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LIFI: Visible Light through Wireless Communication

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A B S T R A C T

Li-Fi is using visible light instead of radio waves for communication. This new wireless technology can save a large amount of electricity by transmitting data through the light bulbs. In an age where we face a challenge of data congestion in the free air medium, where we strive hard to squeeze in all the data in the allocated spectrum. Something we generally use every day, there is not any area where we do not use light. With this emerging technology we can use all the light around us that we produce to transmit data. .Let us consider the amount of dependency that we have in the present world on the use of cell phones or laptops or the internet it is a need of the present world that we check alternate ways to transmit all this huge amount of data we generally use. By flickering the light from a single LED, any change a human eye can detect, they can transmit far more data than a cellular tower using SIM OFDM technique-- and do it in a way that's more efficient, secure and widespread. 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 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.

Index Terms : Li-Fi, visible light, LED, data congestion, optical current,OFDM

I. INTRODUCTION

Li-Fi is transmission of data through illumination by taking the fiber out of fiber optics by sending data through a LED light bulb that varies in intensity faster than the human eye can follow. Li-Fi is the term some have used to label the fast and cheap wireless-communication system, which is the optical version of Wi-Fi. The term was first used in this context by Harald Haas in his TED Global talk on Visible Light Communication. "At the heart of this technology is a new generation of high brightness light-emitting diodes", says Harald Haas from the University of Edinburgh, UK," Very simply, if the LED is on, you transmit a digital 1, if it's off you transmit a 0,"Haas says, "They can be switched on and off very quickly, which gives nice opportunities for transmitted data." It is possible to encode data in the light by varying the rate at which the LEDs 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. More sophisticated techniques could dramatically increase VLC data rate. Terms at the University of Oxford and the University of Edinburgh are focusing on parallel data transmission using array of LEDs, where each LED transmits a different data stream. Other group are using mixtures of red, green and blue LEDs to alter the light frequency encoding a different data channel. Li-Fi, as it has been dubbed, has already achieved blisteringly high speed in the lab.

Researchers at the Heinrich Hertz Institute in Berlin, Germany, have reached data rates of over 500 megabytes per second using a standard white-light LED. 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.

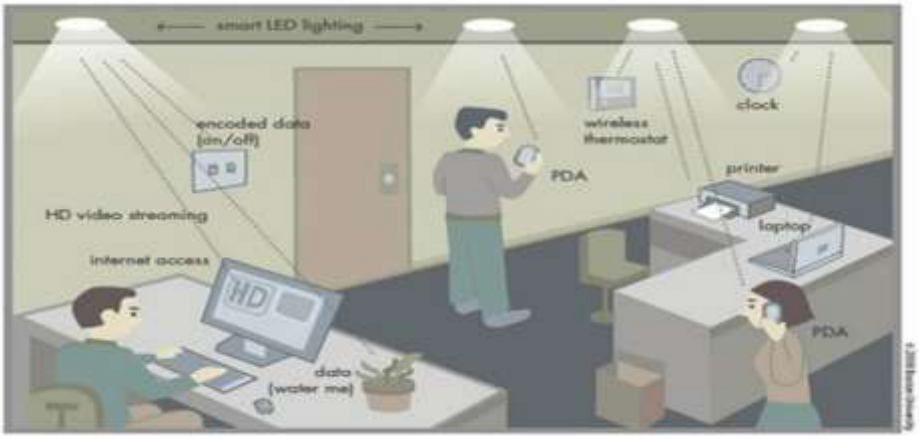


Fig.1.1 Data transmission through LED

II. Proposed System

A. Present Scenario

We have 1.4 million cellular radio waves base stations deployed. We also have over 5 billions of mobile phones. Mobile phone transmits more than 600TBb of data. Wireless communication has become a utility like electricity & water. We use it in everyday life, in our private life, business life. Radio spectrum is congested but the demand for the wireless data doubles each year. Everything, it seems want to use wireless data but the capacity is drying up. Currently wifi uses Radio waves for communication. It is important to look into this technology which has become fundamental to our life. Gama rays can't be used as they could be dangerous. X-rays have similar health issues. Ultraviolet light is good for place without people but dangerous for the human body. Infrared, due to eye safety regulations can only be used with low power.
Hence we are left with only the VISIBLE LIGHTS SPECTRUM.

