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## LI-FI TECHNOLOGY AND ITS APPLICATIONS

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### Abstract

Li-Fi (Light fidelity) refers to visible light communication systems using light emitting diodes and provides high-speed internet. Now a days internet became a major demand, Li-Fi has more capability in terms of bandwidth in visible region. Li-Fi is hundred times greater speed than Wi-Fi and provides security .Light fidelity deals with optical wireless communication which is emerging technology the basic idea behind this technology is the data can be sent through LED light whose strength varies even faster than Wi-Fi. This technology comes to be 10 times low-cost than the Wi-Fi and much safer Li-fi technology can be used in light bulbs in cars , light lamps , street lights , flashlight of mobile and any other light source are providing you internet access at very high-speed. The main advantage of Li-Fi Technology is internet at high-speed and security .It can also be used in various fields Such as in Military for security purposed in hospitals medical instruments, in Air planes to prevent radio signals, Power plants, Under water communication, Multi user communication, Prevention of accidents of vehicles, in tracing the place etc....We expect a future where data for laptops, smart phones and tablets is transmitted through the light only with security

Keywords: Li-Fi Technology, Wi-Fi Technology, LED

### I. Introduction:

The Light which is present in rooms get communicated with each other and creates a bridge of wireless network to provides internet access. Li-fi technology would be the best solution over Wi-Fi technology.Li-Fi is based on a single ability of concrete state lighting systems to generate a binary code of 1's and 0's with a LED shining that is invisible for human eyes[1].With increasing demand for internet, lack of radio spectrum and issues with harmful electromagnetic pollution, Li Fi appears as a eco friend, better and cheaper alternative to Wi-Fi.[2] Moreover Li-Fi makes possible to have a wireless Internet in particular environments the vision for (4G) wireless.



**Fig.1 Data transmission through LIGHT.**

From the above figure we are showing how the data is transferred through light i.e., internet communications sets the download speed at few hundred of Mega bit per second for mobile systems and few Giga bit per second for fixed systems Also, 4th generation systems will include a number of multiple user's [3].LED communication systems can be used not only for indoor uses but also in some outdoor systems. LED systems provide reliability and low cost data. A system using visible light LEDs for traffic light based communications since, the red light has more wavelengthso it is used in traffic light communicationssso the red ultra-bright LEDs to achieve thetransmission for traffic communication. As operation theatres do not allow WIFI due to radiation concerns. Usage of Wi-Fi at hospitals restricts with the mobile and computers which blocks the signals for checking equipment. Therefore the additional for this Wi- Fi is Li-fi.Datacan be easily transferred by making use of Li-Fispotlights with the street lamps. The visible light has very huge spectrum. Visible light provides ten thousand times more frequency spectrum compared to the radio waves.

The speed and bandwidth of the signal is directly proportional to the frequency spectrum of that wave form. As the visible light has much big frequency spectrum allowance than traditional radio waves.Li-Fi provides 10,000 times data transfer speed than Wi-Fi.[5] A single radio wave transmits bits of binary data using single flow at a time. Due to limitations in the bandwidth allowance the parallel data transfer can't be achieved. But due to large bandwidth allowance possible in Li-Fi using VLC technique, parallel data transmission is highly possible resulting high speed data transfer using a single LED lamp From the analyze different type of wireless communication for personal area network. A wireless communication system has some drawback like Speed of data transfer, Power consumption, Variation in frequency, Low bandwidth. Analyze wireless fidelity communication and light fidelity communication for personal area network. [6] So here we use the new technology that is Li- Fi which is based on light produced by LEDs in its place of radio frequency range produced by Wi- Fi. By applying this technology we can save power, increasing data rate and create a harmless environment in specific areas. This technology doesn't deal with radio

waves and create better results than Wi-Fi, so widely useful in the area of personal area like Hospital and Nuclear Plant, Science Lab.

Similarly on large scale it can also easily useful in the places where Bluetooth, Wi- Fi and other source of communication can't reach. The rest of the paper is organized as follows: Section 2 introduces to Li-Fi technology. Section 3 introduces the Li-Fi potential applications Section 4 describes more possibilities to use Li-Fi technology . In Section 5, the LED light is discussed and Section 6 is aimed to describe the modern techniques for Li-Fi technology.

