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A Survey on Data Communication through Li-Fi

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ABSTRACT: Communication has developed a lotsince ages, through birds, through messengers, through postal and courier service. When the data transmission through electronic medium like phone and email started it became much faster. This type of data transmission is being used with the help of radio waves. For the transmission of radio waves towers and transmitters are required. This is known as Wi-Fi technology. Because of this hardware requirement this data transmission is costly and the increasing demand for data is putting lot of pressure on thesystem. Herald has has suggested a new method of data transmission in his TED GLOBAL TALK in 2011.this could be economical and faster. This is knownasLi-Fi technology. In this survey we tried to compare the Wi-Fi using radio waves and the Li-Fi using the visible light for communication. Also we tried to briefly touch upon the possible application.

I. INTRODUCTION.

Now a days internet has become one of the main utilities like the electricity and water. The internet usage is increasing. Previously when the internet was being used in computers, people were using the internet through the date cable. But as the No. of users of the smart phones are increasing, people tend to use the internet at every available opportunity.

This increased usage of internet was supported by the development of Wi-Fi.

This Wi-Fi system uses Radio Frequency waves which has lot many limitations.Some of them are (1)

II.LIMITATIONS OF WI-FI

A.CAPACITY:

The Radio Frequency (RF)waves are costly. Because, more usage of internet needs more spectrum and thecapacity of the spectrum is limited. Moreover, for the transmittance of the

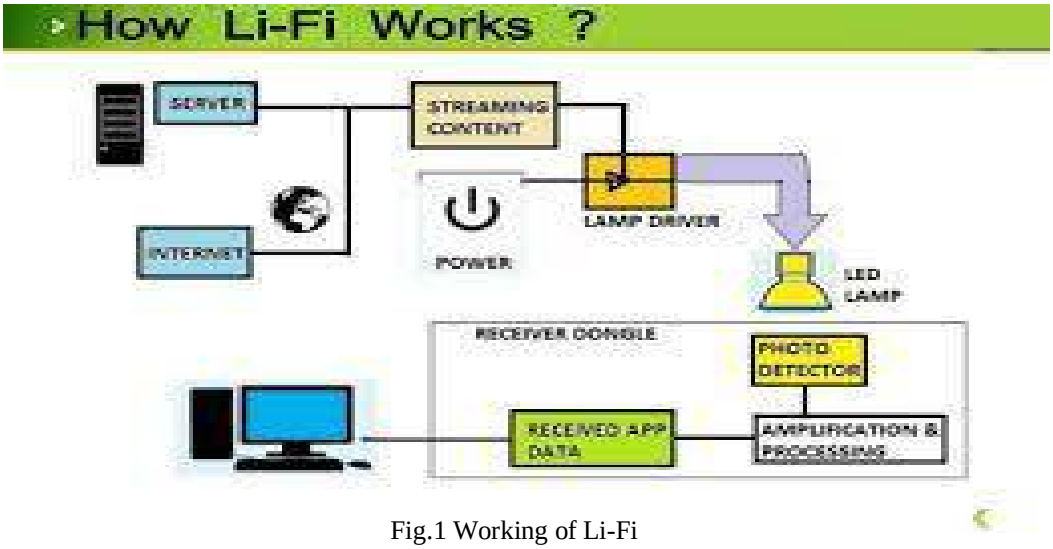

Fig.1 Working of Li-Fi

radio waves for a greater population needmore base stations. Hence the capacity of the Wi-Fi is limited.

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B.EFFICIENCY:

Most of the energy consumed in the base stations is not for the transmittance of the RF waves- but for the cooling of the base station instruments. Hence the efficiency of the base station is approximately 5 percentage only. Because of this it is very costly too.

C.AVAILABILITYLIMITATIONS:

Because the Wi-Fi is using the RF waves, it can interfere with the equipments in an aeroplane or in an operation theatre. Similarly RF waves can cause fire sparks some times and hence they are not used in petrochemical industries also.

D.SECURITY:

RF waves can penetrate through the walls of a room. So others can intercept the RF waves and use your network for their work with bad intentions.

In order to overcome all these limitations HaraldHass proposedthe idea of LI-FI in July-2011at the TED-Global talkon Visible Light Communication, in Edinburg, Scotland**.** In that talk itself he showed a working model-the use of Li-Fi for the communication of the data between the LED light and a data analyzer to project a HD video. However he anticipated lot many applications would be developed in the future using this Li-Fi technology.

III.PRNCIPLE

A.1. LI-FI BASIC PRINCIPLE:

We all know the Wi-Fi means Wireless-Fidelity. Similarly Li-Fi is the acronym for the Light Fidelity.

