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Review on LI-FI Technology

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ABSTRACT: One German physicist, DR. Harald Haas, has come up with a solution he calls "Data Through Illumination"—taking the fiber out of fiber optics by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. It's the same idea behind infrared remote controls, but far more powerful. Haas says his invention, which he calls D-Light, can produce data rates faster than 10 megabits per second, which is speedier than your average broadband connection.

Li-Fi is now part of the Visible Light Communications (VLC) PAN IEEE 802.15.7 standard. "Li-Fi is typically implemented using white LED light bulbs. These devices are normally used for illumination by applying a constant current through the LED. However, by fast and subtle variations of the current, the optical output can be made to vary at extremely high speeds. Unseen by the human eye, this variation is used to carry high-speed data,"

It's the same idea band behind infrared remote controls but far more powerful, can produce data rates faster than 10 megabits per second, which is speedier than your average broadband connection.

KEYWORDS: Li-Fi, LED Bulb, VLC, Light receiver, Radio Frequency, Wi-Fi

I. INTRODUCTION

- Light-Fidelity
- LI-FI is transmission of data through illumination, sending data through a LED light bulb that varies intensity faster than human eye can follow.

In simple terms, Li-Fi can be thought of as a light-based Wi-Fi. That is, it uses light instead of radio waves to transmit information. And instead of Wi-Fi modems, Li-Fi would use transceiver-fitted LED lamps that can light a room as well as transmit and receive information. Since simple light bulbs are used, there can technically be any number of access points.

This technology uses a part of the electromagnetic spectrum that is still not greatly utilized- The Visible Spectrum. 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 eyes cannot notice, so the output appears constant.

More sophisticated techniques could dramatically increase VLC data rates. Teams at the University of Oxford and the University of Edinburgh are focusing on parallel data transmission using arrays of LEDs, where each LED transmits a different data stream. Other groups are using mixtures of red, green and blue LEDs to alter the light's frequency, with each frequency encoding a different data channel.

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

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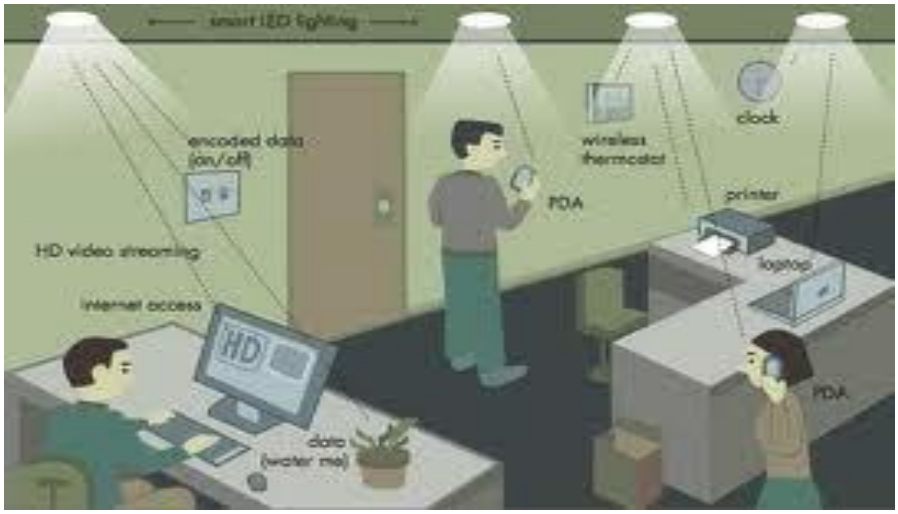

II. REVIEW ON WORKING OF LI-FI

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 us required is 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 .Thus every light source will works as a hub for data transmission .Li-Fi 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 LEDs can be switched on and off very quickly, which gives nice opportunities for transmitting data. 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. Light is inherently safe and can be used in places where radio frequency communication is often deemed problematic, such as in aircraft cabins or hospitals. So visible light communication not only has the potential to solve the problem of lack of spectrum space, but can also enable novel application. The visible light spectrum is unused; it's not regulated, and can be used for communication at very high speeds.

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 (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 LED's flicker on and off to give different strings of 1s and 0s. This method of using rapid pulses of light to transmit

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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.

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 techniques. 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.

Fig: Transfer of data in the form of 0's and 1's

B. Alternative to radio waves in Electromagnetic spectrum

- So there are four major concerns i.e., capacity, efficiency, availability and 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
- Gamma rays are simply very dangerous and thus can't be used for our purpose of communication
- X-rays are good in hospital and can't be used either
- Ultra –violet rays are sometimes good for our skin but for long duration it is dangerous
- Infra red rays are bad for our eyes and are therefore use at low power levels
- We have already seen shortcoming of radio waves

So we are left with only visible light spectrum.

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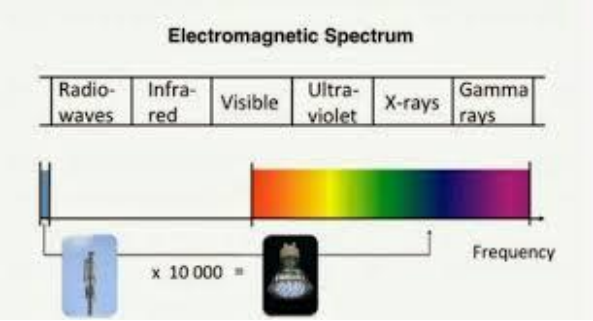

III. LI-FI CONSTRUCTION

The LIFI™ product consists of 4 primary sub-assemblies:

- Bulb
- RF power amplifier circuit (PA)
- Printed circuit board (PCB)
- Enclosure

The PCB controls the electrical inputs and outputs of the lamp and houses the microcontroller used to manage different lamp functions.

