

When LED Bulbs Becomes a Medium of Communication: Li-Fi Technology

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Abstract— In recent era, the use of internet is been increasing day by day. Internet has become more of a primary need than a secondary need. In recent time, Wi-Fi came into existence and life of the people by using internet got easier. But as said, every coin has two sides; Wi-Fi comes with many disadvantages like as the number of users increases for using the Wi-Fi system, the speed of the device decreases. Another disadvantage which being noticed from last few years are the ill-effects Wi-Fi causes to human health. And as every limitation has a way to new innovations. These limitation of Wi-Fi technology is being overcome by a new technology called Li-Fi (Light Fidelity) invented by Professor Harald Haas who proposes these concept as Li-Fi is a wireless optical networking technology that uses light –emitting diodes(LED's) for data transmission. It uses same concepts that are used in infrared.

Index Terms—Description, Wi-Fi, Wi-Fi Disadvantages, Working of Li-fi, Li-Fi vs. Wi-Fi, Advantages and Disadvantages of Li-fi, Fables about Li-fi ,Implementation of Li-fi technology, Purpose, Conclusion, Future Improvement, Acknowledgment.

I. INTRODUCTION

Li-fi technology stands for Light- Fidelity. Li-Fi technology is a Avant grade light based communication technology, which makes use of light instead of radio waves to transmit data. Li-Fi is a wireless optical networking technology that uses light-emitting diodes (LEDs) for data transmission .Li-fi uses LED blubs that similar to those used in homes and offices.

In lay man's language, Li-Fi can be seen as a light-based Wi-Fi. That is, it uses light instead of radio waves to transmit information. And instead of Wireless 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 be countless number of access points.

This 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. Moreover there is 10,000 times more space available in this spectrum and just counting on the bulbs in use, it also multiplies to 10,000 times more availability as an infrastructure, globally.

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.

II. WI-FI AND ITS DISADVANTAGE

Wi-Fi is a worldwide wireless schmoozing technology that uses radio frequencies to transfer data. Wi-Fi allows for high speed Internet networks without the use of cables or wires. The term Wi-Fi is a withering of "wireless fidelity" and commonly used to refer to wireless networking technology.

The Wi-Fi Association claims rights in its uses as a certification mark for equipment certified to 802.11x standards.

Wi-Fi is a liberty, freedom from wires. It allows you to connect to the Internet from just about anywhere - a coffee shop, a bed in a hotel room or a conference room at work without wires. And the best thing of all, it's super-fast - almost 10 times faster than a regular dial-up connection. Wi-Fi networks function in the unrestricted 2.4 radio bands, with an 11 Mbps (802.11b) or 54 Mbps (802.11a) data rate, respectively.

To access Wi-Fi, you need enabled devices (laptops or PDAs). These devices can send and receive data wirelessly from any location armed with Wi-Fi access.

III. effects of using Wi-Fi on Human body

Wi-Fi is suitable but many have raised doubts regarding the safety of hidden powers that pervade everything around us. Since the introduction of Wi-Fi in 1997, researchers have performed dozens of studies to explore the subject. The results are clear and awful — Wifi can damagingly affecting overall health and brain health, especially in children.

Perhaps most shocking is that this information is not new or even that controversial. In fact, in 2008 the well-renowned publication Scientific American ran a piece called "Mind Control by Cell Phone" which explained the danger Wi-Fi has on the human brain. The below points gives a brief on the ill-effects on the human body.

1. Growth of Sleeplessness

Have you ever sensed more alert and awake after being in a Wi-Fi zone or using Wi-Fi enabled mobile phones. Reports of these portents has been provoked in 2007 that gauged

low frequency modulation from mobile phones and its influence on sleep. In the study contributors were exposed to electromagnetic radiations from real mobile phones and others with no radiations i.e. bogus phones. The ones with the electromagnetic radiations had a hard time to fall asleep. It has been advised that sleeping near the phone or having a Wi-Fi connection at home, buildings or anywhere nearby creates an enduring sleep problems. As the constant blitz of these radiations can cause interference in the sleep and sleeping patterns. This also causes depression and hypertension as we do not get adequate sleep is

2. Destructive to Youth Growth

Long time contact to the electromagnetic radiations from Wi-Fi and mobile phones can cause ill-effects of fetal development. In 2004, a study on this showed that it created a delayed in the development of kidney when tested on animals. These findings were also supported by the Australian researchers in 2009. In short, Wi-Fi is hazardous in development issues.