## **II. Existing System**

- A. In office, mall, industry and private area which use wireless networks. Some problem occur like black hat hackers hacks others passwords to connect to the Internet that time probably you would be disturbed at the slow speed as many devices access the same time. Every internet user wants to use wireless data but capacity is drained up
- B. The driving of cars is handled by humans so error may occur and accidents is highly possible while driving there is a chance to collide the two cars due to the lack of visibility and over speed in high way roads and doesn't have the display to show the front travelling car and its condition we cannot able to control ones if the brake failure or using of the control
- C. The speed on most wireless networks is up to the range of specific limit but people wants high speed network
- D. There are many positions in which people get frustrated with the dull performance signals of Wi-Fi at a place with various network connections in seminars conferences etc.

## **III. Proposed System**

This paper proposes a Li-Fi based system to transfer data from one device to another device using visible light. The proposed system consists of Li-Fi technology and its applications .the applications were used in various fields .the future generation is depend on Li-Fi..In every room of home or office will have several of these devices some future techniques will track head and eye movements and will coordinate glowing various light fields to the eyes such that each person in the room continually receives an independently connection With such an optical Li-Fi network

## **IV. Lifi Technology**

In 2011, Harald Haas was the first one to coin the term Light Fidelity (Li-Fi) .Li-Fi is a high speed bi-directional fully connected, visible light wireless communication system and is equivalent to Wi-Fi, which uses radio frequency for communication The Wi-Fi signals have the problem of interference with other RF signals such as its interference with

pilot navigational equipment signals in aircraft. Therefore, in the areas that is sensitive to electromagnetic radiation (such as aircrafts).[3] Li-Fi can be a better solution. A Li-Fi also lends support to the Internet of Things (IOT). A speed up to 10Gbits/s is obtained using Li-Fi, which is 250 times more than the speed of super-fast broadband [3]

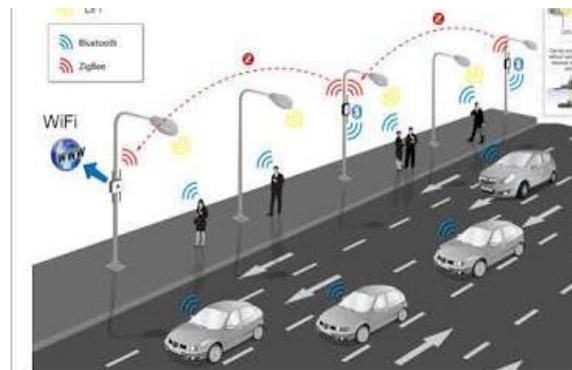


**Fig.2 Replacing Wi-Fi with Li-Fi (In the above figure the devices were accessed by Li-Fi).**

#### IV. Applications

##### A. Li-fi through street light

Any private or public lighting containing street lamps can be used to provide Li-Fi hotspots and the same infrastructures and sensor infrastructure can be used to monitor and control lighting and data .LED light bulbs, or on this case our street lamps, can be potentially changed into a wireless router just by adding a small microchip it's even more secure than Wi-Fi because light can't penetrate through walls this means hackers are unable to access your data.



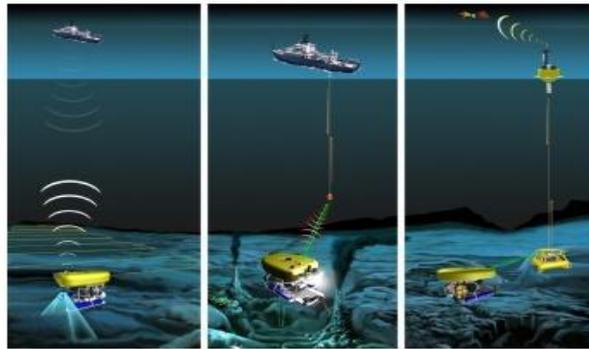
**Fig.3.1 Li-fi through street light.**

Here in this picture the internet has been given to the pedestrians through street light

##### B. Under water communication

RF waves do not travel well in sea water because of its good conductivity. Therefore, VLC communication should be used in underwater communication networks. The Un Tethered Remotely Operated Vehicle (UTROV) is another application of the VLC in under water communication. The different jobs that can be performed using UTROV include viewpoint maintenance of the oceans and positioning opportunity from the ships. Fig. 3.2 outlines the operation of the UTROV. The right pane shows the communication of the UTROV using the optical channel to a fixed infrastructure on the sea floor. In the center one, the communication is achieved by UTROV using an optical

channel with a ship based relay infrastructure. The left most pane shows the communication of the UTROV using low bandwidth underwater communications.