Here the basic principle is LED light can be switched “ON” and “OFF” very fast. If the ONis equal to the digital “1” then the OFF is equal to digital “0”. Hence the On&Off can be used to

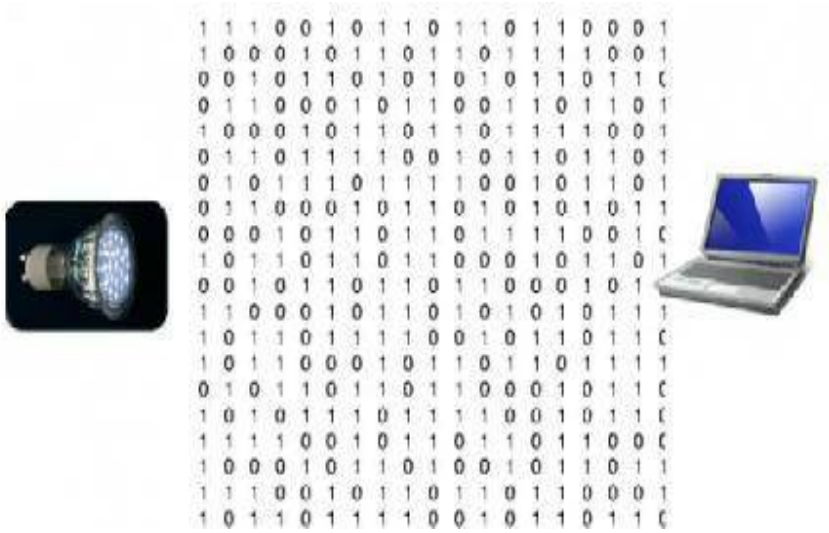

Fig.2 Method of data transmission

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Communicate the BITS of a BI NARY language which forms the basis of the data transmission. Unlike the RF waves the visible light has 10000 times more frequency. Hence it can transmit the data at a faster speed compared to the R F waves used in Wi-Fi. If only one LED is transmitting the ON-OFF signals then the speed may be limited. BUT if an array of LEDS are used then the Data may be transmitted at very high speed.

The device should be having the following components to function efficiently.

- **An wired internet connection** to receive the

data from the web

- **A controller** - to convert the internet data into

the On-Off signals for the LEDs

- **A group of LEDS-** to give the ON-OFF signalsfor the device to be used for data communication.

- **A photo Detector-** to receive the data

B. WORKING PROCEDURE:

Name	Wavelength	Frequency (Hz)	Photon Energy (eV)
Gamma ray	Less than 0.01 nm	more than 10 EHz	100 keV - 300+ GeV
X-ray	0.01 - 10 nm	30 EHz - 30 PHz	120 eV - 120 keV
Ultraviolet	10 nm - 400 nm	30 PHz - 790 THz	3 eV - 124 eV
Visible	390 nm - 750 nm	790 THz - 405 THz	1.7 eV - 3.3 eV
Infrared	750 nm - 1 mm	405 THz - 300 GHz	1.24 meV - 1.7 eV
Microwave	1 mm - 1 meter	300 GHz - 300 MHz	1.24 μeV - 1.24 meV
Radio	1 mm - km	300 GHz - 3 Hz	12.4 feV - 1.24 neV

The working procedure of the Li-Fi is very simple. The On & OFF LED signals bulbs are received by the photo detector of the device. This photo detector converts the ON-OFF into Binary digits. Then these Binary digits are converted into the data(picture or the document)by the controller of the receiving equipment. (3)

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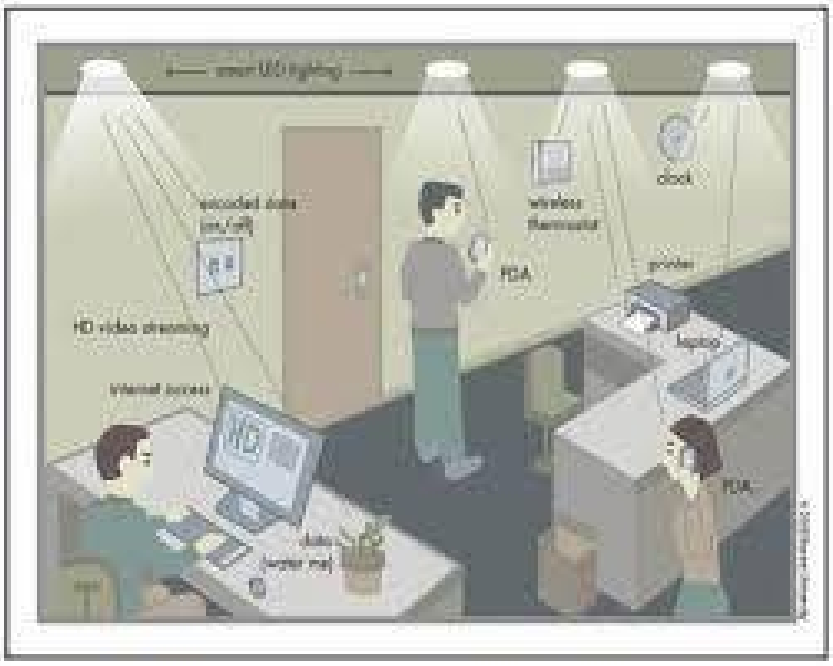

The LEDs can be put ON & OFF very fast- which the human eye is not able to detect. BUT the receiving photo detectors can detect these fast changing signals into binary codes which can be further converted into the data by the controller.