3. Disturbs Cell Development

The researchers after having an experience on insomnia while using Wi-Fi, they experimented the list of effects of Wi-Fi on plants. One set of plants were kept free from the electromagnetic radiations and others were kept between two Wi-Fi routers that causes the harmful radiations. And the outcome was the plants kept in the radiations did not grow.

4. Upsets Brain Utility

Using magnetic Resonance imaging (MRI) technology it was observed that people more staying up in Wi-Fi zone have lesser brain activity.

5. Lessens Brain Action in Females

Researchers have experimented on 25 men and 25 women to give a simple memory test. Firstly for 45 minutes they weren't in the Wi-Fi zone and there seems no problem. After that, the women and the men were exposed to the radiations of Wi-Fi routers and the brain activity were measured. And shockingly there was a noticeable change in the brain activity and energy levels.

6. Nullifies Sperm

Long time that the heat produced by laptops kills sperm. Research has found exposure to Wi-Fi frequencies reduce sperm movement and cause DNA fragmentation. Both human and animal testing has inveterate that exposure negatively affects sperm. May Effect Fertility And, it's not just sperm. The consequences of an animal study suggest that some wireless frequencies may prevent egg imbedding.

7. Aggravates Cardiac Pressure

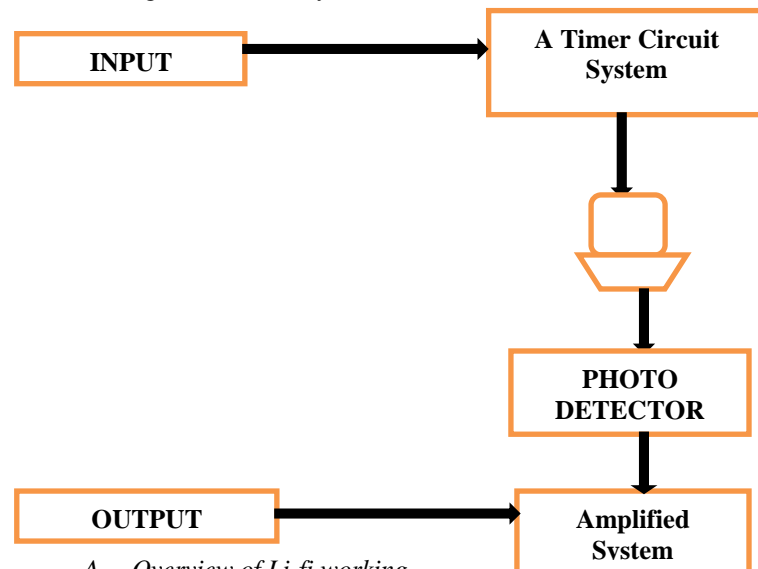
These hazardous radiations increases heart rates and effects human heart in long term.

8. Related to Tumor?

The exposure to electromagnetic radiation increases the risk of tumor growth. While human studies are infrequent, reports and case studies thrive. One such case encompasses a young 21-year-old woman who developed cancer and she developed the lump right on the spot she carried her cell phone .

WORKING OF LI-FI TECHNOLOGY

The below figure gives a detail idea of the concept of functioning of the Li-Fi System



A. Overview of Li-fi working

The li-fi system is mainly made of two parts, the transmitter and the receiver. So it can be said that it is a simple device which transmits the data and receives the data on other hand. The transmitting device revamps the input data with the time required and delivers the data in the form of 1's and 0's using LED bulbs. The 1's and 0's are the gleam of LED bulbs. The receiving device catches this gleam using a photo detector, amplifies it using an amplifying system and gives result i.e. delivery of data.

B. Transmitting Device

Basically, as mentioned above, li-fi consists of two parts transmitter and the receiver. The transmitter device consists of a timer circuit system, input data and a light emitting diode. The input data can be of any type i.e. voice, text, images, videos, etc. The use of the timer circuit is to provide require time intervals between each bit. The 1's and the 0's bits are transmitted in a form of gleam of led bulbs.

C. Receiving Device

The receiving device consists of a photo detector, and amplifying device and a output device. The photo detector device converts the gleam of bulb's i.e. the 1's and the 0's

into electrical waves. This electrical signals are then amplified using the amplifying device and the output is seen i.e. the data is being delivered to the receiving device.

