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INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
Vol. 02, Issue 05, May-2022, pp : 21-27

e-ISSN : 2583-1062
Impact Factor : 2.205

DATA TRANSFER USING LI-FI TECHNOLOGY

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ABSTRACT

Li-Fi stands for Light-Fidelity, for the fast-increasing gadgets and to improve more effective use of lights a new technology is developed which is called- LIFI. Li-Fi is a modern technology which is used in progression with WIFI technology. LIFI uses LED lights which helps in faster and flexible data transfer transmitted through Wi-Fi. As light is everywhere, using light as the transmission medium Li-Fi can provide wireless indoor communication.

1. INTRODUCTION

In the era of overcrowded (data communication) world, The Li-Fi is a new way of wireless communication that uses LED lights to transmit data wirelessly Transmission of data is one of the foremost important day to day activities within the fast-growing world. The current wireless networks that connect us to the online are very slow when multiple devices are connected Also with the increase within the amount of devices which access the Internet, the supply of fixed bandwidth makes it far more difficult to enjoy high data transfer rates and to attach a secure network. Radio waves are just a little a part of the spectrum available for data transfer Li-Fi possesses a way broader spectrum for transmission compared to standard methods of wireless communications that rely on radio waves. The basic ideology. behind this technology is that the info is often transferred through LED light by varying light intensities faster than the human eyes can perceive This technology uses a neighbourhood of the spectrum that's still not greatly utilized the colour spectrum, rather than Gigahertz radio waves for data transfer.

The idea of Li-Fi was introduced for the first time by a German physicist Harald Hass within the TED (Technology, Entertainment, Design) Global talk on light Communication (VLC) in July 2011. He used a table beacon with an LED bulb to transmit a videotape of blooming flowers that was also projected onto a screen behind him. In simple terms, Li-Fi is frequently allowed of as a light- grounded Wi-Fi i.e., rather than radio swells it uses light to transmit data. By adding new and unutilized bandwidth of light to the presently available radio swells for data transfer, Li-Fi can play a serious part in relieving the heavy loads which the present wireless system is facing Therefore it's going to offer fresh waveband of the order of 400 THz compared thereto available in RF communication which is about 300 GHz Also, because the Li-Fi uses the colour diapason, it will help palliate enterprises that the electromagnetic swells coming with Wi-Fi could negatively affect our health. By Communication through visible light, Li-Fi technology has the possibility to change how we access the Internet, stream videos, receive emails and much more. Security would not be an issue as data can't be accessed in the absence of light. As a result, it can be used in high security military areas where RF communication is prone to eavesdropping.

2. ARCHITECTURE OF LI-FI SYSTEM

optic interpretation of Wi-FL Being Visible Light Communication (VLC), boxed Li-Fi uses visible light of electromagnetic diapason between 400 THz and 800 THz as optic carrier for data Li-Fi which can be the future of data communication appears to be a fast and cheap transmission and illumination. It uses presto beats of light to transmit information in wireless medium. The main factors of an introductory LiFi system may contain the following:

a) A high brilliance white LED which acts as transmission source.

b) A silicon photodiode with good response to visible light as the entering element

Switching the LEDs on and off can make them induce digital strings with different combination of 1s and

0s. To induce a new data sluice, data can be decoded in the light by varying the fluttering rate of the

LED. In this way, the LEDs work as a sender by conversion the light with the data signal. The LED affair appears constant to the mortal because they're made to flicker at a phenomenal speed (millions of times per second) and it's insolvable for mortal eye to descry this frequency Communication rate further than 100 Mbps can be achieved by using high speed LEDs with the help of colourful multiplexing ways. And this VLC data rate can be further increased to as high as 10 Gbps via resemblant data transmission using an array of LED lights with each LED transmitting a different data sluice.

The Li - F transmitter system comprises of four primary subassemblies:

Bulb

- RF Power Amplifier Circuit (PA)

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- Printed Circuit Board (PCB)
- Enclosure

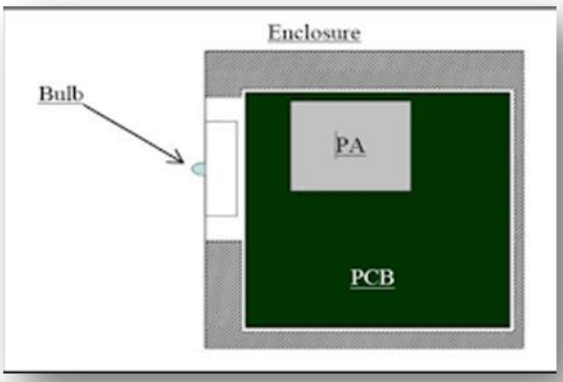

Fig 1: Block Diagram of Li - F_ {1} sub-assemblies.

