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Department of Electronics & Communication

PROJECT Report on

"DATA TRANSFER THROUGH Li-Fi TECHNOLOGY"

Under the guidance of

Prof. Ajaz Hussain Mir

For the Academic year 2020

SUBMITTED BY

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National Institute of Technology

Department of Electronics and Communication Engineering

CERTIFICATE

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Students of 8th semester in B. Tech (Electronics and Communication Engineering) have completed their final year project and submitted this dissertation in partial fulfilment for the award of Bachelor of Technology.

They have completed their project titled **"Audio Transfer Through Light-fidelity (Li-Fi) Technology"** under the guidance of the undersigned. This report is a bona-fide record of their work.

Prof. AJAZ HUSSAIN MIR
Department of E&C

Place: _____
Date: _____

ABSTRACT

In Wireless communication, Wi-Fi is the most used and effective technology which uses radio waves for data transmission. But because of multiple access, Wi-Fi is facing many challenges namely capacity, availability, efficiency and security. The Wi-Fi emits radio waves which are also not very good, radio waves are very harmful for the human body and radio waves interfere with electrical instruments making them less accurate. This project focuses on developing a Li-Fi (light fidelity) based system and analysing its performance by using it for audio transfer through an LED. This system can be adapted where radio waves are restricted, such as airplanes, hospitals, and in some laboratory. Li-Fi is a novel technology used for high density wireless data transfer without the worries of radio interferences in confined area. This technology tells about a future where data for laptops, smart phones, and tablets will be transmitted in an economic, eco-friendly, and a secure medium of light inside a room.

ABBREVATIONS

- Wi-Fi: Wireless Fidelity
- Li-Fi: Light Fidelity
- VLC: Visible Light Communication
- HD: High Definition
- Mbps: Megabits per Second
- Gbps: Gigabits per second
- IC: Integrated Circuit
- IR: Infra-red
- LOS: Line of Sight
- ROV: Remotely Operated Vehicle
- RF: Radio Frequency

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CHAPTER 1

INTRODUCTION

Wireless Communication VS Visible Light Communication

1.1 What is Wireless Communication?

Wireless communication involves the transfer of data from transmitter to receiver without the use of any conductor such as wires, cables or other electrical conductors.

Wireless communication is a broad term that encompasses all processes and types in which one can connect and communicate between two or more devices using certain devices and technologies.

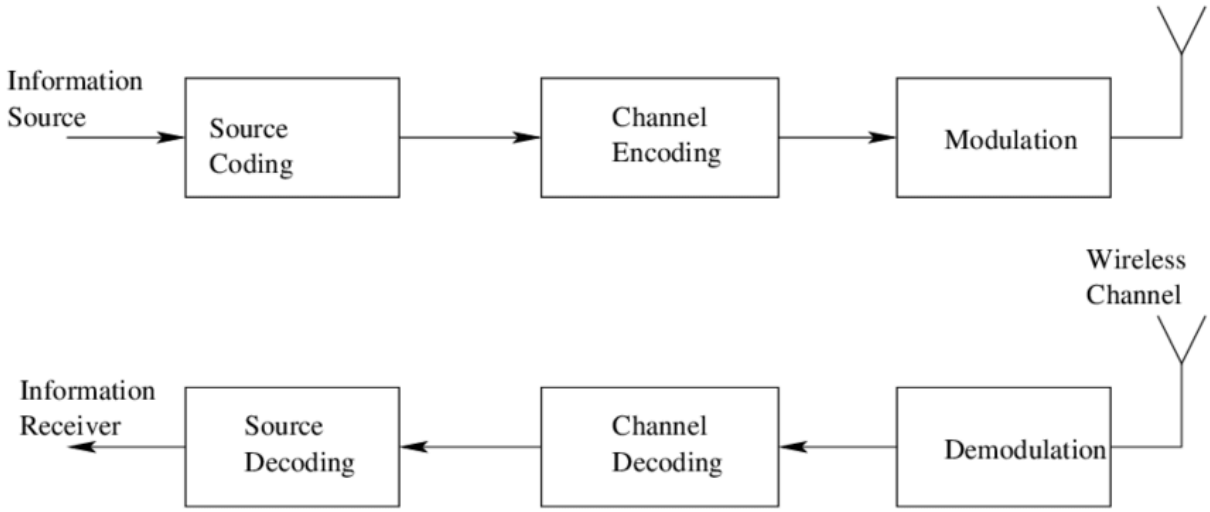


Figure 1. Block Diagram of Wireless Communication

1.1.1 History:

In early times the type of wireless communication used involves the use of pigeons as carrier, pigeons used to fly from one place to other carrying the information that had to be communicated also at that time human used smoke as signals for communication, these early methods of communication were inspiration for the modern day wireless communication. Further the first wireless communication was done in 1890 which is commonly known as radio telegraphy after that in 1920s it was replaced by world radio.

After the first wireless communication till now, the wireless communication has drastically changed, presently the equipment used, speed, cost, and data transfer rates are very efficient

1.1.2 Features of Wireless Communication:

- Wireless communication system has very large range of operation i.e. it can be few meters like in Wi-Fi or it can be kilometers like in radio communication.
- It has a large number of applications such as cellular communication, wireless access to internet, internet of things, etc.
- Wireless communication provides very easy and efficient connections between devices all over the world.

Specifications	Bluetooth	Wi-Fi	RFID
Frequency	2.4GHz	2.4GHz,5GHz	LF,HF,UHF,Microwave
Data Rate	1Mbps	54Mbps	1-200Kbps
Connection Time Setup	3sec	30ms	Depend on type of RFID
Range(Maximum)	10m	100m	0.1-100m

Table 1. Different Types of Wireless Communication

1.1.3 Advantages of Wireless Communication:

- Cost Effective- It is cheaper than some other communication like wired communication because the cost of wires is removed only very less physical infrastructure is required to start a wireless communication
- Flexibility- It allows communication between distant devices irrespective of the position. It is not necessary to be at a particular position to establish a connection.
- Speed- In the last few years the improvement in the speed of wireless communication is increased to a very high number which helps in better connectivity and accessibility.
-

1.2 What is Visible Light Communication:

Virtual light communication (VLC) refers to communications technology, which uses a visible light source as a signal transmitter, air as a transmission channel, and an appropriate photodiode as the receiver part of the communication.

1.2.1 Visible Light:

Visible light is the form in which electromagnetic radiation with wavelengths in a particular range is interpreted by the human brain.

- Visible light is comprised of visually-perceivable electromagnetic waves.
- The visible spectrum covers wave lengths from 380 nm to 750 nm.

