

# **Real Time Data Communication Through Li-Fi In Hospital Environment**

Submitted in partial fulfilment of the requirements for the award of

Bachelor of engineering degree in

**ELECTRONICS AND COMMUNICATION ENGINEERING**

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**Accredited with Grade “A” by NAAC**

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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**BONAFIDE CERTIFICATE**

This is to certify that this project report is the bonafide work of **MALLINA SOMA SEKHAR (37130233)** and **MEKALA TEJ KUMAR(37130250)** who carried out the project entitled “**Real Time Data Communication Through Li-Fi In Hospital Environment**” under our supervision from

**Internal Guide**

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(DR. T. RAVI)**

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**Submitted for Viva voce Examination held on \_\_\_\_\_**

**INTERNAL EXAMINER**

**EXTERNAL EXAMINER**

## **DECLARATION**

We **MALLINA SOMA SEKHAR(37130233)** and **MEKALA TEJ KUMAR(37130250)** here by declare that the Project Report entitled **“Real Time Data Communication Through Li-Fi In Hospital Environment”** done by us under the guidance of **“Dr. P. KaviPriya”, Associative Professor** Department of Electronics and Communication Engineering at Sathyabama Institute of Science and Technology is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in **ELECTRONICS AND COMMUNICATION ENGINEERING.**

**DATE:**

**PLACE:**

**SIGNATURE OF THE CANDIDATE**

**1.**

**2.**

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We wish to express my thanks to all Teaching and Non-teaching staff members of the Department of **Electronics and Communication Engineering** who were helpful in many ways for the completion of the project.

## **ABSTRACT**

The main objective of this project is to transmit the data using LED (Light Emitting Diode). With the increasing popularity of solid state lighting devices, Visible Light Communication (VLC) is globally recognized as an advanced and promising technology to realize short-range, high speed and large capacity wireless data transmission. In this report, a prototype of real-time video broadcast system using inexpensive commercially available light emitting diode (LED) lamps is proposed. Experimental results show that real-time video with the maximum distance of 2ft can be achieved through proper layout of LED sources and improvement of concentration effects. The design and construction of the LI-FI (Light Fidelity) light source enable efficiency, long stable life, as well as full spectrum intensity that is digitally controlled and easy to use.

Wi-Fi innovation is getting greater and greater today. Each open spot and private office have WiFi in light of the fact that the remote range is impeded habitually. Because of the effectiveness, RF impedance is getting more normal, defeating this issue, the presentation of light fidelity (Li-Fi) innovation. Li-Fi utilizes LED light sources to communicate information remotely. This strategy is also called VLC (Visible Light Communication). Build up another method of utilizing Li-Fi as a remote specialized technique. This is a cunning method to give broadband access. Visual light correspondence is utilized to move information from a host PC. The photodetector will go about as a beneficiary. Li-Fi goes about as a remote interface among transmission and beneficiary. In this project we are going to monitor the patient and update the condition of the patient using Li-Fi technology.

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# CHAPTER 1

## INTRODUCTION

LiFi is a method of data transmission that eliminates the fibre in fibre optics by transmitting data through an LED light bulb that changes intensity faster than the human eye can track. Some have coined the term Li-Fi to explain the quick and cheap wireless communication device that's the optical equivalent of Wi-Fi. Harald Haas coined the word during this sense in his TED talk on visible light communication. "You transmit a digital 1 if the LED is on, and a 0 if it is off," Haas explains. "They can be turned on and off very easily, which provides pleasant opportunities for transmitted data." By changing the rate at which the LEDs turn on and off to produce different strings of 1s and 0s, data can be encoded in light. The output tends to be constant since the LED amplitude is modulated at such a high rate that the human eye cannot detect it. With more advanced techniques, the data rate of VLC could be greatly increased. The University of Oxford and therefore the University of Edinburgh supply courses on parallel information transmission mistreatment AN array of LEDs, with every diode sending a special information stream. Another cluster is experimenting with totally different red, green, and blue diode combos to regulate the sunshine frequency and cipher a special information channel. Li-Fi, as it has been dubbed, has already achieved blisteringly high speeds within the work. Researchers at the physicist Institute in Berlin, Germany, have achieved information rates of over five hundred megabytes per second employing a regular white-light diode. The technology was incontestible employing a try of Casio good phones to exchange information mistreatment light-weight of varied intensity emitted from their screens, detectable up to 10 metres away, at the 2012 client natural philosophy Show in urban center.

Light is of course secure and may be utilized in areas wherever frequency communication may be a concern, like craft cabins or hospitals. As a result, actinic radiation communication has the potential to not solely solve the matter of spectrum deficiency, however additionally to permit novel applications. The actinic radiation vary is untapped; it's unregulated and may be used for high-speed communication.



***Fig.1.0.1 Li-Fi environment***

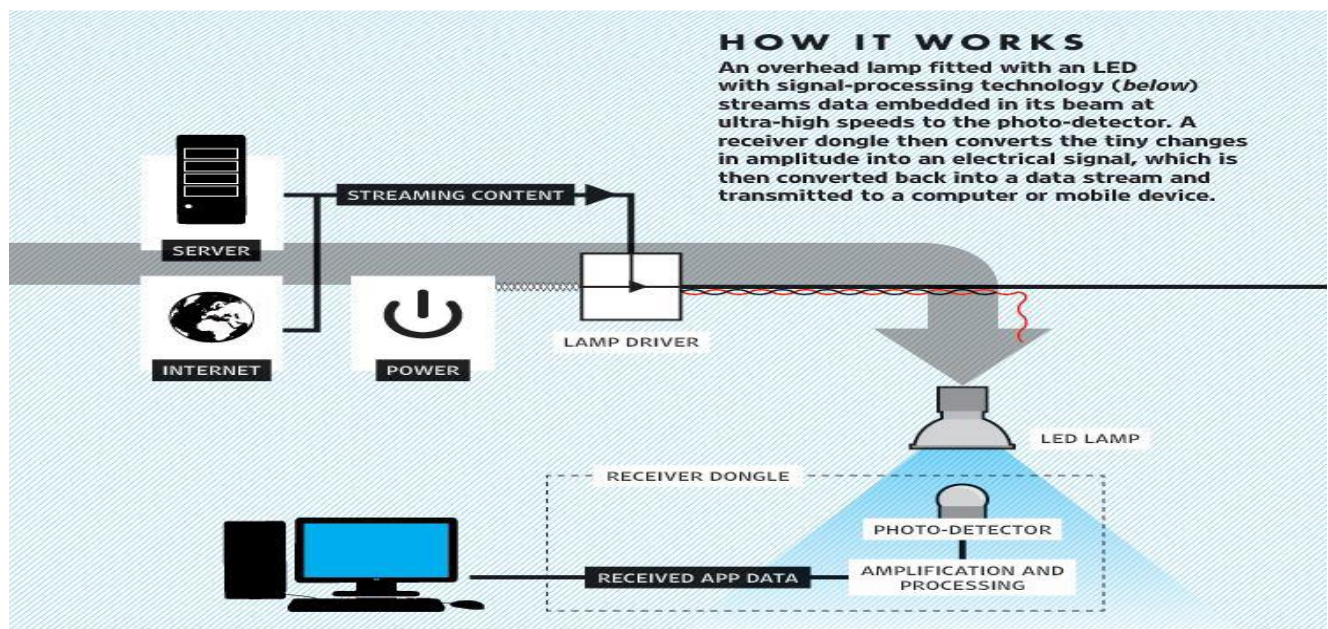
The Li-Fi pool was based in Gregorian calendar month 2011 by a gaggle of firms and business organisations to support high-speed optical wireless systems and to deal with the restricted quantity of radio-based wireless spectrum accessible by employing a totally different portion of the spectrum. The pool claims that speeds of quite ten Gbps square measure doable, doubtless granting the transfer of a high-definition film in thirty seconds.