LI-FI VS WI-FI

Points	Technology	
	Li-Fi	Wi-Fi
Speed	High	Comparatively Lower than Li-fi
Range	Low	Medium
Data Density	High	Low
Security	High	Medium
Reliability	Medium	Medium
Power Availability	High	Low
Transmit/Receive Power	High	Medium
Ecological Impact	Low	Medium
Device to Device Connectivity	High	High
Obstacle Interference	High	Low
Bill of Materials	High	Medium
Market Maturity	Low	High
Medium used for Delivery of data	Light Waves	Radio Waves

ADVANTAGES AND DISADVANTAGES OF LI-FI TECHNOLOGY

As an emerging technology, it deals with many advantages and disadvantages. Some listed below:

Advantages

- Li-fi has low maintenance cost
- It is safe for human body as there are no side effects of light
- Its more eco –friendly den Wi-fi which leads to safer and cleaner environment
- Limitations of Wi-fi i.e. capacity, security , efficiency, availability is solved by this technology.
- It is assumed that the technology can afford a speed more than 10 Gbps, allowing a HD film to be transferred within 30 seconds.

Disadvantages

- The other lights like daylight, sunlight can affect the speed of data transmission.
- Only point to point communication is possible.
- Its works only with straight/direct line of sight.
- The light waves cannot infiltrate through walls.

- In 2012, this technology was shown and it was detectable upto a distance of 10 meter.

FABLES ABOUT LI-FI

- It’s a thought that Li-fi can replace Wi-fi which is not true, because both the concept may be similar but works on different capabilities.
- Wi-Fi is inexpensive than Li-Fi, here implementing Li-Fi is pricy but it is long time asset but Wi-Fi seems cheaper at cost but it need maintenance.
- Once we structure Li-Fi we don’t need to recompense internet bills, this is done only when we use Li-Fi for only LAN purpose
- Li-Fi will upsurge electricity bill, this is also not thing we are suggesting that implement Li-Fi where we need to use light 24x7, places like hospitals, chemical plants, public transport station. Also LED light consume very low electricity so they save more electricity than normal light bulbs. Every light source in homes and offices could possibly be a “Li-Fi” within 20 years.
- When this technology becomes practicable like the Wi-Fi, then our life will be awe-inspiring on earth.
- This is the technology that could start to touch every part of human life within an epoch

IMPLEMENTATION OF LI-FI TECHNOLOGY

Some of the future applications of Li-Fi are as follows:

1) Edification systems

Li-Fi is the newest technology that can offer wildest speed internet access. So, it can substitute Wi-Fi at educational societies and at companies so that all the people can make use of Li-Fi with the same speed envisioned in a specific area.

2) Health Organization

Operation theatres (OTs) do not allow Wi-Fi due to radiation worries. Practice of Wi-Fi at hospitals interferes with the mobile and pc which blocks the signals for monitoring equipment’s. So, it may be detrimental to the patient's health. To overcome this and to make OT tech savvy Li-Fi can be used to retrieving internet and to control medical equipments. This can even be beneficial for robotic surgeries and other computerized processes.

3) Inexpensive Internet in Airlines:

The travelers travelling in planes get contact to low speed internet at a very high rate. Also Wi-Fi is not used because it may interfere with the directional systems of the navigators. In aircrafts Li-Fi can be used for data communication. Li-Fi can easily provide high speed internet via every light source such as overhead reading bulb, etc. present inside the airplane.

4) Submerged applications:

Underwater ROVs (Remotely Operated Vehicles) operate from large cables that supply their power and allow them to receive signals from their pilots above. But the rope used in ROVs is not long enough to allow them to discover larger areas. If their wires were 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 as fast and handy as a Wi-Fi enabled device in the open air. Also, another shortcoming is that it only works in direct line of sight. Still, Li-Fi could arise as a boon to the rapidly exhausting bandwidth of radio waves. And it will certainly be the first choice for accessing internet in a limited room at cheaper cost.

5) Other Applications:

There are numerous applications of this technology, from public internet access through street lamps to auto-directed cars that communicate through their headlights. Applications of Li-Fi can extend in areas where the Wi-Fi technology lacks its presence like medical technology, power plants and various other areas. Since Li-Fi uses just the light, it can be used safely in aircrafts and hospitals where Wi-Fi is banned because they are prone to interfere with the radio waves. All the street lamps can be transferred to Li-Fi lamps to transfer data. As a result of it, it will be possible to access radiation types are bad for sensitive areas surrounding the power plants. Li-Fi could offer safe, abundant connectivity for all areas of these sensitive locations. This can save money as compared to the currently implemented solutions. Also, the pressure on a power plant's own reserves could be lessened. Li-Fi can also be used in petroleum or chemical plants where other transmission or frequencies could be risky. Replacement for other technologies: Li-Fi doesn't work using radio waves. So, it can be easily used in the places where Bluetooth, infrared, Wi-Fi, etc. are banned.