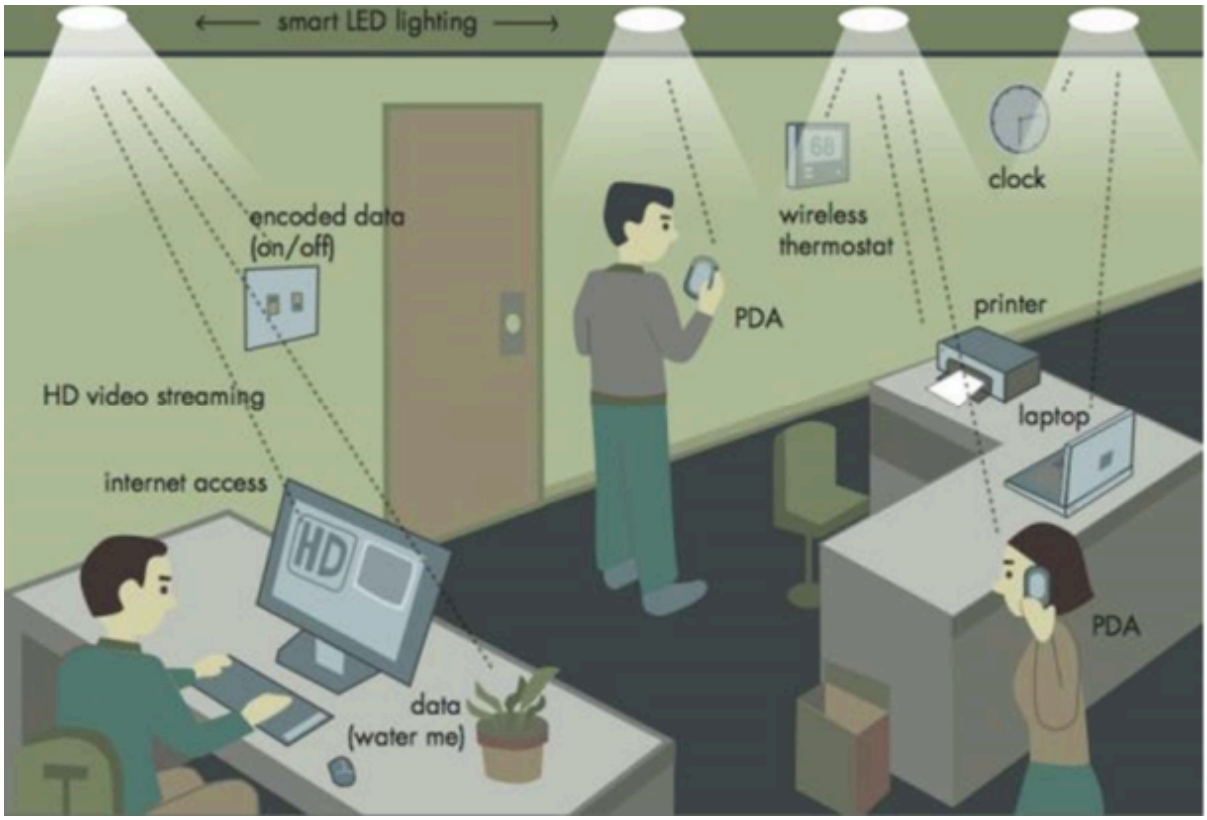


Figure 2. Basic Li-Fi Implementation

1.2.2 History of Visible Light Communication:

The Visible Light Communication started in 1880s in Washington DC where a Scottish born scientist Alexander Graham Bell invented the photophone. Photophone transmitted speech on modulated sunlight over several hundred meters.
After Alexander Graham Bell major work done in the field of visible light communication was in 2006 when use of LEDs was started to transmitted data, since then the visible light communication has reached to a very advanced level.
In 2010 demonstration of data transfer with 500 Mbit/s using a single white LED was done over the distance of 5 meters, this was demonstrated by team of researchers
from Siemens and Fraunhofer Institute for Telecommunications.

1.3 Difference between Wireless Communication and Visible Light Communication

	VISIBLE LIGHT COMMUNICATION	WIRELESS COMMUNICATION
1	Visible light communication (VLC) is a data communications variant which uses visible light between 400 and 800 THz (780-375 nm	Wireless communication spans the spectrum from 9 kHz to 300 GHz
2	Data rate can go upto 35 Gbps	Data rate can go upto 10 Gbps depending upon the type of infrastructure used.
3	Data transfer is done through light.	Data transfer is done through air.
4	Used in Li-Fi	Used in Wi-Fi

Table 2. Difference between VLC and Wireless Communication

1.4. Advantage of Visible Light Communication over Wireless Communication

1.Since the communication will be done through air, there will be no interference with radio systems.

2.It will be better because the infrastructure cost will decrease as already present high power

3. LEDs can be used in visible light communication.

4.Addition of the infrastructure into the old LEDs is nor costly nor complex.

5.Simple opaque objects can be used for data protection.

6.Limiting the communication to a certain area is very easy like a connection can be established such that nobody outside that closed room can interfere.

1.5. Disadvantages of Visible Light Communication

1.Communication cannot be done in the absence of light.

2.Since light cannot pass through opaque objects therefore there are many physical barriers in Visible light communication. For example- walls, trees, etc.

4.During communication other source of light may interfere in the communication.

5.Some other disadvantages of visible light communication includes light absorption, shadowing, beam dispersion etc.

CHAPTER 2

LIGHT FIDELITY(Li-Fi)

2.1. What is Li-Fi?

Everywhere there is light. Look around. Everywhere. Look at your smart phone. It has a flash light, an LED flash light. These are potential sources for high-speed data transmission.

(Harald Hass)

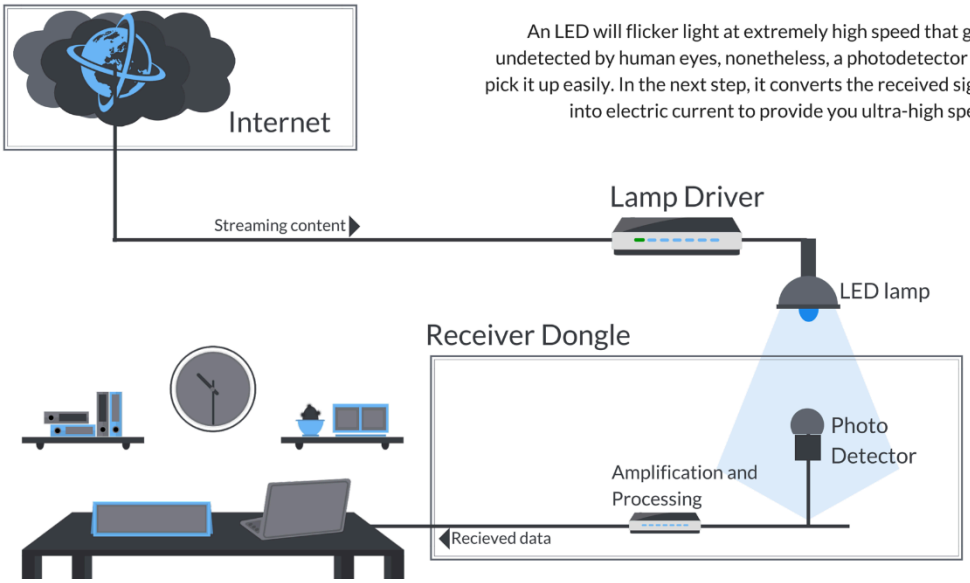


Figure 3. Li-Fi Working

Li-Fi is wireless communication technology which utilizes light to transmit data between devices. The term was first introduced by Harald Haas who is a German Professor of Mobile Communication at the University of Edinburgh.
In technical terms, Li-Fi is a light communication system that is capable of transmitting data at high speeds over the visible light, ultraviolet, and infrared spectrums.
VLC is the main concept that is used to in all communication technologies that use visible light. LI-Fi uses the basic concept of VLC to create a communication that is two-way and provide a high-speed network connectivity.

2.2. History of Li-Fi

The term Li-Fi was first introduced to the world in 2011 in a Ted Talk, to prove the existence of Li-Fi Harald Hass demonstrated transfer of a large HD video through a simple light bulb. Although the term was introduced in 2011 but Professor Harald and his team started their

research in the field of VLC in 2006.

In 2012 a company was started to market Li-Fi and was named puleVLC by professor Harald Haas after some time the company was renamed as pureLiFi and was an original equipment manufacturer (OEM) that was started to increase commercialize Li-Fi and also to implement Li-Fi in already existing LED light bulbs.



Figure 4. Pure Li-Fi.

The advancements in the technology were very fast, in August 2013 LiFi systems were able to demonstrate data rates of over 1.6 Gbit/s over a single-color LED also one of the biggest concerns of the technology which was need of line of sight for communication was somewhat solved in 2013.