### **1.1.WORKING TECHNOLOGY**

Harald Haas of the University of Edinburgh, UK, first presented this brilliant concept in his TED Global talk on VLC. "It's really clear, if the LED is on, you transmit a digital 1, and if it's off, you transmit a 0," he explained. The LEDs can be turned on and off easily, providing excellent data transmission opportunities." So all you need are some LEDs and a controller that can programme data into them. Depending on the data we want to encrypt, we simply need to change the rate at which the LEDs flicker. This approach can be improved further by using an array of LEDs for parallel data transmission or by

combining red, green, and blue LEDs to change the light's frequency, with each frequency encoding a different data path. Such developments pledge a theoretical speed of 10 Gbps, implying that a complete high-definition film can be downloaded in less than 30 seconds. Simply amazing! However, blazingly high data speeds and dwindling bandwidths around the world aren't the only advantages this technology has. Since Li-Fi relies solely on light, it can be used safely in aircraft and hospitals where radio waves can cause interference.

Imagine having the ability to urge public net access by hovering below a street light-weight, or downloading a picture show from your table lamp. there is a new technology on the block that would 'shed light-weight on' a way to satisfy the ever-increasing demand for high-speed wireless networking, each virtually and metaphorically. in an exceedingly new information transfer system called Li-Fi, radio waves ar replaced by light-weight waves. Since light-emitting diodes will activate and off quicker than the human eye will understand, the sunshine supply seems to air all of the time.



**Fig 1.1.1 Data transmission using LED**

## **1.2. ANALYSIS OF THE RELATIONSHIP BETWEEN Li-Fi and WLAN**

Light that can be seen The method of transmitting information wirelessly using rapid bursts of light is known as communication. As a means of touch, LED lighting may be

used. The LED production appears constant to the human eye due to the fast flickering rate. Using high-speed LEDs and reliable multiplexing techniques, a data rate of more than 100 Mbps can be achieved. The data rate of VLC can be increased by using LED arrays to transfer data in parallel. Each LED emits a distinct data stream.

| TECHNOLOGY           | SPEED              | DATA DENSITY |
|----------------------|--------------------|--------------|
| WIRED                |                    |              |
| FIRE WIRE            | 800 Mbps           | *****        |
| USB3.0               | 5 Gbps             | *****        |
| THUNDERBOLT          | 2X 10 Gbps         | *****        |
| WIRELESS (CURRENT)   |                    |              |
| WI-FI-IEEE (802.11N) | 150 Mbps           | *            |
| BLUETOOTH            | 3 Mbps             | *            |
| IrDA                 | 4 Mbps             | ***          |
| WIRELESS (FUTURE)    |                    |              |
| Wi-Gig               | 2 Gbps             | **           |
| Giga-IR              | 1 Gbps             | ***          |
| <b>Li-Fi</b>         | <b>&gt;10 Gbps</b> | <b>****</b>  |

**Table 1.2.1. Comparison between current and future wlan technology**

According to the table, Wi-Fi, Bluetooth, and IrDA are some of the most recent wireless technology that can be used to relay data between users. Only Wi-Fi currently offers incredibly fast data rates. The IEEE 802.11n specification allows for up to 150 megabits per second in most implementations (the standard allows for up to 600 megabits per second theoretically), but in practise, you'll get even less. It's worth remembering that optical technology is used in one in every three of these.

Li-Fi technology, which is based on LEDs, is used to transmit data. Every kind of light can be used to transmit data, regardless of which part of the spectrum it comes from.

Any type of light, from any part of the spectrum, can be used to transmit information.

Li-Fi, or light fidelity, is a term used to describe 5G visible light communication systems that, like Wi-Fi, use light from light-emitting diodes (LEDs) as a medium for networked, mobile, high-speed communication. The Internet of Things, in which every electronic device is connected to the internet and the LED lights on such devices are used as internet access points, may be a product of Li-Fi. From 2013 to 2018, the Li-Fi market is expected to grow at an annual rate of 82 percent, reaching a value of over \$6 billion.

The human eye cannot sense visible light communications (VLC) signals so they transform on and off lights in nanoseconds. Although Li-Fi bulbs must be switched on to transmit data, they can be dimmed to the point that they are no longer visible to humans while still transmitting data. Light waves have a far narrower range than Wi-Fi because they cannot travel through walls, but they are more secure against hacking. To send a signal, Li-Fi does not need a clear line of sight, and light reflected off walls can exceed 70 Mbps.



**Fig. 1.1.2. Li-Fi Tx and Rx**

Li-Fi has the upside of having the option to be utilized in electromagnetic touchy zones, for example, in airplane lodges, clinics and thermal energy stations without causing electromagnetic impedance. Both Wi-Fi and Li-Fi send information over the electromagnetic range, however though Wi-Fi uses radio waves, Li-Fi utilizes obvious light. While the US Federal Communications Commission has cautioned of a potential range emergency since Wi-Fi is near full limit, Li-Fi has basically no impediments on limit. The noticeable light range is multiple times bigger than the whole radio recurrence range. Specialists have arrived at information paces of more than 10 Gbps, which is in excess of multiple times quicker than superfast broadband. Li-Fi is required to be multiple times less expensive and more harmless to the ecosystem than Wi-Fi. Short reach, low unwavering quality and high establishment costs are the possible drawbacks.

The knowledge speed of 'Li-fi' is achieved by the use of LED illumination. Analysts in the United Kingdom claim to have achieved 10Gbit/s data transfer speeds using "li-fi," or light-based remote network access. The researchers used a miniature LED light to transmit 3.5Gbit/s in each of the three primary tones that make up white light: red, green, and blue. This means that speeds of up to 10 Gbit/s are possible. Li-fi is a new technology that will have specific LED lights bulbs provide a convenient distributed web network all around the world.



**Fig 1.1.3. Micro-LEDs**

## **SPEED IS HIGH:**

The super equivalent visible light correspondences project is a collaborative effort between Edinburgh, St Andrews, Strathclyde, Oxford, and Cambridge, and is funded by the Engineering and Physical Sciences Research Council.

The tiny miniature LED bulbs developed by the University of Strathclyde in Glasgow allow for equivalent amounts of light to be radiated at the same time, expanding the amount of data that can be communicated at any given time.

"Imagine a shower head isolating water into equal streams," said Prof Harald Haas, an expert in optical remote interchanges at the University of Edinburgh and one of the project's leaders.

Using a computerised adjustment technique known as Orthogonal Frequency Divisional Multiplexing (OFDM), researchers were able to allow miniature LED lights to deal with a large number of changes in light force per second, effectively serving as an extremely fast on/off switch.

This allows huge chunks of two-dimensional data - a series of ones and zeros - to be transmitted at high speeds.

In recent lab tests, Germany's Fraunhofer Heinrich Hertz Institute confirmed that data rates of up to 1Gbit/s per LED light recurrence were possible. Furthermore, Chinese researchers are said to have developed a microchipped LED bulb that can generate data rates of up to 150 megabits per second (Mbps), with one bulb providing network access to four PCs. 'Light loyalty'

## **CHAPTER 2**

### **LITERATURE SURVEY**

#### **2.1. Using commercial phosphor-based white leds for visible light communication:**

We show a high-speed visible light communication system using a commercially available high-power phosphor-based white light LED. Using obtained eye diagrams, a passive post-equalizer circuit for the blue LED component is designed to achieve a high 3-dB modulation bandwidth of up to 85 MHz, as well as a transmission rate of 250 Mbps using On-Off Keying.

In a high-speed visible light communication system, a commercially available high-power phosphor-based white light LED is used.

#### **2.2. Patient Monitoring System using Li-Fi:**

It shows a patient care system that uses Li-Fi technology. The abbreviation for Light Fidelity is Light Fidelity. Harold Haas, a German physicist, suggested Li-Fi technology, which transmits data by lighting at differing intensities faster than the human eye can detect. Li-Fi is a bidirectional, high-speed, and fully networked wireless optical networking system based on visible light.

These sensors collect data from the human body and translate it to digital form using an analogue to digital converter. The data of these sensors is received by the microcontroller. This project makes use of an AVR microcontroller.

