

Study on Li-Fi Technology

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Abstract— Li-Fi or Light Fidelity means High Speed Light Communication System through light emitting diodes as a medium. Nowadays, where Internet is everyone's favourite, Li-Fi or New Life of Data Communication is another alternative to Wi-Fi in terms of wireless communication. Professor Harald Hass of University of Edinburgh invented the Li-Fi technology. Li-Fi is more capable in bandwidth and hence does not interfere with other communications with use frequency bands. Li-Fi is a thousand times faster than Wi-Fi and is more secure as the visible light cannot penetrate through walls which may be considered as a new era of Wireless Communication. Li-Fi is based on transmission of data through fast flickering of light which is not visible to naked human eye but it is focused on photo detector which transfers the binary data via the on-off state. It has gained a lot of popularity since its invention in the past two years. Li-Fi is the future to greener, safer and cheaper communication. This paper discusses about the working of Wi-Fi technology and its applications in various domains.

Index Terms— Li-Fi (Light Fidelity), LED (Light Emitting Diode), Wi-Fi (Wireless Fidelity), VLC (Visible Light Communication), RF (Radio Frequency)

1 INTRODUCTION

The idea of Li-fi is as of now pulling in a lot of intrigue, not slightest on the grounds that it offers an honest to goodness and extremely proficient contrasting option to RF. As a developing number of individuals and their late gadget get to remote web, the wireless transmissions are turning out to be progressively stopped up and inaccessibility of free data transmissions to each gadget, making it harder to get a dependable, rapid flag. The chance to misuse a totally distinctive part of the electromagnetic range is exceptionally engaging. Li-Fi has different points of interest over Wi-Fi, for example, safe to use at atomic power plants, warm power stations where Wi-Fi can't be utilized. In such stations RF waves can be unsafe and can make mishap, convey in such districts just noticeable light range can be protected. Aside from unfriendly locales Li-fi can likewise be utilized as a part out of every other place on earth where Wi-Fi can be utilized. Li-fi is available wherever there is accessibility of light, thus destroying the need of having problem areas just at those places. There are four measures to judge on the working of Li-Fi and Wi-Fi that is, limit, productivity, accessibility and security. Both Li-fi and Wi-Fi utilizes electromagnetic range for information transmission, yet though Wi-Fi uses radio waves, Li-Fi utilizes obvious light correspondence as a part of the scope of 100Mbps. The present paper manages the VLC which give a wide and quick information rate like 500Mbps. In this paper, the examination is made between Wi-Fi and Li-Fi innovation. This paper like-

wise talks about the working, execution and enhancements in Li-fi innovation.

2 LITERATURE REVIEW

Using Li-Fi, every bulb can be used like a Wi-Fi hotspot to transmit wireless data and it will proceed towards cleaner, greener, safer and brighter wireless future. The concept of Li-Fi is a genuine and very efficient support to radio-based wireless. As the number of people and their devices accessing wireless internet increases, the airwaves are becoming increasingly clogged, making it more and more difficult to get a reliable, high-speed signal. Li-Fi may solve these issues such as the shortage of radio-frequency bandwidth and also allow internet where traditional radio based wireless is not allowed such as aircraft or hospitals. In future the work can be done for analyzing the effect of interference from external light sources like sunlight and normal bulbs and how to reduce that effect.[18]

Whether you're using wireless internet in a coffee shop, stealing it from the guy next door, or competing for bandwidth at a conference, you've probably gotten frustrated at the slow speeds you face when more than one device is tapped into the network. As more and more people and their many devices access wireless internet, clogged airwaves are going to make it increasingly difficult to latch onto a reliable signal.

The coexistence between Wi-Fi and Li-Fi is a new promising research area. We have discussed the primary characteristics of both technologies and the possibility for them to coexist. We have demonstrated that a close integration of both technologies enables off-loading opportunities for the WiFi network to free resources for more mobile users because stationary users will preferably be served by LiFi. In this way, LiFi and WiFi can efficiently collaborate. We have implemented several ways of channel aggregation for the suggested coexistence and demonstrated by proof-of-concept results, using

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state-of-the-art LiFi and WiFi frontends, that both technologies together can more than triple the throughput for individual users and offer significant synergies, yielding a combined solution that can adequately address the need for enhanced indoor coverage with highest data rates needed in the 5th generation of mobile networks (5G). Finally, we have outlined a roadmap for future research opportunities towards the integration of both technologies.

Visible Light Communication: A possible Solution to the global wireless spectrum shortage

Li-Fi is a fast and cheap optical version of Wi-Fi, which is based on Visible Light Communication. VLC is a data communication medium using visible light between 400THz (780nm) to 800THz (375nm) as optical carrier for data transmission and illumination. Data can be encoded in the light to generate a new data stream by varying the flickering rate, to be clearer, by modulating the LED light with the data signal, the LED illumination can be used as a communication source. This is a whole new spectrum of possibilities as compared to the radio waves spectrum and is 10000 times more in size [1]. Visible light is not injurious to vision and are a mandatory part of an infrastructure, therefore abundantly available and easily accessible. Comparing the number of radio cellular base stations (1.4 million) to the number of light bulbs (14 billion) installed already the ratio is coincidentally same i.e. 1:1000

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, on one way, it can transmit the data at higher rate and on the other it is very cheap as compared with WI-FI .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 radiofrequency bandwidth and also allow internet where traditional radio based wireless isn't allowed such as aircraft or hospitals.