2.3 PROJECT- AUDIO TRANSFER THROUGH Li-Fi

2.3.1. EXISTING SYSTEM

Transmitting data through photodiodes has been happening for a long time through our IR Remotes. Every time we pressed a button on our Television remote the IR LED in Remote pulses very fast this will be received by the Television and then decoded for the information. But this old method is very slow and cannot be used to transmit any worthy data. Wi-Fi and Bluetooth are the two consistent wide rang sources used by multiple applications today. However, this method use radio frequency spectrum and noise of the signal is very high. Other inconveniences of these methods are special equipment requirement, high power consumption, and high cost. Secure data transmission is not available here.

2.3.2. PROPOSED SYSTEM

Visible light communication is a new technique of data transmission. In Li-Fi, data is transmitted by modulating the intensity of the light, which is then received by a Photo detector. Visible light communication consists of a light source at transmitter and a photo-detector at receiver. Louder the voice, the glow of the LED will be more. In our proposed system the receiver section interprets light which is detected using a solar panel and converts to the audible sound signal with the help of LM386 based audio amplifier circuit.

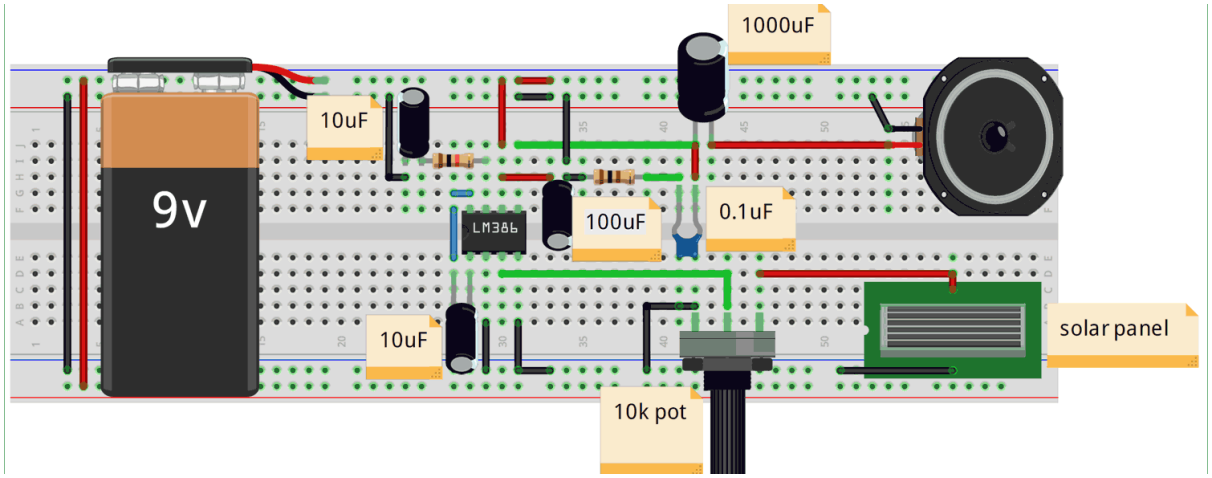


Figure 5. Circuit Diagram of Proposed System

2.3.2.1. BLOCK DIAGRAM

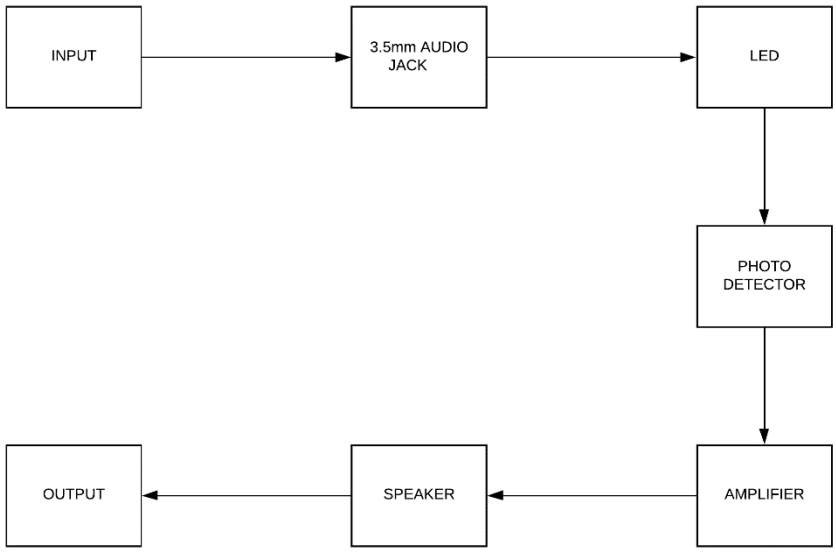


Figure 6. Block Diagram of the Circuit

2.3.2.2. COMPONENTS REQUIRED AND THEIR USE

- 3.5 mm Audio Jack
- LED
- 9V Battery
- 5-6V Solar Panel
- LM386 Based Audio Amplifier

1. 3.5 mm Audio Jack-

It is a mobile connector generally used to connect mobile phone to other audio devices, in daily usage 3.5mm jack is used to take analog input from mobile in the form of voltage.



Figure 7. 3.5 mm audio jack

A basic 3.5mm jack has the following three conductors:

1. Ground
2. Right Audio (Right-hand channel for stereo signals)
3. Left Audio (Left-hand channel for stereo signals)

2. Light Emitting Diode (LED)-

Light Emitting Diodes or simply LED´s, are the most widely used of all the different types of semiconductor diodes available today and are commonly used in TV's and color displays.

Light emitting diodes are made from a very thin layer of heavily doped semiconductor material, depending on the semiconductor material used and the amount of doping, when forward biased an LED will emit a colored light at a particular wavelength.

When the diode is in forward bias, electrons from the conduction band of the semiconductor recombine with holes from the valence band producing sufficient energy to create photons which emit a monochromatic of light. Because of this

thin layer a number of these photons can leave the junction and radiate away producing a colored light output.

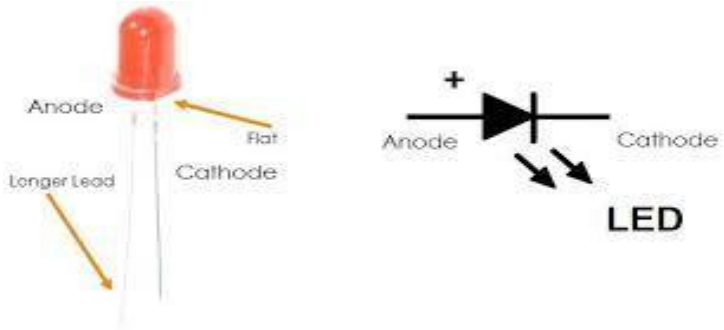


Figure 8. LED and its symbol

In our project the use of LED is very essential, the analog audio signal from the 3.5mm audio jack will will be passed to the LED, left and right conductor from the 3.5mm will be connected to the positive terminal of the LED.
When the input audio signal is connected to the LED, the audio signal produces fluctuations in voltage according to the signal which in turn makes the LED fluctuate, these fluctuations in the LED will be fed to the photodetector used in the project i.e the solar panel.