The Published circuit board (PCB) controls the electrical inputs and labours of the beacon and houses the microcontroller used to manage different beacon functions. A Radio Frequency (RF) signal is generated by the Power Amplifier and is directed into the electric field of the bulb. As a result of the high attention of energy in the electric field, the contents of the bulb will get wracked into a tube state at the bulb's centre. And this controlled tube in turn will produce a violent source of light All of these subassemblies are contained in an aluminium quadrangle as shown in Fig. 1 over.

Li-Fi Bulb sub-assembly:

The bulb sub- assembly is the heart of the Li-Fi emitter. It consists of a sealed bulb bedded in a dielectric material which serves two purposes one, it bears as a waveguide for the RF energy transmitted by the PA (Power Amplifier) and two, it acts as an electric field absorption that focuses the energy into the bulb. The collected energy from the electric field swiftly heats the material in the bulb to a tube state that emits light of high intensity of Visible light spectrum. Figure 3 shows the sub- assembly of the bulb

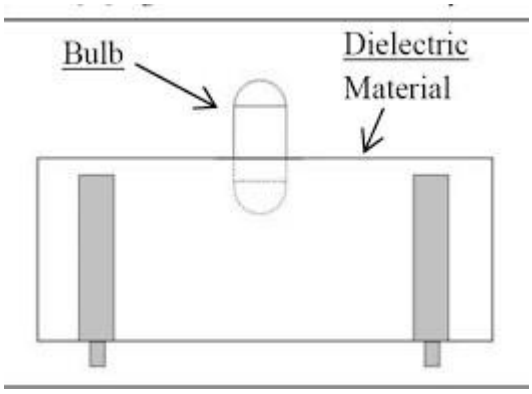

Fig 2: Bulb Sub Assembly

There are colourful essential advantages of this approach which includes high brilliance, excellent colour quality and high luminous efficacity of the emitter-in the range of 150 lumens per watt or lesser. The structure is mechanically robust without typical declination and failure mechanisms associated with tungsten electrodes and glass to essence seals, performing in useful beacon life of hours. In addition, the unique combination of high temperature tube and digitally controlled solid state electronics results in an economically produced family of lights scalable in packages from to over lumens. Important factors that should be considered while designing Li-Fi are as follows

1) Presence of Light
2) Line of Sight (Los)
3) for better performance use fluorescent light & LED

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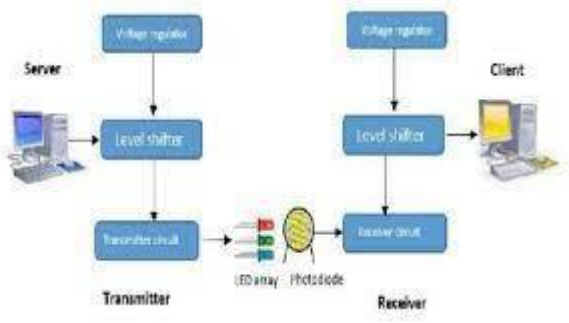

Fig 3: Construction of Li-Fi System

3. WORKING OF LI-FI

Basic Concept:

Light Fidelity (Li-Fi) technology is a wireless communication system grounded on the use of visible light between the violet (800 THz) and red (400 TH2). Unlike Wi-Fi which uses the radio part of the electromagnetic diapason, Li-Fi uses the optic diapason i.e., Visible light part of the electromagnetic diapason The principle of Li-Fi is grounded on transferring data by breadth modulation of the light source in a well- defined and formalized way. LEDs can be switched on and off faster than the mortal eyes can descry since the operating speed of LEDs is lower than 1 second. This unnoticeable on-off exertion enables data transmission using double codes. However, a digitalis's transmitted and if the LED is out, a digital'0'is transmitted Also these LEDs can be switched on and off veritably snappily which gives as a veritably nice occasion for transmitting data through LED lights, If the LED is on. This puts Li-Fi in a unique position of extremely fast wireless communication over short distances