Apart from many advantages over Wi-Fi, Li-Fi technology is experiencing some challenges. One of these shortcomings is that it works in direct line of sight. Another challenge is how the receiving device will transmit to the transmitting device. One cannot shift the receiving device in case of indoor arrangement of the apparatus as light cannot penetrate through walls and is easily blocked by somebody simply walking in front of LED source.

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 .In future, data for laptops, smart phones & tablets can be transmitted through light in room by using Li-Fi. Researchers are developing micron sized LED which are able to flicker on & off around 1000 times quicker

than larger LED. They offers faster data transfers and take up less space so we could save space or add more LED's to further boost the channel of communication used something like a Wi-Fi hotspot

The first VLC smartphone prototype was presented at the Consumer Electronics Show in Las Vegas from January 7–10 in 2014. The phone uses Sun Partner's Wysips CONNECT, a technique that converts light waves into usable energy, making the phone capable of receiving and decoding signals without drawing on its battery. A clear thin layer of crystal glass can be added to small screens like watches and smartphones that make them solar powered. Smartphones could gain 15% more battery life during a typical day. This first smartphones using this technology should arrive in 2015. This screen can also receive VLC signals as well as the smartphone camera. The cost of these screens per smartphone is between \$2 and \$3, much cheaper than most new technology.

Philips lighting company has developed a VLC system for shoppers at stores. They have to download an app on their smartphone and then their smartphone works with the LEDs in the store. The LEDs can pinpoint where they are located in the store and give them corresponding coupons and information based on which aisle they are on and what they are looking at.

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.

Using an array of LEDs for parallel data transmission or using mixture of red, green and blue LEDs to alter the light's frequency with each frequency encoding a different data channels. Such advancements promise a theoretical speed of 10 GBPS - meaning one can download a full high definition film in just 30 seconds.

3 WORKING OF LIFI

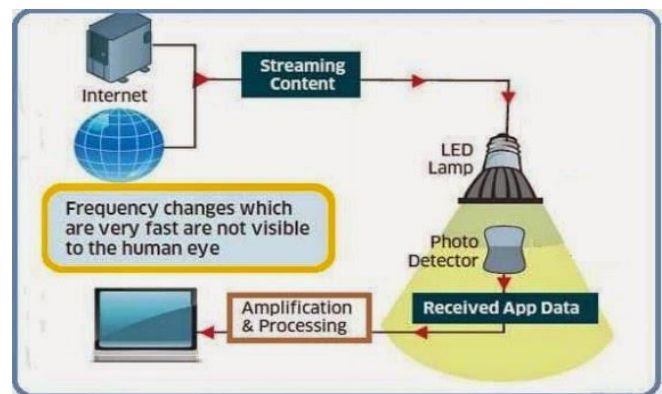


Fig 1.Working with LiFi Technology

In the above figure the binary information is caught by few

light receptors, which are introduced on a wide range of associated gadgets, from PCs to tablets, to telephones, TVs or apparatuses. Matter specialists clarify that the light heartbeats are intangible to the human eye, without bringing on harm or inconvenience of any sort. Likewise, any light or electric lamp can turn into a hotspot. How Li-fi functions is straightforward: You have a light toward one side (a LED), and a photo detector (light sensor) on the other. In the event that the LED is ON, the photograph finder enlists a parallel one; otherwise it's a twofold zero. Streak the LED enough times and you develop a message. Utilize a variety of LEDs, and maybe a couple of various hues, and soon you are managing information rates in the scope of hundreds or megabits every second, this is expert by the flashing of LED lights to make twofold code (on = 1, off = 0), and is done at higher rates than the human eye can recognize. The more LEDs in your light, the more information it can prepare.



Fig 2. Connection between LED and Device

Likewise the figure indicates brief association of web with LED and data recovered on the PC. One LED exchanges information at a slower rate, so a huge number of LEDs with one micron size are introduced in the knob. The diminishment of size of LEDs does not diminish its ability to exchange information or force on the inverse it expands the effectiveness of one light to transmit the information at an out of the blue higher rates. Moreover, these miniaturized scale LEDs are eventually just pixels — and at one micron, these LEDs would be a great deal littler than those in your Smartphone's retina show. You could have a gigantic exhibit of these LEDs that bend over as a room's light source and a show—and gives organizing capacity as an afterthought. Maybe a next-cutting edge support would speak with your gamepad, Smartphone, and different peripherals by means of a Li-Fi-prepared TV. It without a doubt gives a parkway lighting that enlightens the street, gives progressive movement information/notices, and gives web access to your auto, in addition to the majority of the gadgets on-board.