#### **2.3. Patient Monitoring In Hospital Using Li-Fi:**

Li-Fi is a type of bidirectional, high speed and fully interconnected wireless optical Networking in visible light communication. To avoid frequency contact with the human body, the proposed model uses the Li-Fi concept rather than Wi-Fi technologies to help in hospital patient monitoring. This model uses temperature, pulse, glucose, and respiration sensors to perform its functions. These sensors collect information from the human body, which is then converted to digital form using an analogue to digital converter

before being sent to the microcontroller. This project makes use of the PIC16F877A microcontroller.

#### **2.4. Li-Fi Based Patient Monitoring System:**

Li-Fi might be a bidirectional, fast and completely arranged remote optical correspondence and might be such a light correspondence. The proposed model aides inside the patient checking inside the clinics and might be finished by utilizing the idea of Li-fi as opposed to Wi-Fi innovation to keep away from the recurrence impedance with the human body. Sensors like temperature, heartbeat, movement, ECG cardiogram chart are utilized in the model to play out its separate capacities. These sensors gather the information from the human body and afterward the information is shipped off the ATmega8 microcontroller and afterward it changes over computerized signal into optical sign which is produced by drove or lasers and at the less than desirable end we have photograph indicators to get the light discharged signals and afterward it shipped off another miniature regulator and afterward its associated with pc or show where it shows the readings of the multitude of sensors joined to the patient's body.

#### **2.5. A comparative and critical Li-Fi technology review:**

Communication has been the cornerstone of ICT since the advent of technology. ICT had transformed our world into a city. Everyone today (businesses, institutions, organisations, and entrepreneurs) is under pressure to get the right information at the right time and in the right place. This necessitates high-speed internet access, cutting-edge technology, and a diverse range of platforms. The topic of this paper is the Future of Communication (LI-FI), which will have an effect on everyone's lives. It's a system that could be as fast as 500MBPS (30GBPS per minute), making it a more cost-effective, reliable, and useful alternative to Wi-Fi. Visible light contact, which may be the Internet's future.

#### **2.6. New Epoch of Wireless Communication:**

Wi-Fi hotspots can be found at home, in coffee shops, hotels, airports, and even towns, and the Wi-Fi network infrastructure is rapidly expanding. As a result, radio spectrum is becoming increasingly congested, and demand for wireless data is growing at an

unprecedented rate every year. Everyone wants to use wireless data, but there isn't enough of it. Wireless radio frequencies are increasing in frequency, complexity is increasing, and RF interference is increasing. Since 2011, light-fidelity (Li-Fi) technology has existed to help solve this issue in the future. Li-Fi is a wireless networking device in which light, rather than the conventional radio frequency used by Wi-Fi, serves as the carrier signal. Li-Fi is a wireless data transmission system that uses light emitting diodes. Visible light communication (VLC) transmits information wirelessly using rapid bursts of light that are invisible to the human eye. The advantages of Li-Fi technology over Wi-Fi technology, as well as the challenges of the latest VLC technology, will be discussed in this article.

## **2.7. Wi-Fi Network Implementation in Rural Areas Networks of Windbelt:**

This study examines how wind belt-cantenna technology can be used to improve Wi-Fi coverage in rural areas. The paper assesses the main elements that should be considered during the implementation process. For starters, the paper mentions rural areas as one of the places where wind belt-cantenna technology can improve the Wi-Fi network. Second, the paper evaluates the different stakeholders that must be taken into account during the implementation process. Schools, hospitals, community system maintenance workers, local telephone providers, local/national governments, and community representatives are among the key stakeholders considered.

## **CHAPTER 3**

### **AIM AND SCOPE**

#### **3.1. EXISTING SYSTEM**

When you use WLAN at home, in a coffee shop or at an airport or when you rally for bandwidth, slow network speeds can lead to restricted access and long processing times. The obstructed airwaves make it impossible for more users to tap into their mobile devices by attaching a secure signal. In case Wi-Fi in many hospitals is installed, mobile phone interference and computer interference can cause signal loss in surveillance equipment.

#### **DRAWBACKS**

- Hundreds or megabits per second are common data rates.
- The cost of an LED bulb is high.
- LED bulbs use more energy.
- The rate of bit errors is high.
- For data transmission testing, ATPG (Automatic Test Pattern Generation) is needed.

#### **3.2. PROPOSED SYSTEM:**

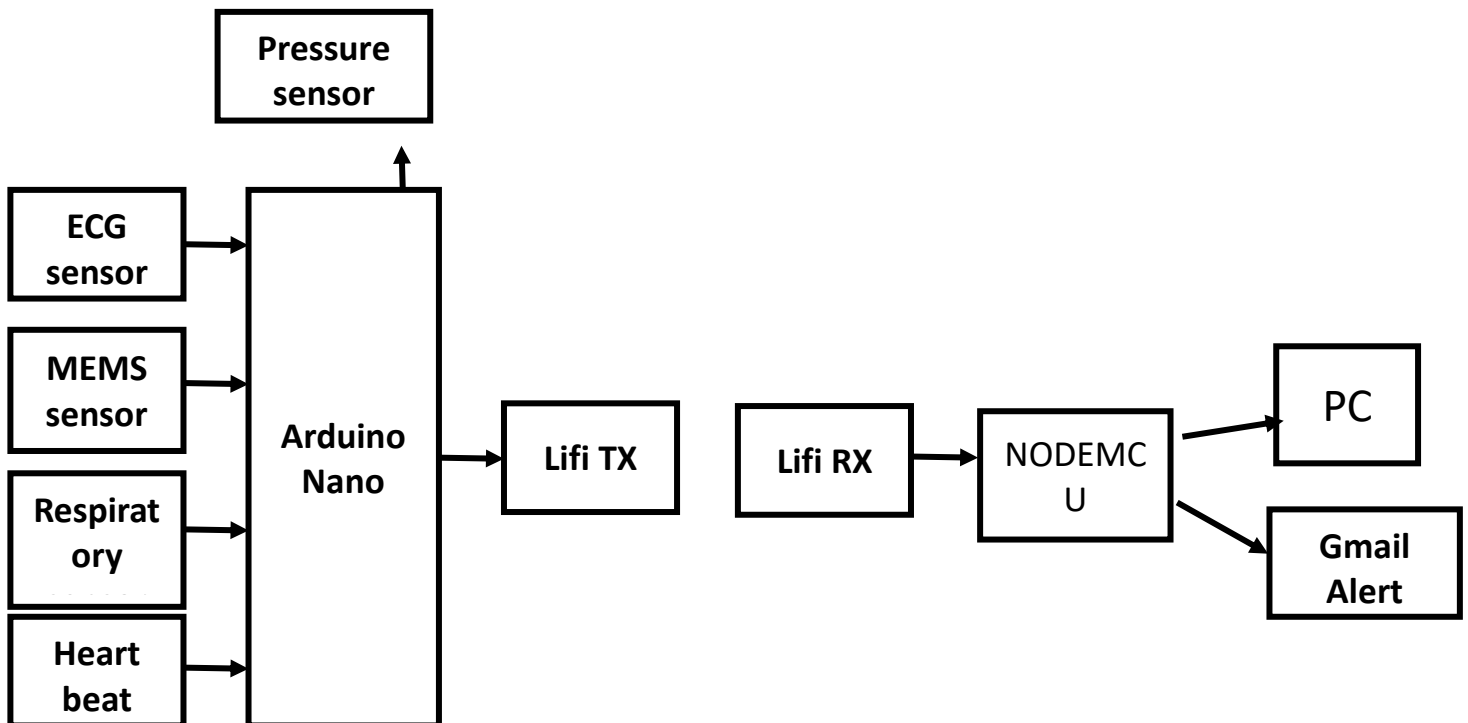
We suggested a project that already exists in the hospital community. This is solely for data transmission in the medical field.

- The light signal is used in hospitals to relay data; since it is not EM waves, it has no effect on humans.
- Using Li-fi as a wireless medium, data transfer between microcontrollers from sensor to PC.
- LEDs use short light pulses to relay data wirelessly.
- Data transfer at a high rate.
- The rate of bit errors is lower.

## ADVANTAGES

- Data transmission between microcontrollers from sensor to PC using Li-fi as a wireless medium.
- LED uses fast pulses of light to transmit information wirelessly.
- High speed data transmission.
- Bit Error rate is less.
- ATPG is no needed for testing the data transmission.