**Fig.3.2 Under water communication.**

The communication under will affects the marine life so this can be replaced with Li-Fi

### C. Aero plains communication

Radio waves are not available everywhere and it has range limitations. Also there are some security related issues like, it is not suitable to use mobile phones in airplanes as it can disturb the avionics system and disturb the RADAR signals. High Frequency radio waves can be dangerous at places like petrochemical plants and petrol pumps as these waves can catch fire the chemicals. There are some issues related with data security that radio waves penetrate through walls and thus can be intercepted by the third person. If a person has knowledge and Bad purposes then he may misuse it.Safe & secure Li-Fi network in airplanes can be used



**Fig.3.3 Li-Fi can be used in aero plains.**

In airplanes Wi-Fi is not supposed to use because it works on radio waves so Li-Fi can be used here

### D. Vehicle to vehicle communication

VLC can be used for vehicle communication due to the presence of the vehicle lights and the existing traffic light frame. The high priority applications indicated by the Vehicle Safety Communications include cooperative forward accident warning, crash sensing, emergency electronic brake lights, road change warning, and stop sign movement supporter, left turn assistant, traffic signal respect warning and curve speed warning. All of the high priority

applications require reliable reach ability with extremely low potential. Due to the extremely low allowable potential in the vehicle safety communication, a high speed visible light communication system like Li-Fi can be used. In an outdoor VLC system using Controller Area Network (CAN) was proposed and the back lights and headlights were used in the proposed system for communication system

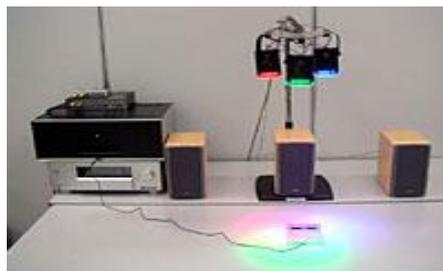


**Fig.3.4 vehicle to vehicle Li-Fi communications.**

Road accidents can be minimized by the communication between the vehicles

E. A sound communication system

Red, green and blue LEDs are used for the transmission of music signals as shown in below figure.



**Fig.3.5 sound signals can be transmitted through Li-Fi.**

F. Location Based Services (LBS):

Highly precise location-specific information services such as presenting and direction finding that enables the receiver to receive appropriate, valid information in a timely manner and location

G. Hospital & Healthcare

Li-Fi emits not at all electromagnetic interference and so does not interfere with medical instruments, it interfered with by MRI scanners

H. Smart Lighting:

Any private or public lighting including street spots can be used to provide Li-Fi hotspots and the similar communications and sensor infrastructure can be used to monitor and control lighting and data.

I. Mobile Connectivity: Laptops, mobiles, tablets and other mobile devices can interconnect directly using Li-Fi.

Small range links give very high data rates and also offers security.

J. Hazardous Environments

Li-Fi provides a safe to electromagnetic interfering from radio frequency infrastructures in environments such as mines and petrochemical plants

K. Security purpose

The application is capable. for museum, cultural center and gallery environments and delivering a tour guide in both audio or text formats and in various languages, and it also allows users to mark their tour, with it added data security; Li-Fi data transmissions do not penetrate through walls so the museum data is more secure, and unlike radio frequency data transfer technology like Wi-Fi, Li-Fi does not generate any electromagnetic pollution

L. Li-Fi technology leads to artificial intelligence

Lidar(a detection system which works on the principle of radar, but uses light from a laser.) systems are integral to almost all autonomous vehicles and many other robots that operate autonomously in commercial or industrial environments

V. Comparison Between Curent technology And Fucture technology

TECHNOLOGY	SPEED
<b>WIRED</b>	
FIRE WIRE	800 Mbps
USB 3.0	5 Gbps
THUNDERBOLT	2×10 Gbps
<b>WIRE LESS (CURRENT)</b>	
WI-FI – IEEE(802.11N)	150 Mbps
BLUETOOTH	3 Mbps
IrDA	4 Mbps
<b>WIRE LESS (FUTURE)</b>	
Wi-Gig	2Gbps
Giga-IR	1Gbps
LI-FI	>10Gbps

## **VI. Conclusion**

The possibilities are many and can be explored further. If this technology can be put in practical use, every bulb can be used approximately like a Wi-Fi hotspot to transmit wireless information. General overview on LED based communication systems through visible light was introduced. Many works were done so far to improve performance of these systems making them the best solution for future wireless communications, providing cheap high bandwidth and fast data transmission for huge number of applications for indoor and outdoor short range communications.

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