6) Transportation Organization:

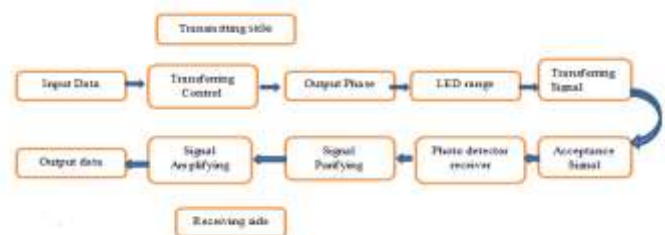
In traffic signals Li-Fi can be used which will communicate with the LED lights of the cars which can help in managing the traffic in a better method and the accident numbers can be decreased [1]. Also, LED car lights can alert drivers when other vehicles are too nearby.

PURPOSE OF THIS PAPER

The main purpose to take up this topic as a research is to make cognizance in public and government throughout the world to implement Li-Fi technology instead of the current Wi-Fi technology.

The proposed plan of action for is to launch an optical wireless communication model that gives high data rates and transmission distances. This model should successfully be able to transmit data from one device to another using LEDs, thereby establishing a Li-Fi network in a restricted environment. The system block diagram to be used for this project is shown. The system architecture consists of a transmit section and a receive section. The transmit section consists of

the data input which is then fed into a switching control system. Based on the data, the switching control generates a stream of 1s and 0s thereby indoctrinating the data in binary. The output of this control is given to the array of LEDs which turn OFF and ON at extremely high speeds. This ON-OFF modulation of the LED light conveys the data. LED is the choice for light source since it devours very less power when compared to glowing lamp or a light bulb. It consumes about one-tenth the power when compared to conservative methods of lighting. Also, the lifetime of a typical LED bulb is several tens of thousands of hours. LEDs are also fast switching with good visibility. Thus, LEDs are ideal for use as the downlink transmitter. For the uplink transmitters, Infrared (IR) can be chosen to be the uplink transmitter for user convenience. This avoids fitting an LED light source on or next to the mobile devices. The receive section consists of a photodiode, e.g. silicon photo detector or an Infrared germanium cylindrical detector. The photo detector demodulates the incoming received signal based on the sequence of 1s and 0s. The demodulated signal is then sent to a filter to remove unwanted noise. This filtered signal is then amplified using signal amplification mechanism. The filtered and amplified signal is then given to an output device such as an LCD display or a speaker. Recent Advancements in LI-FI Technology the input signal is thus remotely transmitted and received. Thus, a Li-Fi network is time-honored.



BLOCK DIGRAM

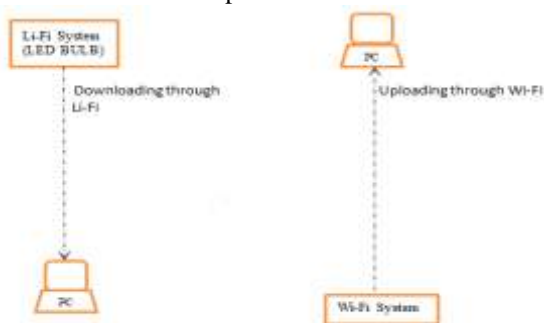
CONCLUSION

The concept of li-fi can be great life changing experience if implemented. Every bulb, every LED light used at home, offices, education centre medical centre would be used as a data transmitting device. By the implementation of this technology we can make this world a more better place to live which is more cleaner and greener. As discussed above, the ill-effects of Wi-Fi to human body so implementation of Li-Fi should be done as soon as possible. This technology will not only empower us with higher bandwidth, availability and capacity but also more of the security and efficiency.

FUTURE IMPROVEMENT

What if there comes an obstacle while transferring data using Li-fi. Well to overcome this kind of obstacle we can combine the two technologies i.e. Li-Fi and Wi-Fi. As we discussed both the technologies has its own limitation. So combination of the positive points of both technologies can be beneficial. We can use Li-fi to send data to the device i.e. downloading the data can be done using Li-Fi. While in the reverse direction the uploading process i.e. from user to network could be done using Wi-Fi technology. This can be an

much interesting innovation as 12 times more faster the data can be downloaded than uploaded.



Other enchantment which can be done is using a collection of LED lights can be used for corresponding data transmission to modify the light's occurrence with each frequency encrypting a different data networks. These can help use to download a Full HD video in just 30 seconds.

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