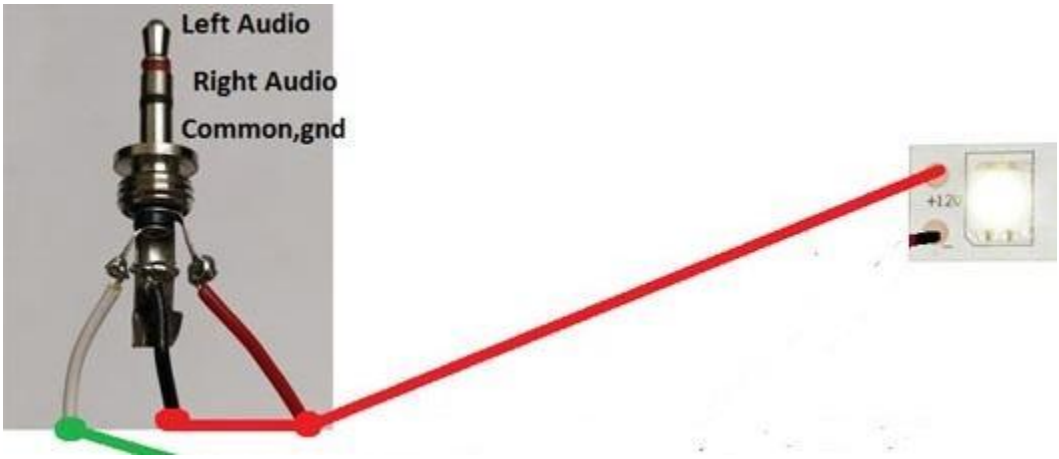


Figure 9. Internal view of Auxiliary pin

3. 9 V Battery-



Figure 10. A 9 V Battery

A 9v battery is a DC power source which was earlier introduced to the world for its use in transistor radios. It is in the shape of cuboid with bounded edges and a polarized snap connector at the top. Majority of 9V batteries are made up from six 1.5 V batteries



Figure 11. 1.5 V batteries combined to form 9 V battery

In our project the 9V battery is used because the power coming from the audio source is not sufficient to make the LED glow hence the battery is used as an external power source to make the LED glow so that the output can be captured at the receiver photo-detector.

After the connection are made between the battery, LED and the 3.5 audio jack, the connections look as shown in the image below:

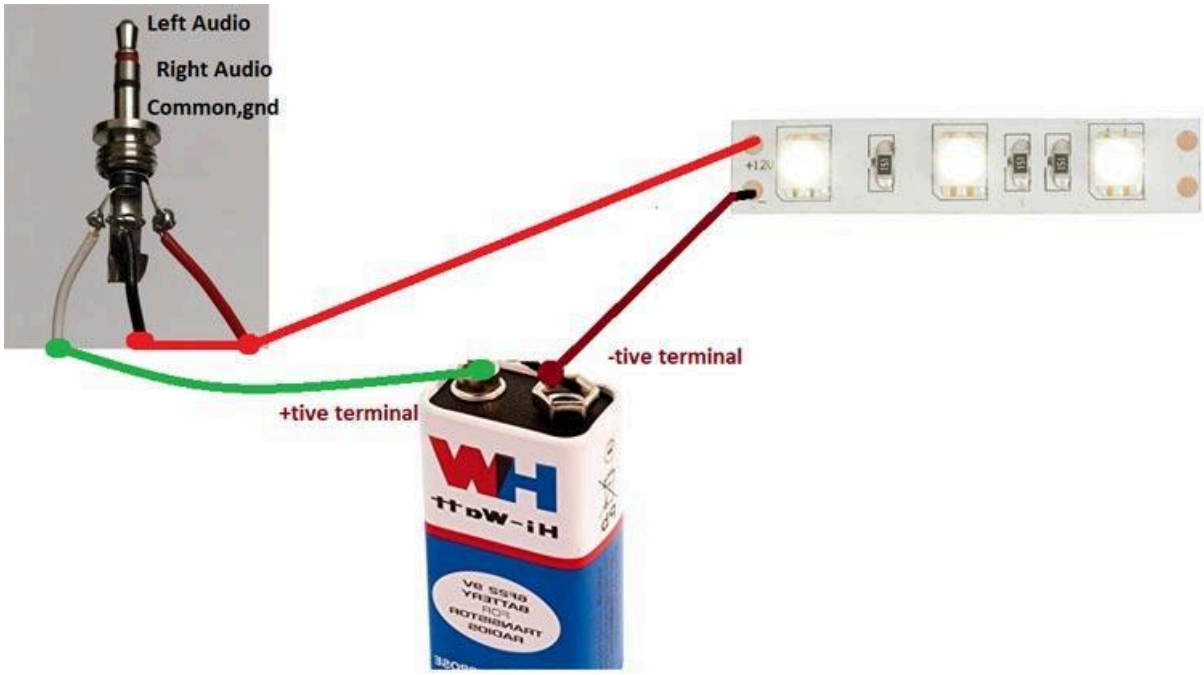


Figure 12. Connection of Aux pin with Battery

4. Solar Panel-



Figure 13. Solar Panel as a Photodetector

Solar panels are made out of photovoltaic cells that convert the sun's energy into electricity. Photovoltaic cells are placed between layers of a semi-conducting material such as silicone. Each layer has different electronic properties that gets energies when hit by photons from sunlight hence creating an electric field. This is known as the photoelectric effect and this effect creates the current needed to produce electricity. In a solar panel the electricity produced is direct current and is changed to alternating current if needed.

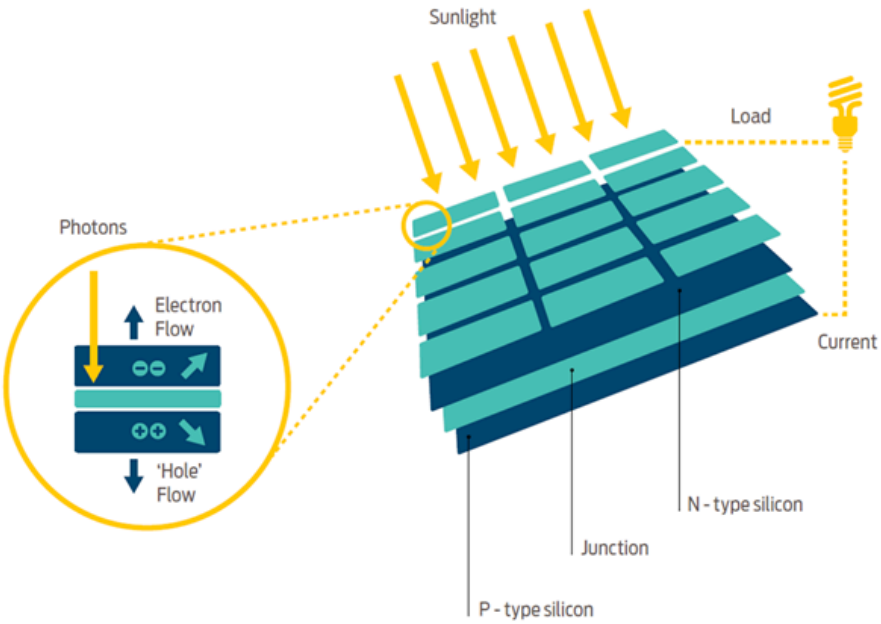


Figure 14. Internal Working of Solar Plate

In our project there is a need of solar panel because the transmitted signal from the LEDs has to be detected, demodulated and acknowledged. So, in order to detect the message signal from the blinking LED light, we use a solar panel or a Solar Cell. The solar panel detects only the variation of the light, and output of the solar panel will be the message signal in the analog form. So, using solar panel we could detect the message signal.