B. Four issues with radio waves:

- Capacity : We transmit wireless data through radio waves. Radio waves are limited, scar and expensive. We only have a certain range of it. With the advent of the new generation technologies as of likes of 2.5G, 3G, 4G and so on we are running out of spectrum.
- Efficiency : There are 1.4 million cellular radio base stations. They consume massive amount of energy. Most of this energy is not used for transmission but for cooling down the base stations. Efficiency of such a base station is only 5% and that raise a very big problem.
- Availability : We have to switch off our mobiles in aeroplanes. It is not advisable to use mobiles at places like petrochemical plants and petrol pumps. Availability of radio waves causes another concern.
- Security : Radio waves penetrate through walls. They can be intercepted. If someone has knowledge and bad intentions then he may misuse it.

Alternative to Radio waves in Electromagnetic Spectrum: So there are four major concerns i.e., capacity, efficiency, availability, security related with Radio waves. But on the other hand we have 40 billions of light box already installed and light is part of electromagnetic spectrum. So let's look up at this in context of EM spectrum

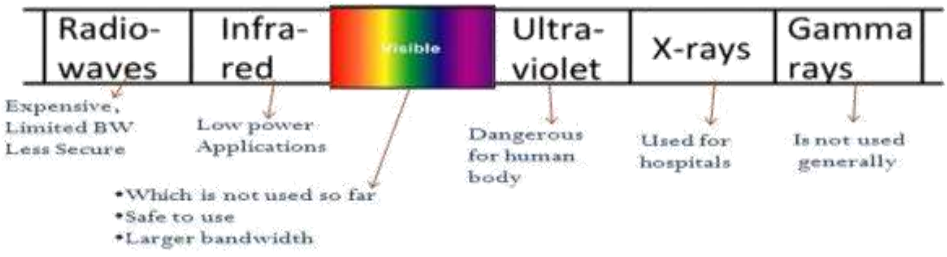


Fig.1.2 Electromagnetic Spectrum

C. Proposed System with block diagram :

This brilliant idea was first showcased by Harald Haas from University of Edinburgh, UK, in his TED Global talk on VLC. He explained," 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." So what you require at all are some LEDs and a controller that code data into those LEDs. We have to just vary the rate at which the LED's flicker 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 you can download a full high-definition film in just 30 seconds. Simply awesome! But blazingly fast data rates and depleting bandwidths worldwide are not the only reasons that give this technology an upper hand. Since Li-Fi uses just the light, it can be used safely in aircrafts and hospitals that are prone to interference from radio waves. This can even work underwater where Wi-Fi fails completely, thereby throwing open endless opportunities for military operations.

Imagine only needing to hover under a street lamp to get public internet access, or downloading a movie from the lamp on your desk. There's a new technology on the block which could, quite literally as well as metaphorically, 'throw light on' how to meet the ever-increasing demand for high-speed wireless connectivity. Radio waves are replaced by light waves in a new method of data transmission which is being called Li-Fi.Light-emitting diodes can be switched on and off faster than the human eye can detect, causing the light source to appear to be on continuously. A flickering light can be incredibly annoying, but has turned out to have its upside, being precisely what makes it possible to use light for wireless data transmission. Light-emitting diodes (commonly referred to as LEDs and found in traffic and street lights, car brake lights, remote control units and countless other applications) can be switched on and off faster than the human eye can detect, causing the light source to appear to be on continuously, even though it is in fact 'flickering'. This invisible on-off activity enables a kind of data transmission using binary codes: switching on an LED is a logical '1', switching it off is a logical '0'. Information can therefore be encoded in the light by varying the rate at which the LEDs flicker on and off to give different strings of 1s and 0s. This method of using rapid pulses of light to transmit information wirelessly is technically referred to as Visible Light Communication (VLC), though it's potential to compete with conventional Wi-Fi has inspired the popular characterization Li-Fi.