IV. ADVANTAGE S OF LI-FI:

Cost effective:

The additional advantage of these fast changing LEDSs are that, they ca n be used for the illumination of the room since the human eye is not able to detect the ON- OFF. (This phenomenon is similar to the continuous moving picture). Thus we pay for the illumination an d get the data usage free.(1)

Plenty of availability:

It is estimated that at present 14 billion LED bulbs are being used world wide compared to the 1.4 million base stations of the RF waves. Hence there is no limitation for the Light source of Li-Fi.

Safety:

The wavelength frequency and photon energy details of various rays of the electromagnetic spectrum is given in the following table. It has been scientifically proved that the gamma rays are not good for health. X rays are used in the hospital for limited applications. The UVV rays are good for the destruction of the bacteria. I R waves, micro waves and radio waves are also harmful if exposed continuously. But people have been using the Visible light spectrum for hundreds of year now without any issue. Since the Li-fi uses the Visible light spectrum it is safe in all the aspects

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No Limitations:

Since the Li-Fi is using only visible light, it can be freely used in the hospitals and petrochemical Industries. It can have limited applications in air planes too like transmission of internally stored entertainment programs like video or songs. (In air plane also the use of web based internet is not possible as the Li-fi needs a wired internet connection for working set up)

Security:

Because the light waves cannot pass through the walls of the room the date cannot be misused by others. Hence it has full security.

V. APPLICATIONS

Underwater research:

Because of the low frequency the RF waves when used underwater is getting absorbed by the water. Hence the RF waves can not be used for the underwater research. However the light waves can be used without any issues. Hence the Li-Fi can be conveniently used underwater.

Spectrum relief:

Because the Li-Fi uses the visible light – the demand on the radio wave spectrum is reduced. Hence the bottle neck areas which puts pressure on the RF wave spectrum can be eliminated by using Li-Fi. (e.g. Tall and high rise building where the RF signal cannot enter with full strength can use the Li-Fi device)

Interconnectivity of the devices:

Laptops, mobile phones, tablets, etc. can be interconnected using the Li-Fi device. The Li-Fi can be used for the office illumination and also for the Data transfer. Li-Fi can be used to reduce the weight of the aeroplanes by eliminating the electric cables. Also the same Li-Fi devices can be used for the "In flight Entertainment" system

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Reduction in the number of road accidents:

Li-Fi Devices can be fitted on the road junctions.

These can communicate the data with the moving vehicles viz. “to slow down, to start, or to stop and wait “and can be useful to reduce the accidents.

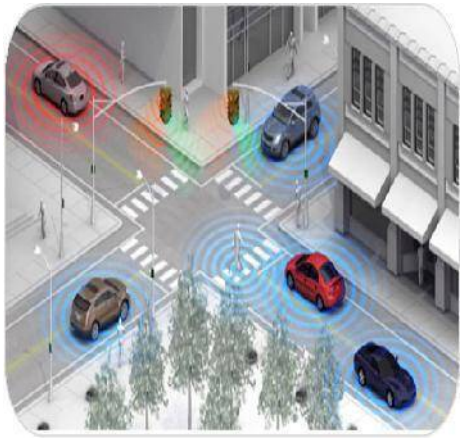

Fig.5 Reduction in the Number of Road Accident

Smart power plants:

Power plants need data for faster actions. But they cannot use Wi-Fi as it can cause sparks and also the RF waves can interfere with the panel equipment’s. But here the Li-Fi can be used safely.

Petrochemical plants and hospitals:

Li- Fi can be used safely in petrochemical plant and hospitals.

Fig.3 Interconnection of the device*Aeroplanes:*

VII. LIMITATIONS OF Li-Fi:

Because light cannot pass through the obstruction, even if the LED source is inadvertently blocked, the data transmission is interrupted. Because of the same reason the range is also limited.

Because light can travel only in a straight line, the Li-Fi cannot pass the data to a moving object (where as the Wi-Fi can do this)

VIII. CONCLUSION

The Li-Fi technology is currently attracting a lot of interest because it is cost effective and energy efficient. The possibilities to develop new applications using this technology are numerous. If this technology is put to practical use, every illuminating source can become a node for the data communication. The technical world is moving towards convergence, i.e., the education, entertainment and communication are moving towards the same point using a single device known as the mobile phone. So the Li-Fi is having a greater scope in the future.Applications like switching on the light and fan when you are entering the house and switching them off when you are getting out can be developed by using the Li-Fi. Similarly many more applications can be developed based on the individual’s imaginations.
Hence the Li-Fi can be considered as the future technology for the data communications.

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