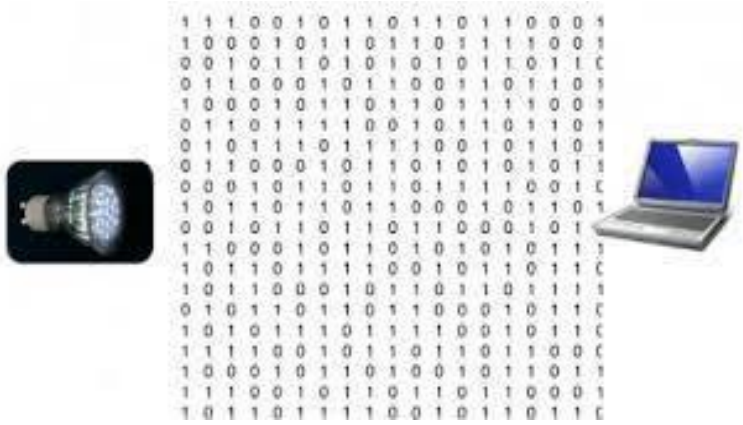

Fig 4: Li-Fi Transmission

How it Works:

The working of Li-Fi is authentically simple. There's a light emitter on one end ie an LED transmitter, and a print sensor (light detector) on the other. The data input to the LED transmitter is encrypted into the light (technically appertained to as Visible Light Communication) by varying the fluttering rate at which the LEDs flitter 'on' and 'out` to induce different strings of Is and 0s. The on off exertion of the LED transmitter which seems to be unnoticeable (The LED intensity is modulated so fleetly that mortal eye cannot notice, so the light of the LED appears constant to humans). enables data transmission in light form in agreement with the incoming double canons switching ON a LED is a logical 'I', switching it OFF is a logical 0. By varying the rate at which the LEDs flitter on and off, information can be decoded in the light to different combinations of 1s and 0s.

In a typical setup, the transmitter (LED) is connected to the data network (Internet through the modem) and the receiver (print sensor light detector) on the entering end receives the data as light signal and decodes the information, which is either displayed on the device connected to the receiver. The receiver (print sensor) registers a double'1'when the transmitter (LED) is ON and a binary'0'when the transmitter (LED) is OFF. accordingly, twinkling the LED multiplex times or using an array of LEDs (conceivably of a limited different colours) will finally hand over data grades in the lea of hundreds of Mbps. The Li-Fi working is explained in a block- illustration (Fig 5)Fig 5: Block diagram of Li-Fi Sub System (Source):

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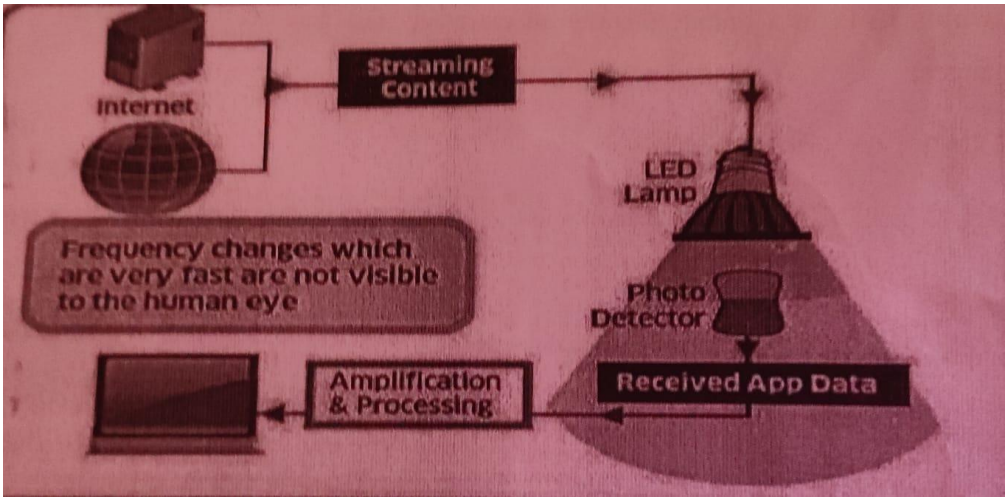

Hence all that's needed, is some or an array of LEDs and a regulator that controls/ encodes data into those LEDs. All bone must do is to vary the rate at which the LEDs flitter depending upon the data input to LEDs. another data rate improvements can be made in this manner, by using array of the LEDS for correspondent data transmission, or utilizing compounds of red, green and blue LEDs to change the light's frequency, with each frequency garbling a different data channel. Figure 6 shows working deployment of a Li-Fi network connecting the impulse in a space.