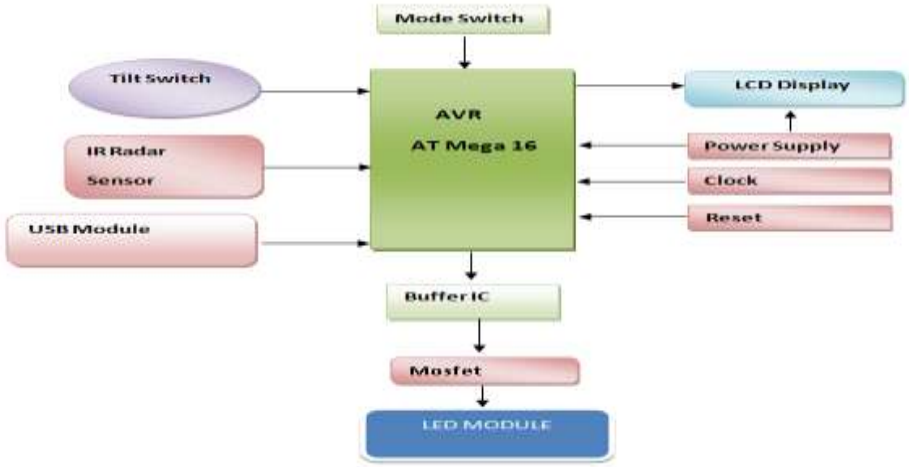


Fig 1.3 : Transmitter Block Diagram

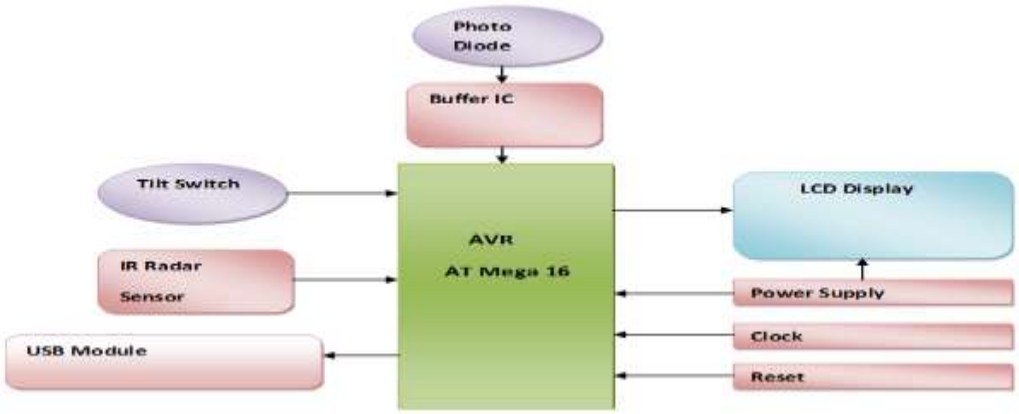
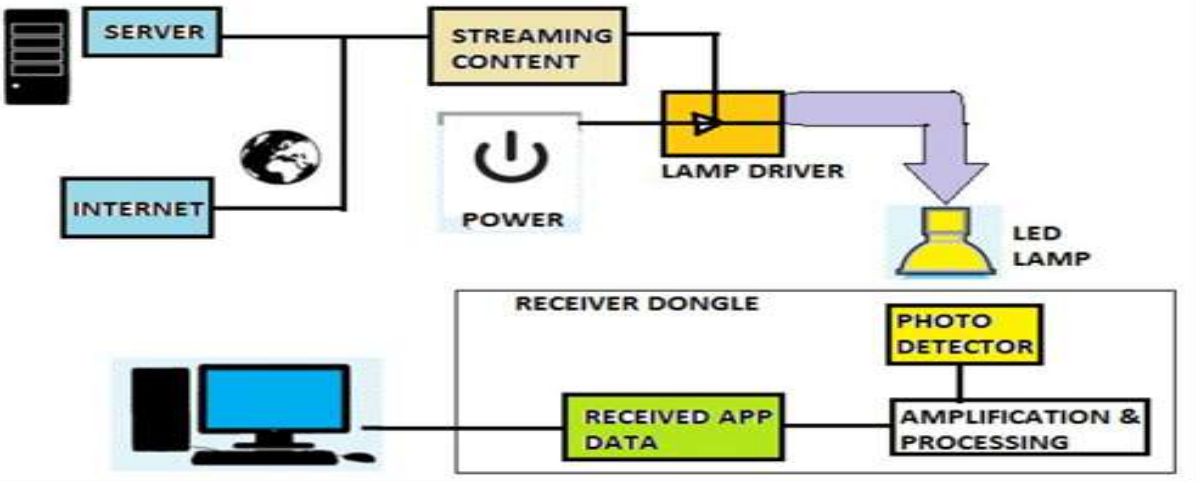


