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Light-Fidelity (Li-Fi): Data Transmission through Light of Future Technology

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ABSTRACT: The efficiency, durability, and lifetime of light-emitting diodes (LEDs) have led to their use in a variety of applications, including general illumination, vehicle lights, sign age, and displays ,In fact, it is often predicted that LED bulbs will soon replace all traditional incandescent bulbs, as well as compact fluorescent alternatives, in general lighting applications It has long been recognized that LEDs used in such systems can be simultaneously modulated to provide a dual function of communications. Proposed applications for visible light communications (VLC) include indoor local area networks through room lighting in-flight data downlinks through airplane reading lamps intelligent transportation positioning in wireless sensor networks and underwater. We have designed a prototype.Though Wi-Fi gives us speed up to 150mbps as per IEEE 802.11n, it is still insufficient to accommodate no of users. To remedy this limitation of Wireless Fdility, we are introducing concept of Li-Fi. As per germen phycist Harald Haas 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. 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

Keywords: Wi-Fi, Light-emitting diode (LED), Video LAN Client (VLC), Technology, Entertainment and Design (TED), Visible Light, Data utilization, server, lamp driver.

1. INTRODUCTION

i-Fi, as coined by Prof. Harald Haas during his TED Global talk,[1] is bidirectional, high speed and fully networked wireless communications similar to Wi-Fi. Li-Fi is a subset of optical wireless communications (OWC) and can be a complement to RF communication (WiFi or Cellular network), or a replacement in contexts of data broadcasting. It is wireless and uses visible light communication or infra-red and near ultraviolet (instead of radio frequency waves) spectrum, part of Optical wireless communications technology, which carries much more information, and has been proposed as a solution to the RF-bandwidth limitations. A complete solution includes an industry led standardization process. Light Fidelity is a new wireless communication technology which enables a wireless data transmission through LED light. Light Fidelity 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 [3] 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, Light Fidelity 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

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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 Light Fidelity 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. Light Fidelity 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 WiFi. 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 lightemitting 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. Reserved 115 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. Fig2: Harald haas Other groups are using mixtures of red, green and blue LEDs to alter the light frequency encoding a different data channel. The Li-Fi Consortium is an international platform focusing on optical wireless Technologies. It was founded by four Technology based organizations in October 2011. The goal of Li-Fi Consortium is to foster the Development and distribution of optical wireless technologies such as communication, navigation, natural user interfaces and others This is accomplished by inviting technology experts, OEMs, end users and standardization groups to discuss needs, There are around 14 billion light bulbs worldwide, they just need to be replaced with LED ones that transmit data," says Haas. "We reckon VLC is a factor of ten cheaper than Wi-Fi." Because it uses light rather than radio-frequency signals, VLC could be used safely in Aircraft, integrated into medical devices and hospitals where Wi-Fi is banned, or even underwater, where Wi-Fi doesn't Work at all. His technology uses a part of the electromagnetic spectrum that is still not greatly utilized- The Visible Spectrum. Light is in fact very much part of our lives for millions and millions of years and does not have any major ill effect.

2. WORKING PROCESS OF LI FI

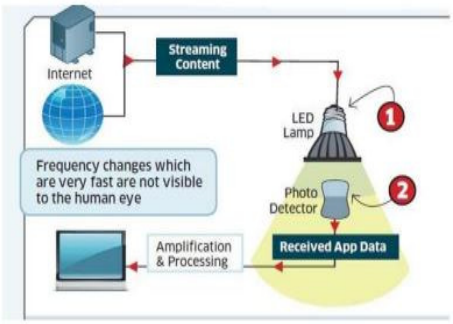

Fig 2.1 Working of LIFI

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Light Fidelity 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 Light Fidelity 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 which the LED‘s flicker depending upon the data we want to encode. Further at 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. To further get a grasp of Light Fidelity consider an IR remote. This system, fig 2.1, is capable of sending thousands of such streams at very fast rate. 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. The University of Strath clyde in the UK has created a research center aimed at turning the constant flicker of LED lights into a way to transmit internet communications using visible light, as opposed to radio waves (Wi-Fi, cellular) or via cables. Dubbed, the Intelligent Together the consortium aims to conduct research on a smaller LED than other groups around the world that are also investigating this technology. First, a bit on what they call Li-Fi from the university release (or you can go catch a TED talk on the topic):Underpinning Li-Fi is the use of lightemitting diodes (LEDs), a rapidly spreading lighting Technology which is expected to become dominant over the next 20 years. Imperceptibly, LEDs flicker on and off thousands of times a second: by altering the length of the flickers, it is possible to send digital information to specially-adapted PCs and other electronic devices – making Li-Fi the digital equivalent of Morse code. This would make the visible part of the electromagnetic spectrum available for internet communications, easing pressure on the increasingly crowded parts of the spectrum currently being used. Instead of researching Li-Fi LEDs around 1mm2 in size, the EPSRCfunded[9] team is developing tiny, micron-sized LEDs which are able to flicker on and off 1,000 times quicker than the larger LEDs.

3. APPLICATIONS

- 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.

4. COMPARISION

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

LiFi uses visible light and this property can

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be exploited in finding the location of people. Suppose if a child is misplaced and he/she is wearing an earing which is made of Led's. this led can constantly communicate with the visible light available and reveal the location of the child.

Navigation System : since visible light is present everywhere, we can create internal navigation systems for the bigger areas to create automated machinery/ automatic navigation for the visitors.

- 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.

5. CONCLUSION

If this technology becomes justifiably marketed then every bulb can be used analogous to a Wi-Fi hotspot to transmit data wirelessly. 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. 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.

6. FUTURE SCOPE

The area of Li-Fi is very broad in the manner of Hospitals, Academics, Airlines and more. Can be used in the places where it is difficult to lay the optical fiber like hospitals. In operation theatre LiFi can be used for modern medical instruments. In traffic signals LiFi can be used which will communicate with the LED lights of the cars and accident numbers can be decreased. Thousand and millions of street lamps can be transferred to LiFi lamps to transfer data. In aircraft LiFi can be used for data transmission. Such advancements promise a theoretical speed of 100 Gbps - meaning one can download a full high definition film in just 3 seconds

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