## BLOCK DIAGRAM:



*Fig.3.2.1. Block diagram of proposed system*

### **3.3. WORKING PRINCIPLE**

LIFI is a modern form of high-intensity light source in solid conditions that offers clean lighting solutions for general and special lighting applications. In terms of energy consumption, a long usable life, full spectrum and dimming, LIFI illumination systems exceed the conventional approaches. This technology brief describes both the general construction of LIFI lighting systems and the basic blocks of technology that allow them to operate.

#### **3.3.1. LIFI CONSTRUCTION**

The LIFI product is divided into four main sub-assemblies:

- Printed circuit board (PCB)
- Bulb
- RF power amplifier circuit (PA)
- Enclosure

The lamp's electrical inputs and outputs are regulated by the PCB, which also houses the microcontroller that manages the lamp's various functions. The solid-state PA generates an RF (radio-frequency) signal that is directed through an electric field around the bulb. The high concentration of energy in the electric field causes the contents of the bulb to vaporize, resulting in a regulated plasma state at the bulb's base, which produces an intense source of light. An aluminum enclosure contains all of these subassemblies.

#### **3.3.2. THE SUB-ASSEMBLY BULB Feature**

At the core of LIFI is the bulb subset, which contains a screened bulb in a dielectric material. This idea outperforms conventional sources of light using degradable bulb electrodes. The dielectric material has two functions: firstly, the RF energy transmitted by the PA is a wave guide, and secondly it acts as a concentrator for the electric field which concentrates energy in the bulb. The energy of the electric field heats the material in the bulb rapidly into a plasma state which gives full-spectrum, high intensity light.

### **3.3.3. Light Fidelity Applications:**

LiFi has a variety of uses, including aviation, green information technology, multi-user connectivity, and underwater ROVs, among others. It also has a number of benefits, which are addressed in this project study. This LiFi report can only be used for research and reference.

The LIFI light source's design and construction allow performance, long-term stability, digitally regulated full spectrum intensity, and ease of use.

### **PRESENT SCENARIO:**

We have deployed 1.4 million cellular radio waves base stations.

- In addition, we have over 5 billion cell phones.
- A mobile phone transmits over 600 terabytes of data.
- Wireless contact, like electricity and water, has become a necessity.
- We use it in our daily lives, our personal lives, and our professional lives.
- Currently, Wi-Fi communicates through radio waves.
- It is critical to investigate this technology, which has become so significant in our lives. Four| Issues with Radio Waves

### **Capacity:**

- Radio waves are used to transmit wireless data; however, radio waves are scarce, costly, and restricted.
- We just have a limited amount of it.
- With the introduction of next generation technology such as 2.5G, 3G, and 4G, we are rapidly running out of spectrum.

### **Efficiency:**

- There are 1.4 million cellular radio base stations, which use a tremendous amount of electricity, the majority of which is used to cool down the base stations rather than for transmission.

### Availability:

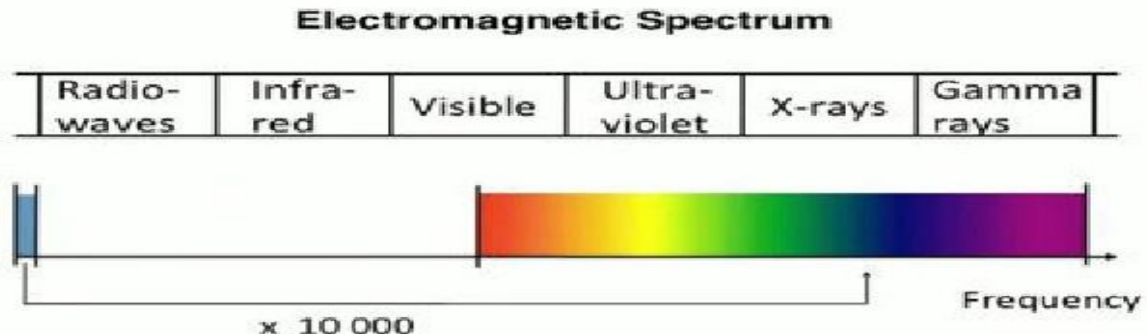
- In planes, we must switch off our cellphones; in areas like petrochemical plants and gas stations, it is not advisable to use cellphones.
- Another problem is the availability of radio waves.

### Security:

- Walls are not impervious to radio waves.
- They're vulnerable to being intercepted.
- If someone has experience and bad intentions, he will use it to his advantage.

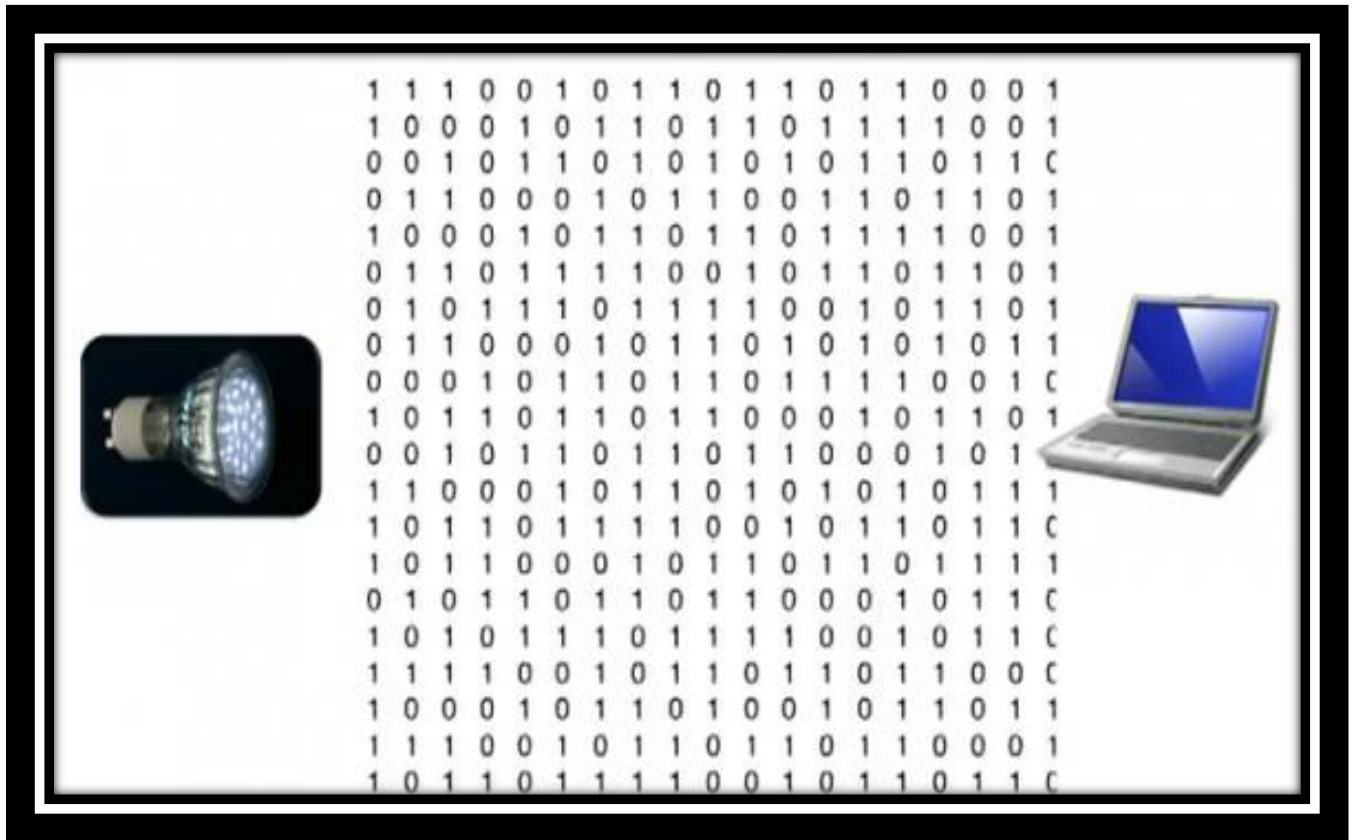
### Alternative to Radio waves in Electromagnetic Spectrum:

when it comes to radio waves, there are four major concerns: power, performance, availability, and protection. On the other side, we already have 40 billion light boxes.