a. LM386 Based Audio Amplifier

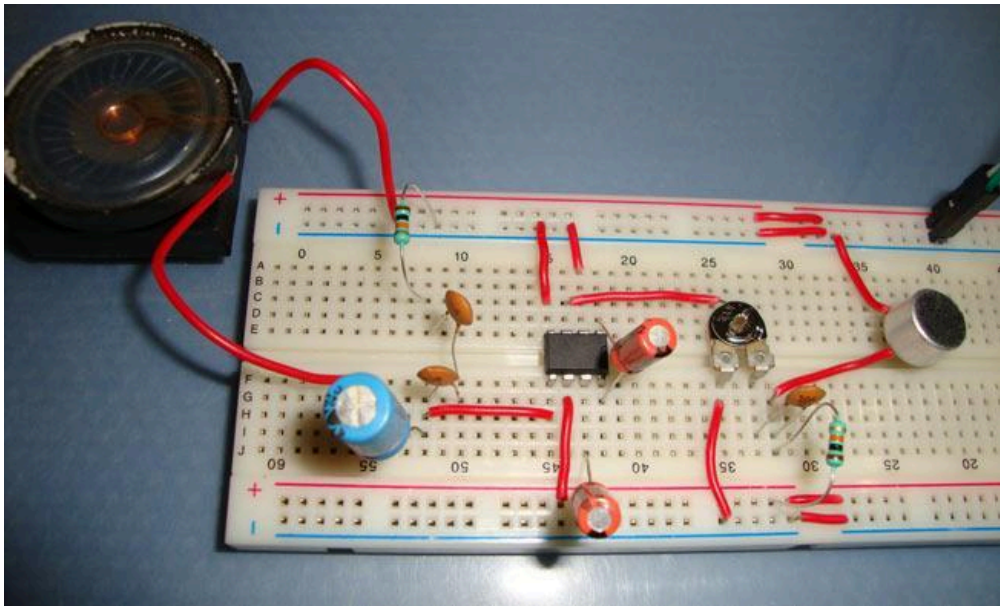


Figure 15 LM386 Based Audio Amplifier

The circuit shown above is an image of LM386 based audio amplifier circuit. This circuit can be used as microphone as well as a room speaker. This circuit can also be used in portable music players, intercoms, radio amplifiers. It is cheap, operates at low power and only need few components to work. LM386 IC is used to amplify sound.

LM386 is a low voltage audio amplifier used in battery powered devices like radios, speakers, etc. The gain range is 20 to 200 and the gain is internally set to 20 but can be increased to 200 by using a resistor and a capacitor between PIN 1 and 8, or just with a capacitor.

Voltage gain simply means that Voltage output is 200 times the Voltage input. LM386 has a wide supply voltage range 4-12V.

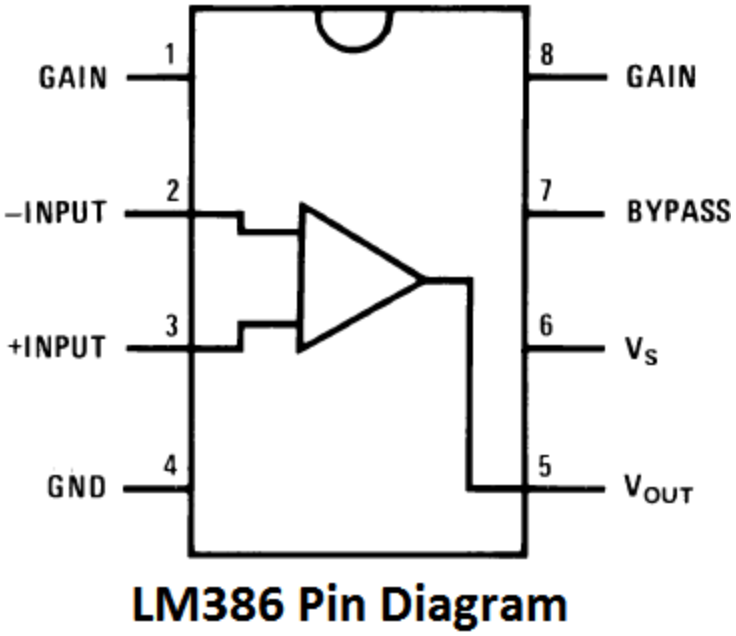


Figure 16. Pin Diagram of LM386

Pin description of the LM386 is shown in the above diagram

Components used in LM386 Based Audio Amplifier

- IC LM386
- Microphone
- Speaker 8ohm
- Capacitors- 220uF, 10uF (two), 0.1uF, 0.05uF
- Resistor- 10k (two)
- Potentiometer- 100k
- Battery 5-12v

Working of LM386 Based Audio Amplifier is as follows:

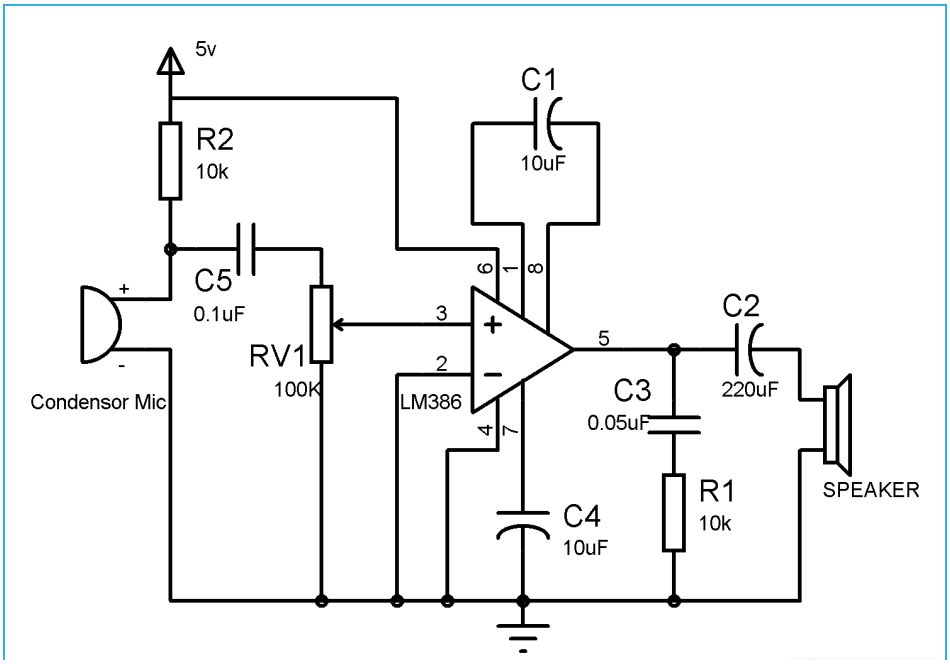


Figure 17. Circuit Diagram of LM386

- PIN 1 and 8: These are the gain control PINs, internally the gain is set to 20. Gain can be adjusted to any value between 20 to 200 by using proper capacitor.

- Pin 2 and 3: These are the input PINs for sound signals. Pin 2 is the negative input terminal. Pin 3 is the positive input terminal. In our circuit it is connected to the positive terminal of the condenser mic with a 100k potentiometer. Potentiometer acts as volume control knob.

- A capacitor of 0.1uF has also been used along with potentiometer, to remove the DC component of input signal and only allow audio (AC component) to be fed into LM386.

- Pin 4 and 6: These are the power supply Pins of IC, Pin 6 for is +Vcc and Pin 4 is Ground. The circuit can be powered with voltage between 5-12v.

- Pin 5: This is the output PIN, from which we get the amplified sound signal.

- The output signal has both AC and DC component, and DC component is undesirable so to remove this DC component, another capacitor of 220uF has been used. This has the same function as Capacitor of 0.1uF at input side.

- Along with this capacitor, a filter circuit of Capacitor. 05uF and resistor 10k has been used at the output PIN 5. This filter also called the “Zobel network”, this electronic filter is used to remove the noise.

- Pin 7: This is the bypass terminal. It can be left open or can be grounded using a capacitor for stability.

- **Resistor** 10k has been used as a Pull up resistor to connect microphone to the positive supply voltage, to provide the power to the microphone. A suitable resistor should be used for proper working of microphone.

2.3.2.3 Working of Audio Transfer circuit using Li-Fi:

In transmitter side, when we connect 3.5mm jack (audio jack is inserted in any audio output device such as a mobile phone or laptop) to audio to a LED, LED will glow but there is no blinking in the LED when the audio source is turned OFF. When we play the audio from the mobile phone, we will notice that there is frequent change in intensity of light (blinking). When we increase the volume, LED’s intensity will change faster such that it cannot be seen through naked eyes.

Solar panel is so sensitive that it can catch small intensity change in the light from LED therefore there is change in the voltages at output of solar panel. Hence when the light of LED falls on the panel, voltages will vary according to the intensity of light. Then voltages of solar panel are fed into LM386 based audio amplifier which will play the output as a loud speaker.