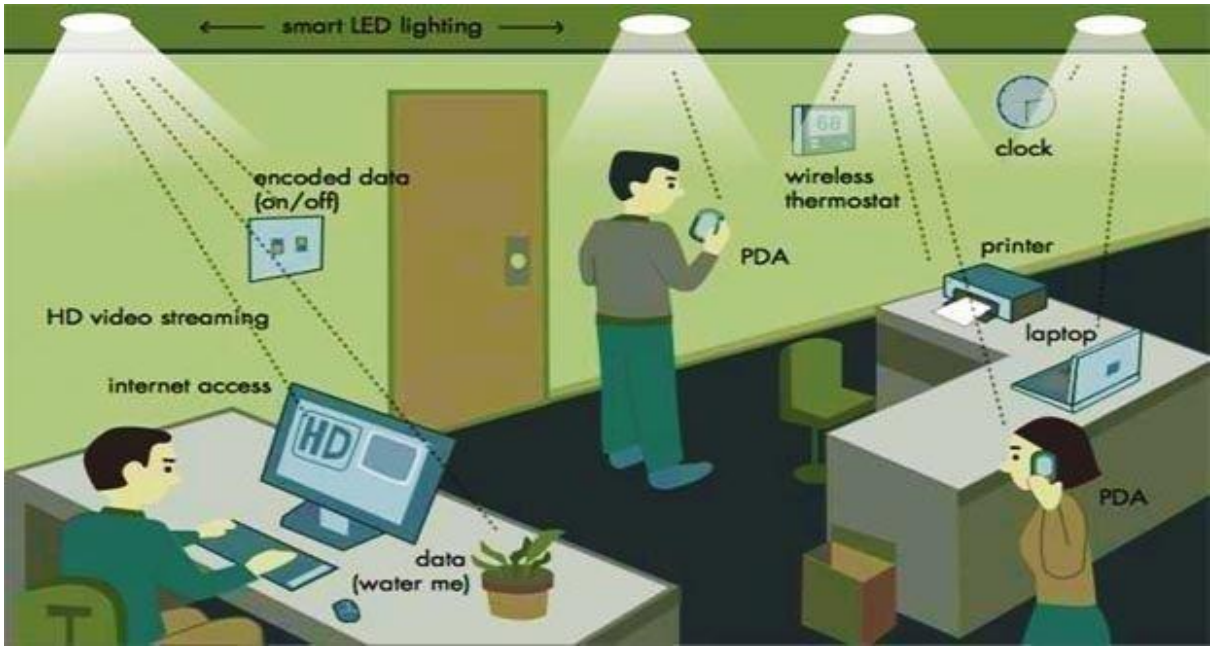

Fig 6: Li-Fi system connecting devices in a room

Why Visible Light Communication:

The frequency diapason that's available to us in the atmosphere consists of numerous surge regions like X-rays, gamma shafts, -v region, infrared region, visible light shafts, radio swells, etc. Any one of the below swells can be used in the forthcoming communication technologies but why the Visible Light part is chosen? The reason behind this is the easy vacuity and lower dangerous goods that do due to these shafts of light. VLC uses the visible light between 400 TH 2 (780 nm) and 800 THz (375 nm) as medium which are less dangerous for high- power operations and humans can fluently perceive it and cover themselves from the noxious goods whereas the other surge regions have following negatives

- Radio waves are expensive (due to spectrum charges) and less secure (due to interference and possible interception etc.)
- Gamma rays are harmful because it could be dangerous dealing with it, by the human beings due to their proven adverse effects on human health
- X-rays have health issues, like the Gamma Rays.
- Ultraviolet light can be considered for communication technology purposes at place without people, otherwise they can also be dangerous for the human body when exposed continuously.
- Infrared, due to high safety regulation, can only be used with low power.

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Hence the Visible light portion (from red to blue) of the electromagnetic spectrum does not do any detriment to the people as observable shafts are secure to apply, hand over largish bandwidth and also have a promising future in the communication field.