***Fig.3.3.1. Electromagnetic Spectrum***

- Since gamma rays are extremely harmful, they cannot be used for our contact purposes.
- X-rays are useful in hospitals but cannot be used at home.
- Ultraviolet rays are often beneficial to our skin, but they are harmful if used for an extended period of time.
- We've all seen how radio waves can be problematic.
- As a result, we are just left with the visible light spectrum.



*Fig 3.3.2. Transmission of bits to PC*

## **CHAPTER 4**

### **REQUIREMENTS**

#### **Hardware Requirements**

- Arduino Board
- LM35 – Temperature Sensor
- Heart beat sensor
- MEMS sensor
- Pulse sensor
- PC
- Li-Fi Module

#### **Software Requirements**

- Embedded C
- Arduino IDE

### **4.1. EMBEDDED SYSTEMS**

#### **4.1.1. Overview of embedded systems**

A PC system inserted for one or more dedicated ability, with continuous processing imperatives, is a specific purpose. A framework is inserted. It is commonly mounted as a complete gadget with mechanical parts and appliances. Interestingly, a large-scale PC, such as a PC, can carry out different programming tasks. The frameworks that have been installed are now crucial as they govern a significant number of the usual devices.

Because of the explicit tasks of the implanted system, manufacturers may enhance the framework, reduce the size and expense of the item or extend unwavering consistency and implementation.

In reality, frames are added, ranging from multiple gadgets such as computerised watches and MP3 players, to large fixed facilities such as traffic signal systems, factory control systems and thermal station frameworks. The complexity shifts from low to very high with a single microcontroller chip with several modules, peripherals and groups within or fenced in the region.

"Installed framework" is generally anything but a defined concept, given that many frameworks have some programming aspect. Handheld PCs, for example, share certain components with embedded frames.

Installed frameworks give a few capacities

- Monitor the climate; installed frameworks read information from input sensors. This information is then handled and the outcomes showed in some organization to a client or clients
- Control the climate; implanted frameworks produce and communicate orders for actuators.
- Transform the data; implanted frameworks change the information gathered in some significant manner, like information pressure/decompression

Despite having a significant part of embedded frameworks in the cooperation with the outside world through sensors and actuator, these frameworks are still useful for their uses.

Implanted systems usually perform applications, such as control rules, small state machines, and sign calculations preparation. Both systems can also define and address weaknesses both in the internal recording environment and in the electromechanical frameworks.

The frameworks built from advanced gadgets to home computers to control frameworks are various classifications. Include models;

- Communication gadgets

e.g.: modems, cells

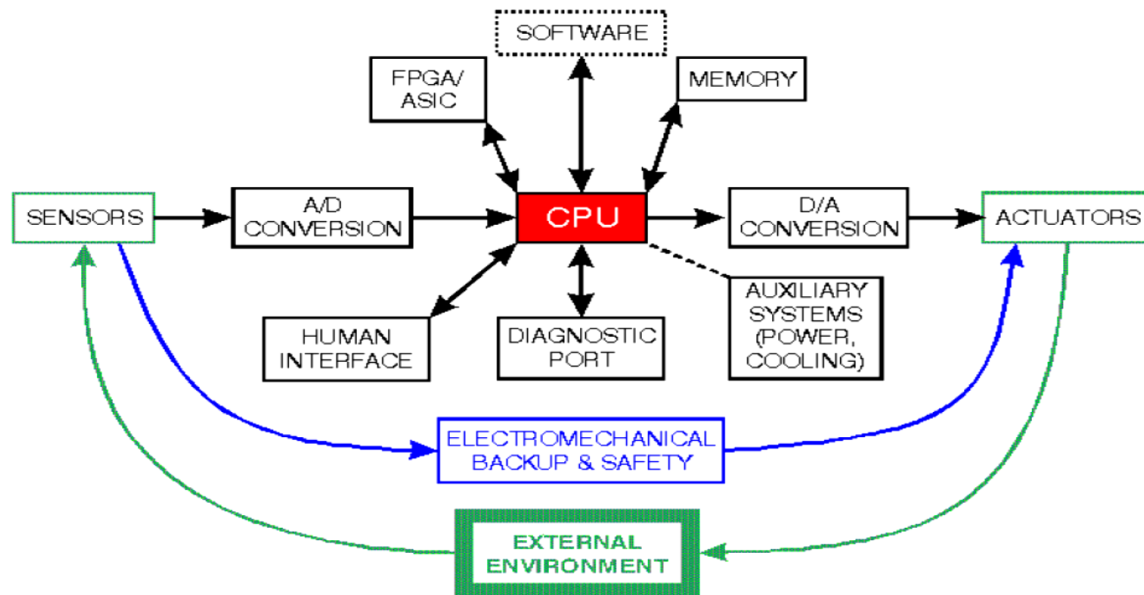
- Home Appliances

e.g.: CD player, VCR, microwave

- Control Systems

e.g.: Automobile stopping automations, mechanical technology, satellite control

#### 4.1.2 Blocks of an embedded system:



**Fig 4.1.1 Block diagram for a typical embedded system**

An inserted framework as a rule contains an implanted processor. Numerous apparatuses that have an advanced interface - microwaves, VCRs, vehicles - use installed frameworks. Some implanted frameworks incorporate a working framework. Others are extremely specific bringing about the whole rationale being executed as a solitary program. These frameworks are implanted into some gadget for some particular reason other than to give broadly useful processing . An ordinary installed framework is appeared in Fig 4.1.1.

#### **4.1.3. Characteristics of embedded systems**

Inserted frameworks are portrayed by a one of a kind arrangement of attributes. Every one of these qualities forced a particular arrangement of plan requirements on implanted frameworks creators. The test to planning implanted frameworks is to adjust to the particular arrangement of imperatives for the application.

##### **Application Specific Systems:**

Implanted frameworks are not broadly useful PCs. Installed framework plans are improved for a particular application. Large numbers of the work attributes are known before the equipment is planned. This permits the creator to zero in on the particular plan limitations of a very much characterized application. In that capacity, there is restricted client reprogrammability. Some installed frameworks, in any case, require the adaptability of reprogrammability. Programmable DSPs are regular for such applications.

##### **Reactiv Systems**

As referenced before, a common inserted frameworks model reacts to the climate through sensors and control the climate utilizing actuators. This requires installed frameworks to run at the speed of the climate. This quality of implanted framework is classified "responsive". Receptive calculation implies that the framework (essentially the product segment) executes in light of outer occasions. Outside occasions can be either intermittent or aperiodic. Occasional occasions make it simpler to plan handling to ensure execution. Aperiodic occasions are more diligently to plan. The greatest occasion appearance rate should be assessed to oblige most pessimistic scenario circumstances. Most installed frameworks have a huge receptive segment. Perhaps the greatest test for implanted framework planners is playing out an exact most pessimistic scenario plan examination on frameworks with factual execution attributes (e.g., store memory on a DSP or other installed processor). Constant framework activity implies that the rightness of a calculation depends, to some degree, on the time at which it is conveyed. This regularly prompts excessively critical appraisals deciding in favor alert. Many inserted frameworks have a huge prerequisite for continuous activity to meet outer I/O and control solidness necessities. Some constant frameworks are additionally responsive frameworks.

## **Distributive System**

A characteristic consistency of an installed System consists of a number of steps to impart communication on a few CPUs or ASICs connected with it. This is economic reasoning. Microcontrollers in conservative 4 8-cycle format could be less costly than 32-bit processors. Such an approach could be suitable even after incorporating the cost of the correspondence interfaces. Many processors are normally used in this technique to handle various time-sensitive tasks. Implanted systems can also really be used to match gadgets.