Output will come as long as solar panel is in contact with the LED. We can put the LED at max. 18-20cm distance from the solar panel to get the clear audio output. The distance between the solar panel and LED can be increased if a LED with greater light intensity is used.

2.3.2.4. Advantages of Audio Transfer through Li-Fi

- Faster Data Transmission than Wi-Fi.
- Easy and Inexpensive to Deploy.
- Security Due to the Limitations of Light.
- No interference electromagnetic interferences.
- Low Cost
- Portability
- Low bit error rate
- High efficiency
- Consumes less energy

CHAPTER 3
APPLICATIONS OF Li-Fi

The applications of Li-Fi are unlimited and promising for the future of communications on the planet. In this chapter we will talk about some of its applications.

3.1 Life with Li-Fi

The amazing growth in the use of LEDs with lighting provides the opportunity to incorporate Li-Fi technology in a plethora of LED locations, for example any lighting devices such as car lamps, roof lamps and street lamps are used as a hotspot which helps to reduce the cost of hotspot formation.

This technology is well suited to many popular online programs; you can download movies, games and music for a few minutes with the help of Li-Fi.

Figure 7 shows the environment with Li-Fi technology where light bulbs are used as data communications in the center of the PC, Laptop and Tablet as they all have a photo detector attached to it as a receiver.

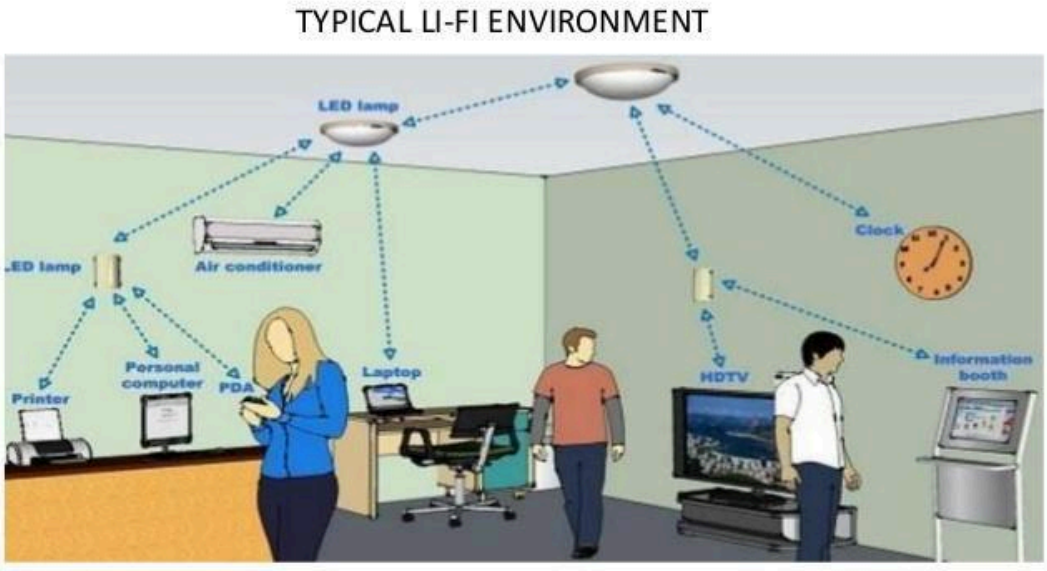


Figure 18. Li-Fi environment.

3.2 Future of Li-Fi

Each of our devices will be connected to the internet, as we move into the Internet of Everything era. Is Wi-Fi upto the task of handling all that internet traffic alone? The short answer is no.

With the ever-growing demand for connectivity, Li Fi would be able to combine illumination and wireless data transmission to accelerate the relay of data across the globe. It can be considered as incredible companion of Wi fi technology.

The company started by Professor Herald Haas in 2012 known as pureLifi is performing experiments and enormously researching the advancements in this field. A startup known as Velmenni is at the forefront of this technological revolution in India. There is certainty of development of future applications of the Li-Fi which can be extended to different platforms and various walks of human life. This technology has the potential to become mainstream and ubiquitous, so gear up for it!

3.3 Li-Fi Applications

Because of its benefits, Li-Fi has many Life applications. Here we will discuss some important applications about it.

A. Underwater Communication

Use of RF signals is not possible due to proper signal transduction in water. Li-Fi provides a solution for short communications. Submarines can use their home articles to communicate with one another, processing da

independently and send their recipients periodically back in the face to Underwater Remotely Operated Vehicles (ROV). The other important issue is that Wi-Fi can work even underwater when Wi-Fi fails completely, therefore it is open to military operations.

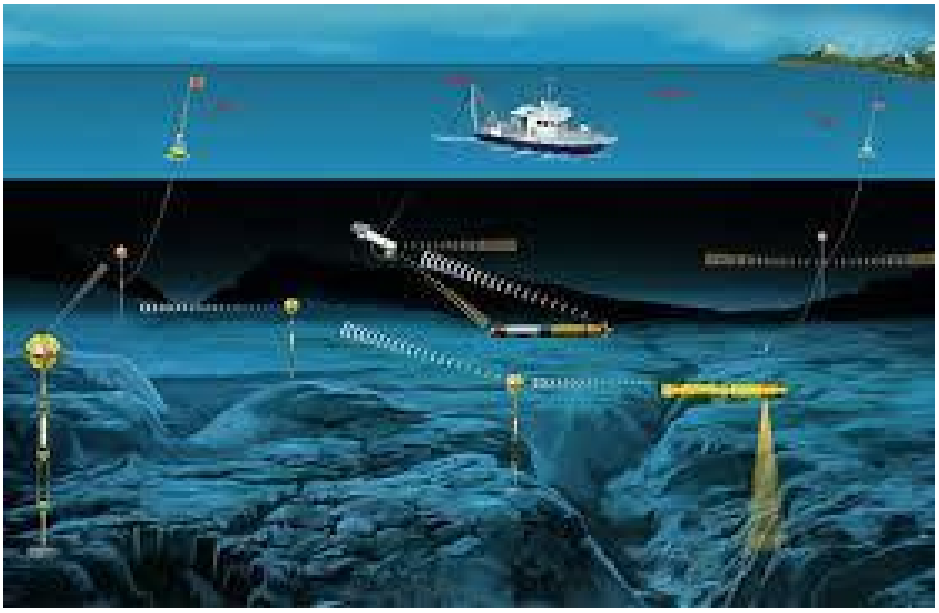


Figure 19. shows water vehicles that use light to communicate with each other and send data between them.

B. Traffic Management

Li-Fi can help managing traffic better and risk number of accidents are reduced. Traffic lamps to communicate with the car and with each other to manage traffic on the road. Traffic light can play the role of data sender to provide information to the vehicle in traffic situation or in the form of other vehicles as shown in Figure 9. the vehicles can be contacted and prevent accidents by exchanging data. For example, LED car lamps can alert drivers when they are cars are very close.

