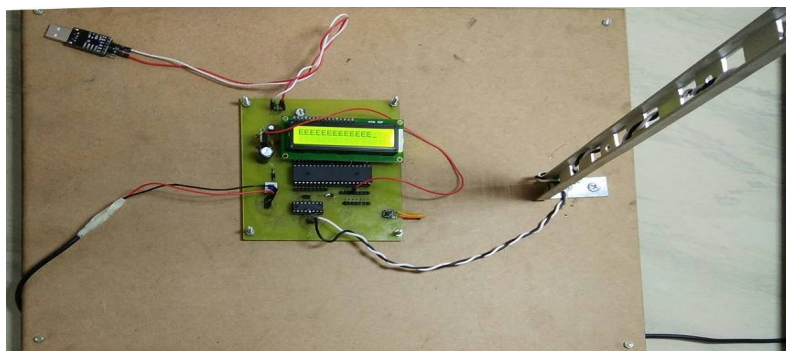


Fig 4: Transmitter Module with Controller Circuit interfaced with LED Panel

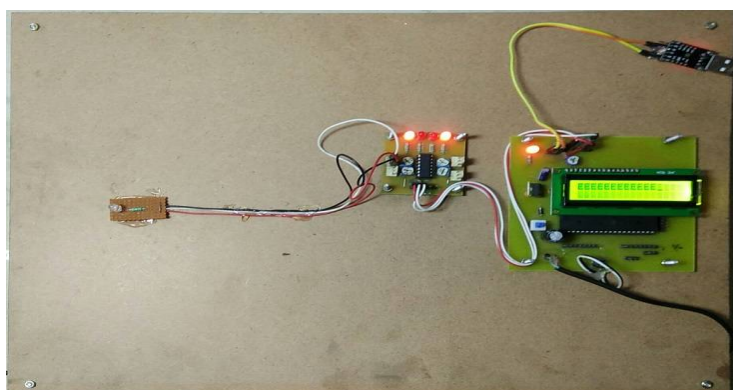


Fig 5: Receiver Module with Controller Circuit with Photodiode



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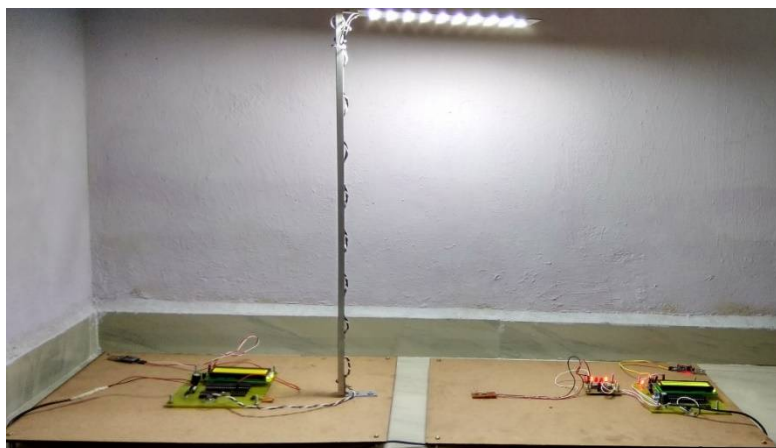


Fig 6: Working Model of Transmitter and Receiver using Li-Fi Technology

**Explanation:**As shown in figure no. 4, 5 and 6 the experimental result which shows that the Li-Fi Technology working Model. In this figure no. 4 shows the Transmitter Module with its continuous transmitting alphabet “E” Displayed on LCD screen is successfully received by Receiver Module as shown in figure no. 5. Here the signal alphabet “E” is received by receiver which can be seen on receiver LCD and figure no. 6 shows complete setup of transmitter and receiver with Data communication from transmitter to receiver. Further other devices like personal computers can be interfaced using USB-to-Serial converter for multiple device data communication.

## VIII. CONCLUSION

In this research we have successfully implemented the Li-Fi system using the visible light as a medium of communication, where the scattered light signals is used as a Data source through which data can be Transmit and Receive by communication devices. In this we are further trying to explore the data communication through Computer System and Mobile Devices, so that we can also able to access AUDIO and VIDEOSignals. There are many industrial advantages with Li-Fi Technology as it fastest way of communication than any other medium. With this we have also studied that Li-Fi Technology is better option than Wi-Fi Technology when it's come to Device-to-Device communication.

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