## **Heterogeneous Architectures**

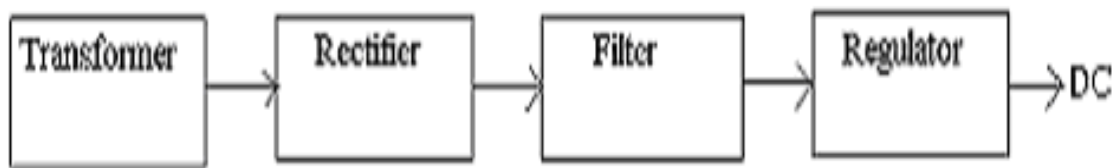
Installed frameworks frequently are made out of heterogeneous designs (Fig 1.2). They may contain various processors in a similar framework arrangement. They may likewise be inconsistent message frameworks. The mix of I/O interfaces, nearby and far off recollections, and sensors and actuators makes implanted.

## CHAPTER 5

### MATERIALS AND METHODS

#### 5.1. POWER SUPPLY

All electronic circuits work just in low DC voltage, so we need a power supply unit to give the fitting voltage supply to their appropriate working. This unit comprises of transformer, rectifier, filter and controller. AC voltage of normally 230volts rms is associated with a transformer voltage down to the level to the ideal ac voltage. A diode rectifier that gives the full wave rectified voltage that is at first separated by a basic capacitor filter to create a dc voltage. This subsequent dc voltage typically has some wave or ac voltage variation. A controller circuit can utilize this dc contribution to give dc voltage that has considerably less wave voltage as well as stays as before dc even the dc voltage fluctuates somewhat, or the load associated with the load dc voltages changes.



***Fig 5.1.1. General Block Of Power Supply Unit***

##### **5.1.1 TRANSFORMER:**

A transformer is a static piece of which electric force in one circuit is changed into electric force of same recurrence in another circuit. It can raise or lower the voltage in the circuit, yet with a comparing abatement or expansion in current. It works with the rule of shared acceptance. In our undertaking we are utilizing a step down transformer to giving an important stockpile to the electronic circuits. Here we venture down a 230volts ac into 12volts ac.

### **5.1.2. RECTIFIER:**

A dc level got from a sinusoidal info can be improved 100% utilizing an interaction called full wave amendment. Here in our venture for full wave amendment we use connect rectifier. From the essential scaffold arrangement we see that two diodes (say D2 and D3) are directing while the other two diodes (D1 and D4) are in off state during the time frame  $t = 0$  to  $T/2$ . Accordingly for the negative pattern of the information the leading diodes are D1 and D4. Thus the extremity across the heap is something very similar.

In the scaffold rectifier the diodes might be of variable kinds like 1N4001, 1N4003, 1N4004, 1N4005, 1N4007 and so forth... can be utilized. Yet, here we utilize 1N4007, on the grounds that it can withstand up to 1000v.

### **5.1.3. FILTERS:**

In order to obtain a dc voltage of 0 Hz, we have to use a low pass filter. So that a capacitive filter circuit is used where a capacitor is connected at the rectifier output & a dc is obtained across it. The filtered waveform is essentially a dc voltage with negligible ripples & it is ultimately fed to the load.

### **5.1.4 REGULATORS:**

The yield voltage from the capacitor is more separated and at last directed. The voltage controller is a gadget, which keeps up the yield voltage consistent independent of the adjustment in supply varieties, load varieties and temperature changes. Here we utilize fixed voltage controller to be specific LM7805. The IC LM7805 is a +5v controller which is utilized for microcontroller.

### **FEATURES AND DESCRIPTION OF REGULATORS**

- Output Current up to 1A
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area Protection

## 5.2. ARDUINO:

The Arduino microcontroller is a simple to utilize yet amazing single board PC that has acquired significant foothold in the interest and expert market. The Arduino is open-source, which implies equipment is sensibly estimated and improvement programming is free. This guide is for understudies in ME 2011, or understudies anyplace who are standing up to the Arduino interestingly. For cutting edge Arduino clients, sneak the web; there are bunches of assets.

This guide covers the Arduino Uno board (~~Sparkfun~~ DEV-09950, \$29.95), a decent decision for understudies and instructors. With the Arduino board, you can compose programs and make interface circuits to understand switches and different sensors, and to control engines and lights with next to no exertion. A significant number of the photos and drawings in this guide were taken from the documentation on the

Arduino site, the spot to turn on the off chance that you need more data. The Arduino area on the ME 2011 site, <https://sites.google.com/a/umn.edu/me2011/>, covers more on interfacing the Arduino to this present reality.

This is what the Arduino board looks like.



**Fig. 5.2.1. Arduino**

## Computer Installation

Adhere to the guidelines on the Getting Started segment of the Arduino site, <http://arduino.cc/en/Guide/HomePage>. Go completely through the means to where you see the pin 13 LED flickering. This is the sign that you have all product and drivers effectively introduced and can begin investigating with your own projects.

Start the Arduino advancement climate. In Arduino-talk, programs are designated "portrays", however here we will simply call them programs.

In the altering window that surfaces, enter the accompanying project, focusing on where semi-colons show up toward the finish of order lines.

```
Void setup () {  
  
    Serial. Begin (9600);  
    Serial.println ("Hello World"); }  
  
Void loop () { }
```

Your window will look something like this



**Fig. 5.2.2. Arduino IDE**

### 5.3. SERIAL COMMUNICATION:

Sequential correspondence is essentially the transmission or gathering of information the slightest bit at a time. The present PCs by and large location information in bytes or some different thereof. A byte contains 8 pieces. A piece is essentially either a legitimate 1 or zero. Each character on this page is really communicated inside as one byte. The sequential port is utilized to change every byte over to a surge of ones and zeroes just as to change over a flood of ones and zeroes to bytes. The sequential port contains an electronic chip called a Universal Asynchronous Receiver/Transmitter (UART) that really does the transformation.

The sequential port has numerous pins. We will examine the communicate and get pin first. Electrically talking, at whatever point the sequential port sends a legitimate one (1) a negative voltage is affected on the communicate pin. At whatever point the sequential port sends an intelligent zero (0) a positive voltage is influenced. At the point when no information is being sent, the sequential port's send pin's voltage is negative (1) and is supposed to be in a MARK state. Note that the sequential port can likewise be compelled to keep the communicate pin at a positive voltage (0) and is supposed to be the SPACE or BREAK state. (The terms MARK and SPACE are additionally used to just indicate a negative voltage (1) or a positive voltage (0) at the communicate pin separately).

When communicating a byte, the UART (sequential port) first sends a START BIT which is a positive voltage (0), trailed by the information (general 8 pieces, however could be 5, 6, 7, or 8 pieces) trailed by a couple of STOP Bits which is a negative(1) voltage. The arrangement is rehashed for every byte sent. Figure 1 shows an outline of what a byte transmission would resemble.

Now you might need to understand what the length of a piece is. At the end of the day, how long does the sign stay in a specific state to characterize a piece. The appropriate response is basic. It is reliant on the baud rate. The baud rate is the occasions the sign can switch states in a single second. Hence, if the line is working at 9600 baud, the line can switch states 9,600 times each second. This implies each piece has the length of  $1/9600$  of a second or about 100μsec.

when communicating a character there are different attributes other than the baud rate that should be known or that should be arrangement. These attributes characterize the whole translation of the information stream. The first trademark is the length of the byte that will be sent. This length overall can be somewhere in the range of 5 to 8 pieces.

The subsequent trademark is equality. The equality trademark can be even, odd, imprint, space, or none. In the event that even equality, the last information bit communicated will be a coherent 1 if the information sent had an even measure of 0 pieces. In the event that odd equality, the last information bit sent will be a consistent 1 if the information communicated had an odd measure of 0 pieces. On the off chance that MARK equality, the last communicated information touch will consistently be an intelligent 1. On the off chance that SPACE equality, the last sent information touch will consistently be a coherent 0. On the off chance that no equality, there is no equality bit communicated.

The third trademark is the measure of stop bits. This worth overall is 1 or 2. Accept we need to send the letter 'A' over the sequential port. The paired portrayal of the letter 'A' is 01000001. Recollecting that pieces are sent from least huge piece (LSB) to most critical piece (MSB), the piece stream communicated would be as per the following for the line qualities 8 pieces, no equality, 1 stop bit and 9600 baud.