4. COMPARISON BETWEEN LI-FI AND, WI-FI AND OTHER RADIO COMMUNICATION TECHNOLOGIES

Both Wi-Fi and Li-Fi can hand over wireless Internet access to druggies, and both the technologies give data over electromagnetic diapason Li-Fi is a visible light communication technology useful to gain high speed wireless communication. The difference is Wi-Fi technology uses radio swells for transmission, whereas Li-Fi utilizes light swells. Wi-Fi works well for general wireless content within structure/ lot/ emulsion, and Li-Fi is ideal for high viscosity wireless data content inside a confined area or room and is free from hindrance issues unlike the Wi-Fi

Table I shows a comparison of transfer speed of various wireless technologies. Table II shows a comparison of Li-Fi with Wi-Fi

Table 1: Comparison of speed of various wireless technologies

Technology	Speed
Li-Fi	~1 Gbps
Wi-Fi – IEEE 802.11n	~150 Mbps
IrDA	~4 Mbps
Bluetooth	~3 Mbps
NFC	~424 Mbps

Table 2: Comparison of *Wi-Fi* and *Li-Fi*

Parameters	Li-Fi	Wi-Fi
Spectrum used	Visible Light	RF
Standard	IEEE 802.15.7	IEEE 802.11
Range	Based on Light Intensity (<10)	Based on Radio propagation & interference (<300m)
Data Transfer Rate	Very high (~1 Gbps)	Low (100 Mbps – 1Gbps)
Power consumption	Low	High
Cost	Low	High
Bandwidth	Unlimited	Limited

Shortcomings of Radio Waves Transmission vis-à-vis Li-Fi Transmission:

The following are the basic issues with radio waves:

a) Capacity: Wireless data is transmitted through radio swells which are narrow and valuable. It has a narrow bandwidth, vis-à-vis Li-Fi. With the fleetly growing world and evolution of technologies like 3G, 4G and so on we're running out of radio diapason.

b) Energy Efficiency: There are a large number of cellular radio base stations that consume massive quantum of energy. Utmost of the energy is used for cooling down the base station rather of transmission. Thus, effectiveness of similar Radio base stations is veritably low.

c) Vacuity: of radio swells is a big concern. Further, Radio swells aren't judicious to be used in planes and at places where radio hindrance may beget undesirable/ disastrous result.

d) Security: Radio swells can access through walls. They can be intercepted. However, they may misuse it, if someone has knowledge and bad intentions. This causes a huge security concern for Wi-Fi.

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Advantages on Li-Fi:

Li-Fi, which uses visible light to transmit signals wirelessly, is an arising technology poised to contend with WiFi Also, Li-Fi removes the boundaries that have been put on the doper by the Radio swell transmission similar as Wi-Fr as clarified above vide

Advantages of Li-Fi technology includes.

- Efficiency Energy consumption can be minimised with the use of LED which are formerly available in the home, services and mullet. For lighting purpose. Hence the transmission of data taking negligible fresh power, which makes it veritably effective in terms of costs as well as energy. But when come to Wi-Fi is medium
- High speed Combination of low hindrance, high bandwidths and high- intensity affair, help Li-Fi give high data rates i.e., 1 Gbps or indeed beyond.
- Availability: Availability isn't an issue as light sources are present everyplace. Wherever there's a light source, there can be Internet. Light bulbs are present everyplace in homes, services, shops, promenades and indeed aeroplanes, which can be used as a medium for the data transmission. LED lights are available everywhen. But Wi-Fi string and router are not.
- Cheaper Li-Fi not only requires less factors for its working, but also uses only a negligible fresh power for the data transmission. Li-Fi is much cheaper than Wi-Fi.
- Security One main advantage of Li-Fi is safeguard. Since light can't pass through opaque structures, Li-Fi internet is available only to the users within a locked area and can't be prohibited and misused, outside the area under operation.
- Li-Fi technology has a great compass in future. The expansive growth in the use of LEDs for illumination indeed provides the occasion to integrate the technology into a plethora of surroundings and operations.
- It has less interference.
- Li-Fi can pass through salty seawater as light can travel through water.
- It can work in the dense region.

Limitations of Li-Fi:

- Some of the major limitations of Li-Fi are Internet cannot be penetrated without a light source. This could restrict the emplacements and condition in which Li-Fi could be used.
- It requires a near or plenary line-of- sight to transmit data Opaque obstacles on pathways can affect data transmission.
- Natural light, sun, and everyday electric light can affect the data transmission. speed
- Light swells do not access through walls and so Li-Fi has an important shorter range than Wi-Fi High original installation cost, if used to set up a full-fledged data network.