Fig 3. Model of Li-Fi LED Light

The above figure is the model of li-fi drove lights, on a more broad level; Li-Fi may be utilized to expand remote systems all through the home, working environment, and in business regions. Li-Fi is limited by observable pathway, so it won't ever supplant Wi-Fi, yet it could increase it pleasantly. Rather than attempting to locate the ideal sweet spot for your home's Wi-Fi switch, it would be much easier if each light in your home basically went about as a remote system connect. It's appeared in the figure. While Li-Fi is still in its initial stages, the innovation could give a contrasting option to utilizing radio waves for remote Internet get to. At present, family unit Wi-Fi switches and portable media transmission towers rely on upon radio signs to send information remotely. Be that as it may, the measure of radio range is constrained. The innovation is perfect for remote docking, information joins with stands and versatile showcases, medium-run radiating, information showers and optical cell systems. Clients will have the capacity to appreciate a remote sans RF client environment with information rates that can exchange a 2-hour HDTV video in under 30 seconds and remotely interface their transport associated truly difficult work fringe cupboards found somewhere else in the room.

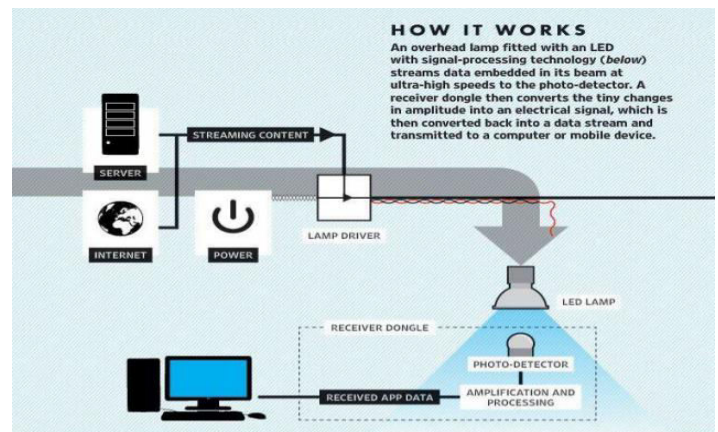


Fig 4. How It Works?

4 APPLICATION

A. Hospital

For a long time, medical technology has lagged behind the rest of the wireless world. Operating rooms do not allow Wi-Fi over radiation concerns, and there is also that whole lack of dedicated spectrum. While Wi-Fi is in place in many hospitals, interference from cell phones and computers can block signals from monitoring equipment. Li-Fi solves both problems: lights are not only allowed in operating rooms, but tend to be the most glaring (pun intended) fixtures in the room. And, as Haas mentions in his TED Talk, Li-Fi has 10,000 times the spectrum of Wi-Fi, so maybe we can, delegate red light to priority medical data. Code Red!.

B. Smarter Power Plants

Wi-Fi and many other radiation types are bad for sensitive areas. Like those surrounding power plants. But power plants need fast, inter-connected data systems to monitor things like demand, grid integrity and (in nuclear plants) core temperature. The savings from proper monitoring at a single power plant can add up to hundreds of thousands of dollars. Li-Fi could offer safe, abundant connectivity for all areas of these sensitive locations. Not only would this save money related to currently implemented solutions, but the draw on a power plant's own reserves could be lessened if they haven't yet converted to LED lighting.

C. Undersea Awesomeness

Underwater ROVs, those favorite toys of treasure seekers and James Cameron, operate from large cables that supply their power and allow them to receive signals from their pilots above. ROVs work great, except when the tether isn't long enough to explore an area, or when it gets stuck on something. If their wires were cut and replaced with light — say from a submerged, high-powered lamp — then they would be much freer to explore. They could also use their headlamps to communicate with each other, processing data autonomously and referring findings periodically back to the surface, all the while obtaining their next batch of orders.

D. It could keep you inform and save life

Say there's an earthquake in New York or a hurricane. Take your pick — it's a wacky city. The average New Yorker may not know what the protocols are for those kinds of disasters. Until they pass under a street light, that is. Remember, with Li-Fi, if there's light, you're online. Subway stations and tunnels, common dead zones for most emergency communications, pose no obstruction. Plus, in times less stressing cities could opt to provide cheap high-speed Web access to every street corner.

E. Uses in various areas

Can be used in the places where it is difficult to lay the optical fiber like hospitals. In operation theatre Li-Fi can be used for modern medical instruments. In traffic signals Li-Fi 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 Li-Fi lamps to transfer data. In aircraft Li-Fi can be used for data transmission. It

can be used in petroleum or chemical plants where other transmission or frequencies could be hazardous.

CONCLUSION

From this 5G Li-Fi innovation, we can see that the Li-Fi is a propelled approach on plan, having the best ever outline of web by to a great extent diminishing the span of gadget which exchanges information, execution by method for having more than 1.4 million lights everywhere throughout the world if supplanted by such LEDS can give possible get to, and last yet not the minimum tremendous applications contrasted with whatever other systems in different fields which can't be envisioned by on utilize systems. In spite of the fact that there are a few drawbacks, however can be disposed of via cautious further research. Li-Fi has given a stage forward innovation in the realm of developing appetite correspondence, this is sheltered to all biodiversity including people and advancing towards a greener, less expensive and brighter fate of advances.

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