#### **5.3.1. NULL MODEM:**

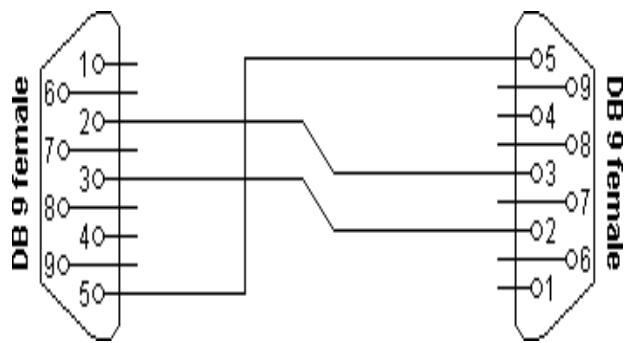
Sequential interchanges with RS232. One of the most established and most broadly spread specialized strategies in PC world. The manner in which this kind of correspondence can be performed is essentially characterized in principles. For example with one special case. The principles show the utilization of DTE/DCE correspondence, the manner in which a PC ought to speak with a fringe gadget like a modem. For your data, DTE implies Data Terminal Equipment (PCs and so forth) where DCE is the shortened form of Data Communication Equipment (modems).

One of the principle employments of sequential correspondence today where no modem is included—a sequential invalid modem setup with DTE/DTE correspondence—isn't so very much characterized, particularly with regards to stream control. The wording invalid modem for the circumstance where two PCs impart straightforwardly is so regularly utilized these days, that the vast majority don't understand any longer the starting point of the expression and that an invalid modem association is an exemption, not the standard.

Ever, viable arrangements were created to allow two PCs to chat with one another utilizing an invalid modem sequential correspondence line. As a rule, the first modem signal lines are reused to play out a type of handshaking. Handshaking can build the most extreme permitted correspondence speed since it enables the PCs to control the progression of data. A high measure of approaching information is permitted if the PC is skilled to deal with it, yet not on the off chance that it is occupied with performing different undertakings. In the event that no stream control is executed in the invalid modem association, correspondence is just conceivable at speeds at which it is certain the accepting side can deal with the sum data significantly under most pessimistic scenario conditions.

### **5.3.2. NULL MODEM WITHOUT HANDSHAKING:**

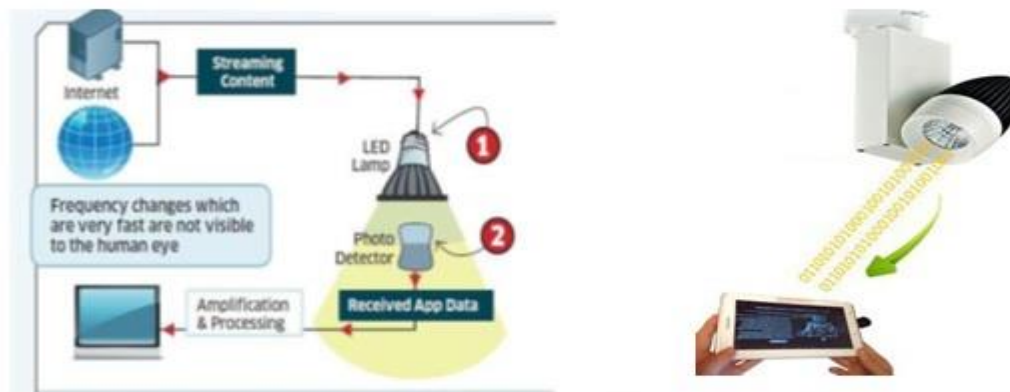
How to utilize the handshaking lines in an invalid modem setup? The easiest route is to don't utilize them by any means. Around there, just the information lines and sign ground are cross associated in the invalid modem correspondence link. Any remaining pins have no association. An illustration of a particularly invalid modem link without handshaking can be found in the figure underneath.



| Connector 1 | Connector 2 | Function      |
|-------------|-------------|---------------|
| 2           | 3           | Rx ← TX       |
| 3           | 2           | TX → Rx       |
| 5           | 5           | Signal ground |

**Fig.5.3.1. Simple null modem without handshaking**

### WORKING OF LI-FI:

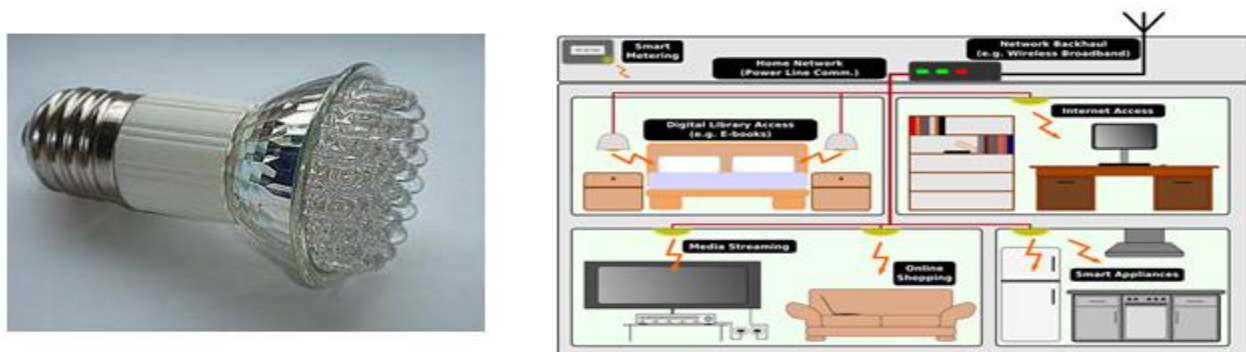


**Fig. 5.3.2. Working of Li-Fi**

In Figure 5.3.2, shows the double information are caught by barely any light receptors are required, and are introduced on a wide range of associated gadgets, from PCs to tablets, to telephones, TVs or machines. Matter specialists clarify that the light heartbeats are intangible to the natural eye, without causing harm or inconvenience of any sort. Also, any light or electric lamp can turn into an area of interest. How Li-fi functions is basic: You have a light toward one side (a LED), and a photodetector (light sensor) on the other. On the off chance that the LED is ON, the photograph locator enlists a parallel one; otherwise it's a paired zero. Streak the LED sufficient occasions and you develop a message. Utilize a variety of LEDs, and maybe a couple of various tones, and very soon you are managing information rates in the scope of hundreds or megabits each second, this is cultivated by the flashing of LED lights to make paired code (on = 1, off = 0), and is done at higher.

Figure 1.5 shows brief association of web with LED and data recovered on the PC. One

LED moves information at a more slow rate, so a huge number of LEDs with one micron size are introduced in the bulb. The decrease of size of LEDs doesn't diminish its capacity to move information or power on the contrary it expands the proficiency of one light to send the information at a startlingly higher rates. Moreover, these miniature LEDs are eventually pixels — and at one micron, these LEDs would be much more modest than those in your Smartphone's retina show. You could have a gigantic exhibit of these LEDs that bend over as a room's light source and a showcase—and gives organizing ability as an afterthought. Maybe a next-cutting edge support would speak with your gamepad, Smartphone, and different peripherals through a Li-Fi-prepared TV. It undoubtedly gives a thruway lighting that enlightens the street, gives forward-thinking traffic information/alerts, and gives web admittance to your vehicle, in addition to the entirety



**Fig. 5.3.3. LED light**

Figure 1.6 is the model of li-fi drove lights, on a more broad level; Li-Fi may be utilized to expand remote organizations all through the home, working environment, and in business territories. Li-Fi is confined by view, so it will not at any point supplant Wi-Fi, yet it could expand it pleasantly. Rather than attempting to track down the ideal sweet spot for your home's Wi-Fi switch, it would be a lot less complex if each light in your home essentially went about as a remote organization connect. It's appeared in the figure 1.7. While Li-Fi is as yet in its beginning phases, the innovation could give an option in contrast to utilizing radio waves for remote Internet access. Right now, family Wi-Fi switches and portable media transmission towers rely upon radio signs to send information remotely.