  Yet to be developed for mass scale relinquishment.

Sustainability of Li-Fi:

As Li-Fi can work without bone like as routers, modems, signal repeaters, surge amplifiers and antennas, it would not dodge an excess charge. At present, Li-Fi cannot totally substitute Wi-Fi as a connectivity source. Still, with the expanded consumer base and demand of fast internet access, it's prognosticated that the Li-Fi would be released to the general public in early 2022 and unborn homes and structure may be housed with Li-Fi.

5. Applications of Li-Fi

- Education systems: Li-Fi is the rearmost technology that can supply fastest speed for Internet access. So, it can compound replace Wi-Fi at educational institutions and at companies so that the people there can make use of Li-Fi with the high speed.
- Medical Applications: Operation theatres (OTS) don't allow Wi-Fi due to radiation concerns Usage of Wi-Fi at hospitals interferes/ blocks the signals for monitoring equipment’s. So, it may have dangerous effect to the patient's health, due to inappropriate working of medical apparatus. To overcome this and to make OT tech expertise Li-Fi can be used to pierce internet and to control medical outfits. This will be salutary for conducting robotic surgeries and other automated procedures.
- Cheaper: Internet in Aircrafts. The passengers travelling in aircrafts get access to low speed Internet that too at a veritably high price. Also, Wi-Fi isn't used because it may intrude with the nautical systems of the aviators. In aircrafts Li-Fi can be used for data transmission Li-Fi can fluently give high speed Internet via every light source similar as overhead reading bulb, etc present inside the aeroplane.
- Aquatic operations (underwater application): Aquatic ROVS (Ever Operated Vehicles) operate from large lines that supply their power and allow them to admit signals from their aviators over. But the tether used in ROVs isn't long enough to

allow them to explore. larger areas. However, high-powered beacon-- also they would be important freer to explore, If their cables were replaced with light say from a submerged. They could also use their headlamps to communicate with each other, recycling data autonomously and transferring their findings periodically back to the face. Li-Fi can indeed work aquatic where Wi-Fi fails fully, thereby throwing open endless openings for military aquatic operations.

- Disaster operation Li-Fi can be used as an important means of communication in times of disaster similar as earthquake or hurricanes. The average people may not know the protocols during similar disasters. Subway stations and coverts, common dead zones for utmost exigency dispatches, pose no inhibition for Li-Fi.

  Operations in sensitive areas Power shops need presto,inter-connected data systems so that demand, grid integrity and core temperature (in case of nuclear power shops) can be covered. The Radio communication hindrance is considered to be bad for similar sensitive areas girding these power shops. Li-Fi can offer safe, abundant connectivity for all areas of these sensitive locales. Also, the pressure on a power shops own reserve.

6. USE CASES

- LADAKH: The Students' Educational and Cultural Movement of Ladakh (SECMOL) has become the first-of-its-kind institute in the Union Territory to have an internet connection using Light Fidelity (LiFi) technology.
- AHMEDABAD In the first step towards creating smart townlets in Gujarat, an Ahmedabad incipiency has powered up two townlets with high- speed internet using LiFi- grounded technology. Akrund and Navanagar townlets in Aravalli quarter of Gujarat have come India's first smart townlets with LiFi- grounded internet connectivity.

7. FUTURE SCOPE

As light is everyplace and free to use, there's a great compass for the use and elaboration of Li-Fi technology. However, each Li-F bulb can be used to transmit wireless data, if this technology becomes mature. As the Li-Fi technology becomes popular, it'll lead to a cleaner, greener, safer dispatches and have a bright future and terrain. The conception of Li-Fi is inferring numerous people as it's free (bear no license) and briskly means of data transfer. However, people will use this technology more and more, If it evolves briskly.

8. CONCLUSION

Although there is still a long way to go to make this technology a marketable success, it promises a great eventuality in the field of wireless internet. A significant number of experimenters and companies are presently working on this conception, which promises to break the problem of lack of radio diapason, space and low internet connection speed. By deployment of this technology, we can resettle to greener, cleaner, safer communication networks. The veritably conception of Li-Fi promises to break issues similar as, deficit of radio- frequency bandwidth and eliminates the disadvantages of Radio communication technologies. Li-Fi is the forthcoming and growing technology acting as catalyst for colourful other developing and new inventions/ technologies. Thus, there's certainty of development of future operations of the Li-Fi which can be extended to different platforms and colourful walks of mortal life.

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