An RF (radio-frequency) signal is generated by the solid-state PA and is guided into an electric field about the bulb. The high concentration of energy in the electric field vaporizes the contents of the bulb to a plasma state at the bulb's center; this controlled plasma generates an intense source of light. All of these subassemblies are contained in an aluminum enclosure

FUNCTION OF THE BULB:-

At the heart of LIFI is the bulb sub-assembly where a sealed bulb is embedded in a dielectric material. This design is more reliable than conventional light sources that insert degradable electrodes into the bulb. The dielectric material serves two purposes; first as a waveguide for the RF energy transmitted by the PA and second as an electric field concentrator that focuses energy in the bulb. The energy from the electric field rapidly heats the material in the bulb to a plasma state that emits light of high intensity and full spectrum.

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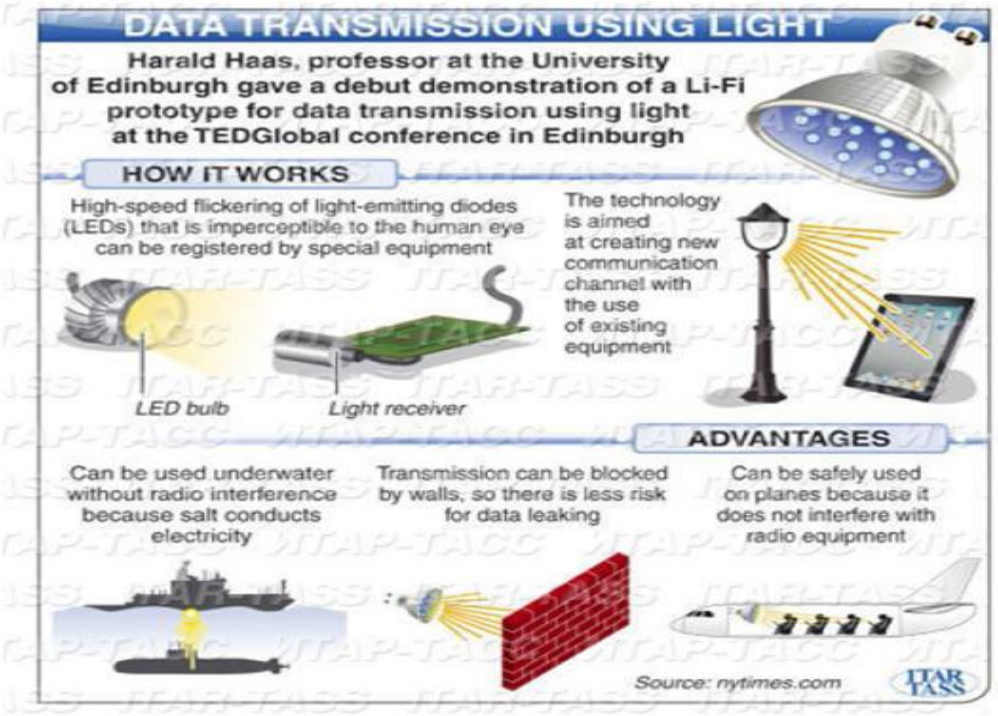

IV. LIGHT FOR WI-FI COMMUNICATION

- Light has been around for millions of years.
- It has created us, has created life and has created all stuffs of life.
- FLICKERING lights are annoying but they may have an upside. Visible light communication (VLC) uses rapid pulses of light to transmit information wirelessly, now it may be ready to compete with conventional WIFI.
- So it is inherently safe use and would be great if we can use it for our wireless communication.

What we have to do?

- We have to replace inefficient fluorescents lights with these new dignitaries of LED lights.
- It is a semi conductive e-device.
- The LED bulb will hold a micro chip that will do the job of processing the data.
- Light intensity can be modulated at very high spends to send data tiny changes in amplitude.

How we do this?

- Remote control has as IR-led
- It creates a single data stream.
- High speed data rates of 10000 b/s to 20000b/s
- Replace remote control with light box
- With this technology we transmit 1000's of data stream in parallel at high speeds.
- We termed this technology as special Modulation.

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V. COMPARISION 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

TECHNOLOGY	SPEED	DATA INTENSITY
Wireless (current)		
Wi-Fi – IEEE 802.11n	150 Mbps	*
Bluetooth	3 Mbps	*
IrDA	4 Mbps	***
Wireless (future)		
WiGig	2 Gbps	**
Giga-IR	1 Gbps	***
Li-Fi >	1Gbps	****

The table also contains the current wireless technologies that can be used for transferring data between devices today, i.e. Wi-Fi, Bluetooth and IrDA. Only Wi-Fi currently offers very high data rates. The IEEE 802.11.n in most implementations provides up to 150Mbit/s (in theory the standard can go to 600Mbit/s) although in practice you receive considerably less than this. Note that one out of three of these is an optical technology.

VI. CONCLUSION

This technology doesn't deal with radio waves, it can simply be used in the places where Bluetooth, infrared, WIFI and Internet are banned. It includes benefits as following: A very broad spectrum over visible wave length range, extremely high colour fidelity, immediate start time.Easy terminal Management. Trouble-free integration into existing light engine platform.In future applications of LIFI can be implemented to an education platform.

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BIOGRAPHY

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