Fig 1.4: Receiver Block Diagram

III. Model Representation :

LiFi (Light Fidelity) is a fast and cheap optical version of Wi- Fi, the technology of which is based on Visible Light Communication (VLC).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. It uses fast pulses of light to transmit information wirelessly. The main components of this communication system are 1) a high brightness white LED, Which acts as a communication source and 2) a silicon photodiode which shows good response to visible wavelength region serving as the receiving element? LED can be switched on and off to generate digital strings of 1s and 0s. Data can be encoded in the light to generate a new data stream by varying the flickering rate of the LED. To be clearer, by modulating the LED light with the data signal, the LED illumination can be used as a communication source. As the flickering rate is so fast, the LED output appears constant to the human eye. A data rate of greater than 100 Mbps is possible by using high speed LEDs with appropriate multiplexing techniques. VLC data rate can be increased by parallel data transmission using LED arrays where each LED transmits a different data stream. There are reasons to prefer LED as the light source in VLC while a lot of other illumination devices like fluorescent lamp, incandescent bulb etc. are available.



Li-Fi technology is based on LEDs 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. Also, the speed of the internet is incredibly high and you can download movies, games, music etc in just a few minutes with the help of this technology.

Also, the technology removes limitations that have been put on the user by the Wi-Fi. You no more need to be in a region that is Wi-Fi enabled to have access to the internet. You can simply stand under any form of light and surf the internet as the connection is made in case of any light presence. There cannot be anything better than this technology.

IV. Comparison between Li-Fi & Wi-Fi:

Li-Fi is a term of one used to describe visible light communication technology applied to high speed wireless communication. It acquired this name due to the similarity to WI-FI, only using light instead of radio. WI-FI is great for general wireless coverage within buildings, and li-fi is ideal for high density wireless data coverage in confined area and for relieving radio interference issues, so the two technologies can be considered complimentary.

V. CHARACTERISTICS

CHARACTERISTICS	LI-FI	WI-FI
Spectrum	10,000 times broad spectrum than Wi-Fi.	Narrow Spectrum
Speed	Controlled Speed due to intensity of light	Uncontrolled speed
Data Density	Due to visible light transfer rate is more	Transfer rate is less
Security	More secure due to non penetration of light through walls	Less secure due to transparency
Bandwidth	Due to broad spectrum bandwidth is more	Due to less spectrum bandwidth is less
Cost	Set up cost is less	Set up cost is more than Li-Fi
Transmitter/Receiver power	More	Less

V.CONCLUSION

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 also we cannot use ultraviolet, x-rays, Infrared and Gama rays due health hazards on human body.

Thus, visible light spectrum 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.

VI.FUTURE SCOPE

The possibilities are numerous and can be explored further. If this 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. 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. So Li-Fi has higher advantages than other wireless technologies and can be seen as a future technology

VII. References

[1]. Jyoti Rani, Prerna Chauhan, Ritika Tripathi ;'Li-Fi (Light Fidelity)-The future technology In Wireless communication' - International Journal of Applied Engineering Research, ISSN 0973-4562 Vol.7 No.11 (2012)
[2].Wang Jia-yuan, Zou Nian-yu, Wang Dong, Irie Kentaro, Iha Zensei, Namihira Yoshinori; 'Experimental study on visible light communication based on LED' - The Journal of China Universities of Posts and Telecommunications - October 2012, 19(Suppl. 2): 197– 200
[3]."Visible-light communication: Tripping the light fantastic: A fast and cheap optical version of Wi-Fi is coming", Economist, dated 28 Jan 2012