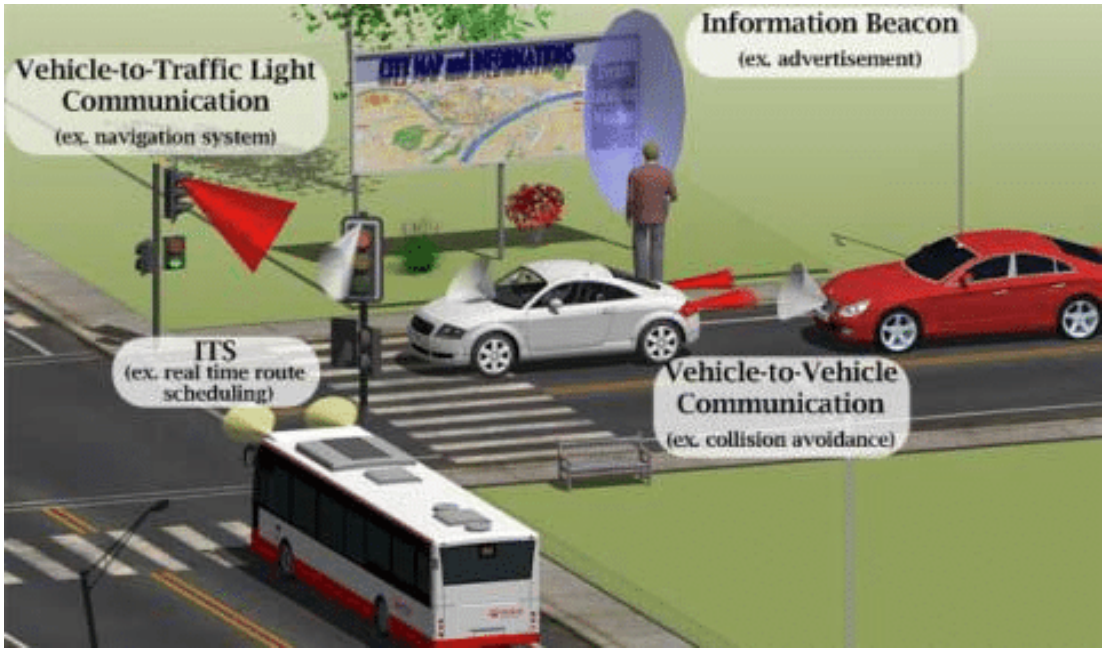


Figure 20: Visual Vehicle Connectivity.

C. Aviation

We should turn off mobiles at airports to prevent the overloading of mobile phones by navigation control the signals used by the aircraft. Li-Fi can be used safely in aircraft because it does not interfere with RF.

As Data is where the light is, we can use the lights on top of the chairs on the plane as a hotspot.



Figure 21. light is used as personal hotspots in an aircraft

D. Application in Health Sector

One of the most important features of Li-Fi is that it can be used in hospitals and in the medical setting you need lack of RF signals affecting medical equipment. For example, OTs (Performance Theaters) do not allow Seminar Li-Fi Technology using Wi-Fi for radiation problems because the use of Wi-Fi prevents screening signals.

Therefore, it can be harmful to the health of the patient.

E. Blind Indoor Navigation System

Indoor roaming is ideal for everyone, and is especially important for the visually impaired. We have suggested such a navigation system for the visually impaired as shown in Figure 10. LED lights come out visible to flash location information and an embedded system or smartphone with a virtual light detector data. An embedded system or smartphone calculates the ideal selection method and communicates with visually impaired by headphone.

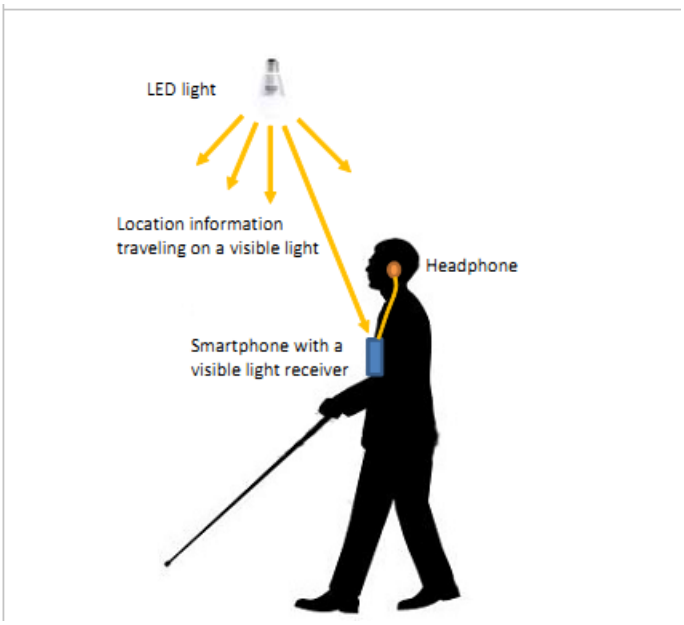


Figure 22: Indoor Navigation system for blind people.

F. In Sensitive Areas or in Hazardous Environments

Li-Fi provides secure connections in areas such as mines and petrol plants, because it does not cause electromagnetic interference from RF communication. Li-Fi can also be used on petroleum or chemical plants where alternatives can be harmful.

For example, power plants such as nuclear power plants require grid integrity and monitoring of the station temperature that need fast, inter -connected data systems. Wi-Fi and many other radiation types are bad for sensitive areas surrounding the power plants. Li-Fi could offer safer ,abundant connectivity for all areas of these sensitive locations .

Moreover, this technology also enables us to control plants and their growth without direct presence.

G. Disaster Management

Li-Fi can be used an a powerful means of communication at times of disaster such as earthquake or hurricanes, for example places like subway stations and tunnels which are common dead zones for most emergency communication, do not pose obstruction for Li-Fi, so it Can be used there, as emergency communication .

H. Internet of Things

Due to its impressive speeds, Li-Fi could make a huge impact on the internet of things. With data being transferred at a much higher level, even more internet-enabled devices will be able to connect to one another.

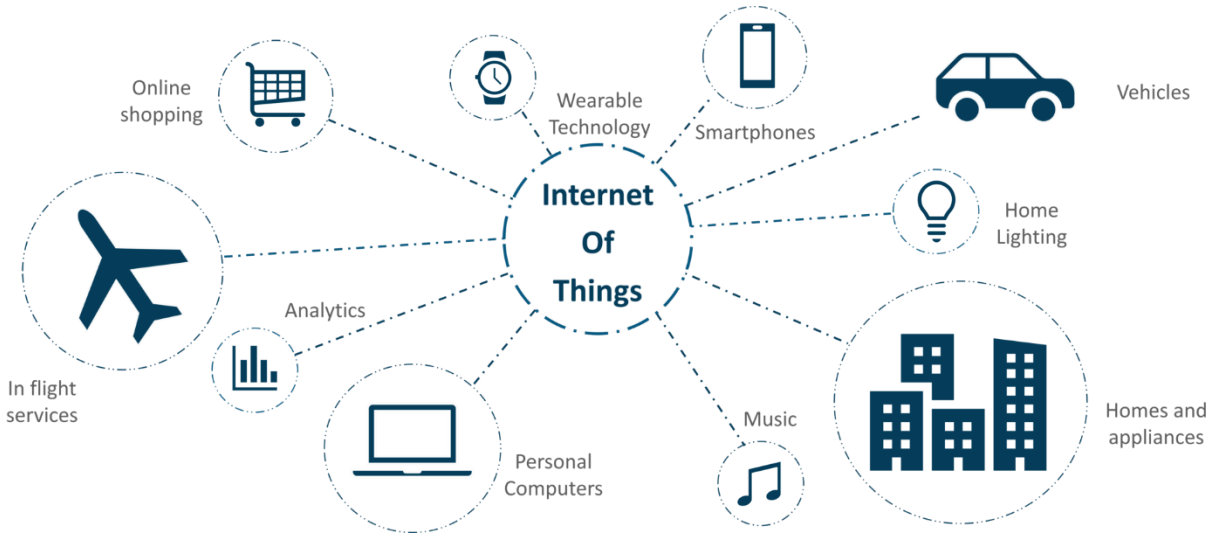


Figure 23. IOT using Li-Fi Technology

CHAPTER 4

SYSTEMS PRESENTLY WORKING ON Li-Fi TECHNOLOGY

4-1 Installed programs

There are certain installed programs and projects that use Li-Fi technology and provide reliability as well as new applications and the use for Li-Fi technology. Some of these are:

I. PureLiFi ™ Company

PureLiFi, home of Li-Fi, is recognized as a leader in the field - the use of visible light spectrum instead of radio waves to enable wireless network communication. PureLiFi provides fast wireless access that provides greater security, security and data integrity than Wi-Fi and emergence structures that eliminate unwanted offline access. In addition, the combination of lighting and information services create an unimaginable reduction in the complexity of infrastructure and energy use.

The company's management team says: “At pureLiFi, we intend to address and abuse the the opportunities presented by this disruptive technology in conjunction with our natural Li-Fi partners. ”

Other company products:

1.Li-First

Li-1st offers a great first opportunity for customers to quickly develop and test VLC systems

at an affordable cost, with high-speed data communication solutions that utilize commercially available LED infrastructure. Figure 11 shows a schematic diagram of the performance of this project.

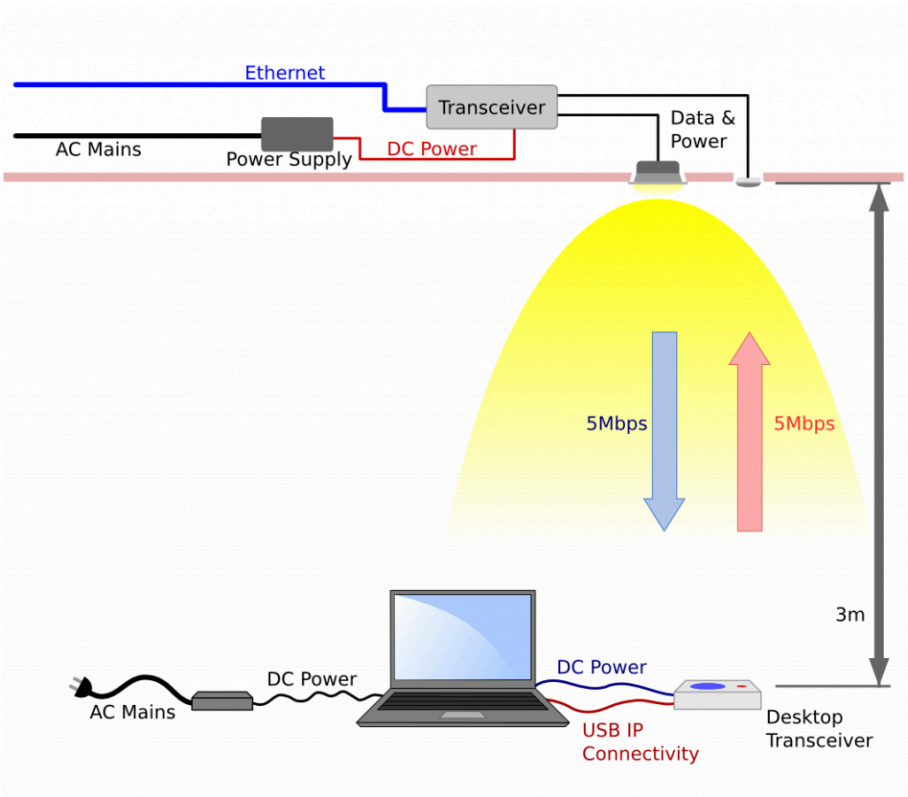


Figure 24. Active diagram of Li-1st.

The product offers 5Mbps full bandwidth at downlink and uplink

over a distance of up to 3 meters, while at the same time illuminating enough space for a desk. The programmable distance depends only on the power of the light source, e.g., the LED lamp. 1sts offers a simple plug-and-play solution for wireless point-to-point Internet access that involves a wide range of internet.

LED lights that work seamlessly with 600 × 600 large panels, and T5s to replace the LED tubes

or lamps. In fact, the Li-1st is a brightly colored LED agility, which provides a unique tool for this implement and exploit switches, resources, business models in the lighting industry. The program has been rolling out a limited release since January 2014.

2.Li-Flame

Li-Flame is the next generation of high-speed wireless broadband network using VLC.

Li-Flame provides:

- A wide range of wireless communication applications including without remaining Wi-Fi.
- Inexpensive delivery of light and detail in a single building.
- Adjustable construction areas with completion of telecommunications cabling.

The Flame was publicly displayed at the Mobile World Congress in Barcelona on March 2 - 5 March at Scottish International Development International stand.

The main products of this project are:

a.Li-Flame Ceiling Unit (CU):

It has some key advantages namely Data and power via a standard, simple Ethernet port installation, multiple access; and Handover control enables seamless switching between Access points (APs).

b.Li-Flame Desk Unit (DU):

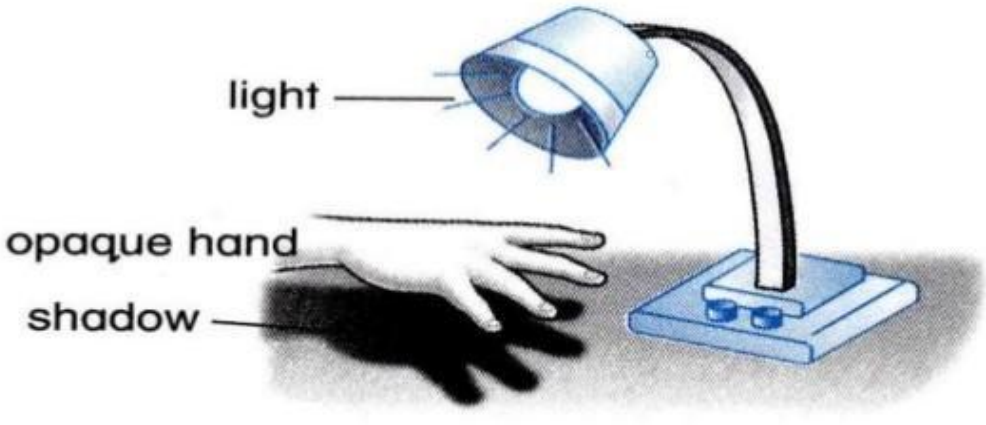
This device has some of the best benefits, Connect to a USB device with USB, 10Mbps infrared loudspeaker rooftop, Handover lets user move from AP to next without losing anything connection speed data, Transceiver swivel head can be changed by the user to optimize i communication and The battery is powerful and portable.

CHAPTER 5

CHALLENGES FOR Li-Fi TECHNOLOGY

While there are many benefits to Li-Fi, there are still some challenges that need to be addressed i.e

- LI-FI requires Sight line.
- Once the equipment is set out, it will need to deal with climate change.
- If the apparatus is set indoors, one cannot transport the recipient.
- The issue of how the recipient will forward the referral is ongoing.
- Light waves can be easily blocked and cannot penetrate into large walls as radio waves can.



We rely on a light source for internet access. If the light source is not working properly, we are lost Internet access. Li-Fi that require a line of sight (LOS) and the receiving device would not move indoors. The biggest challenge is the method adopted by device it will move the data back to the transmitter. Another important issue is the distortion from similar external sources sunlight, light bulbs; the opaque material in the delivery system which will cause distortion in the communication. Another disadvantage is that Li-Fi doesn't work in the dark or light can't pass through objects,

so, if the recipient is improperly blocked in any way, the signal will be terminated immediately. And the signal it is easily blocked by a mere passenger in front of an LED source.

CONCLUSION

The possibilities are endless and can be explored even further.

If this technology is put into practical use, every light source such as bulb, tube light, etc. can be used somewhat like a Wi-Fi connection to transmit wireless data and we will proceed toward the cleaner, greener, secure and better communication. The concept of Li-Fi is currently attracting large number of people, because it may offer a cheap and very efficient alternative to radio-based wireless systems. As a growing number of devices accessing wireless internet, the airwaves are becoming increasingly clogged, making it more and more difficult to get a reliable, high-speed signal. Li-Fi may solve issues such as the shortage of radio-frequency bandwidth and also allow internet where traditional radio-based wireless isn't allowed such as in aircrafts.

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(CIRCUIT)