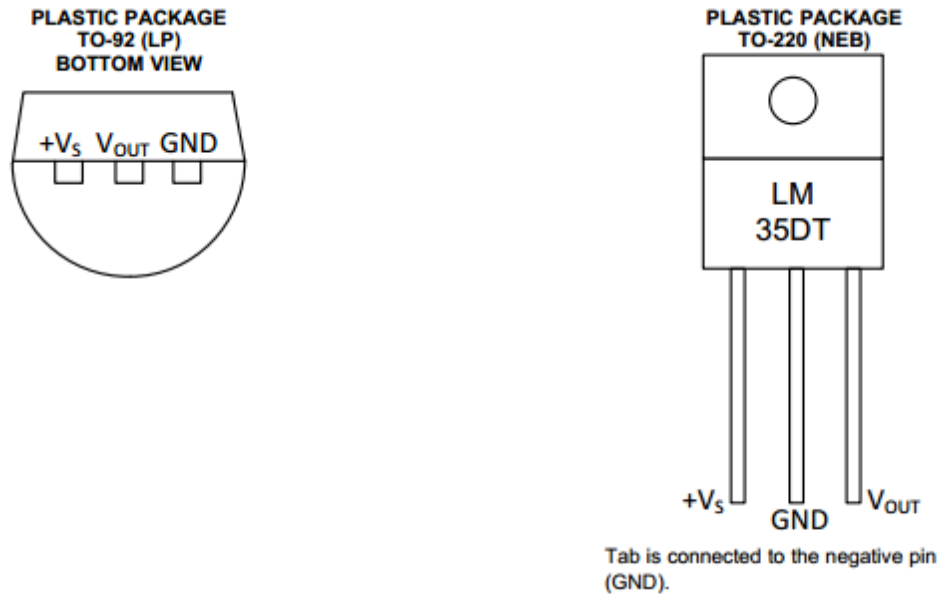
## 5.4. Temperature Sensor (LM35):

### Features Description

- Aligned Directly in ° Celsius (Centigrade)
- Straight + 10 mV/°C Scale Factor
- 0.5°C Ensured Accuracy (at +25°C) LM35 has a benefit over straight temperature.
- Appraised for Full –55°C to +150°C Range
- Appropriate for Remote Applications
- Minimal effort Due to Wafer-Level Trimming
- Under 60-μA Current Drain
- Low Self-Heating, 0.08°C in Still Air
- Nonlinearity Only  $\pm\frac{1}{4}^{\circ}\text{C}$  Typical
- Low Impedance Output, 0.1  $\Omega$  for 1 mA Load

### Description

The LM35 arrangement are accuracy coordinated circuit temperature sensors, with a yield voltage straightly corresponding to the Centigrade temperature. Accordingly the LM35 has a benefit over direct temperature sensors aligned in ° Kelvin, as the client isn't needed to take away an enormous steady voltage from the yield to get helpful Centigrade scaling. The LM35 doesn't need any outside alignment or managing to give regular exact nesses of  $\pm\frac{1}{4}^{\circ}\text{C}$  at room temperature and  $\pm\frac{3}{4}^{\circ}\text{C}$  Cover a full –55°C to +150°C temperature range. Ease is guaranteed by managing and adjustment at the wafer level. The low yield impedance, straight yield, and exact inalienable alignment of the LM35 make interfacing to readout or control hardware particularly simple. As the LM35 draws just 60 μA from the stockpile, it has exceptionally low self-warming of under 0.1°C in still air. The LM35 is appraised to work over a –55°C to +150°C temperature range, while the LM35C is evaluated for a –40°C to +110°C territory (–10° with improved exactness). The LM35 arrangement is accessible bundled in airtight TO semiconductor bundles, while the LM35C, LM35CA, and LM35D are likewise accessible in the plastic TO-92 semiconductor bundle. The LM35Dis additionally accessible in a 8-lead surface-mount little blueprint bundle and a plastic TO-220 bundle.



**Fig 5.3.4. Temperature**

## 5.5. HEARTBEAT SENSOR

An individual's pulse is the sound of the valves in his/her's heart contracting or growing as they power blood starting with one locale then onto the next. The occasions the heart beats each moment (BPM), is the heart beat rate and the thump of the heart that can be felt in any corridor that untruths near the skin is the beat.

### Two Ways to Measure a Heartbeat

Manual Way: Heart thump can be checked physically by checking one's heartbeats at two areas wrist (the outspread heartbeat) and the neck (carotid heartbeat). The method is to put the two fingers (list and center finger) on the wrist (or neck beneath the windpipe) and tally the quantity of heartbeats for 30 seconds and afterward duplicating that number by 2 to get the heart beat rate. Anyway pressing factor ought to be applied least and furthermore fingers ought to be gone all over till the beat is felt.

Utilizing a sensor: Heart Beat can be estimated dependent on optical force variety as light is dispersed or assimilated during its way through the blood as the heart beat changes.

## **Principle of Heartbeat Sensor**

The heartbeat sensor depends on the standard of photograph plethysmography. It estimates the adjustment in volume of blood through any organ of the body which causes an adjustment in the light force through that organ (a vascular area). If there should arise an occurrence of uses where heart beat rate is to be observed, the circumstance of the beats is more significant. The progression of blood volume is chosen by the pace of heart beats and since light is consumed by blood, the sign heartbeats are comparable to the heart beat beats.

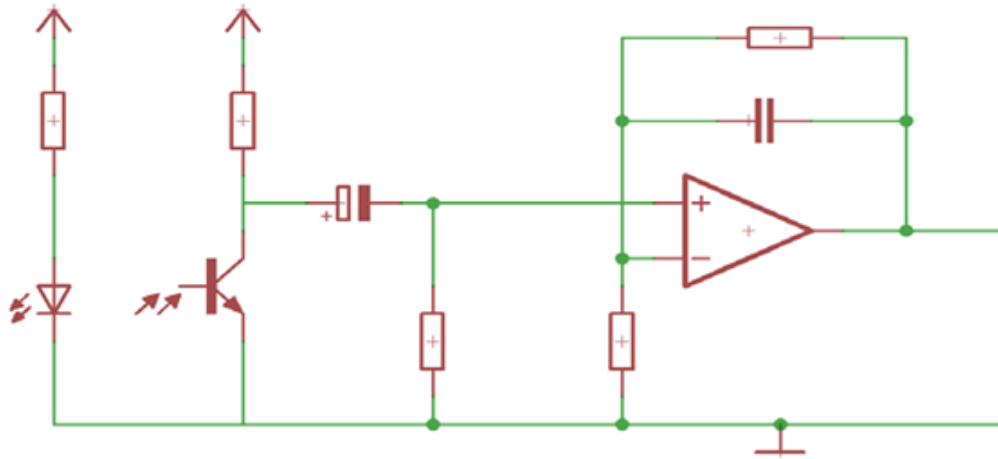
There are two kinds of photoplethysmography:

Transmission: Light produced from the light radiating gadget is communicated through any vascular area of the body like ear cartilage and got by the locator.

Reflection: Light radiated from the light emanating gadget is reflected by the districts.

## **Working of a Heartbeat Sensor**

The essential heartbeat sensor comprises of a light emanating diode and a locator like a light recognizing resistor or a photodiode. The heart beat beats makes a variety in the progression of blood various locales of the body. At the point when a tissue is enlightened with the light source, for example light discharged by the diode, it either mirrors (a finger tissue) or sends the light (ear cartilage). A portion of the light is consumed by the blood and the sent or the mirrored light is gotten by the light indicator. The locator yield is in type of electrical sign and is corresponding to the heart beat rate. This sign is really a DC signal identifying with the tissues and the blood volume and the AC segment simultaneous with the heart beat and brought about by pulsatile changes in blood vessel blood volume is superimposed on the DC signal. In this way the significant necessity is to detach that AC part for what it's worth of prime significance.



To achieve the task of getting the AC signal, the output from the detector is first filtered using a 2 stage HP-LP circuit and is then converted to digital pulses using a comparator circuit or using simple ADC. The digital pulses are given to a microcontroller for calculating the heart beat rate,

$$\text{BPM(Beats per minute)} = 60 * f$$

- Where f is the pulse frequency

### Practical Heartbeat Sensor

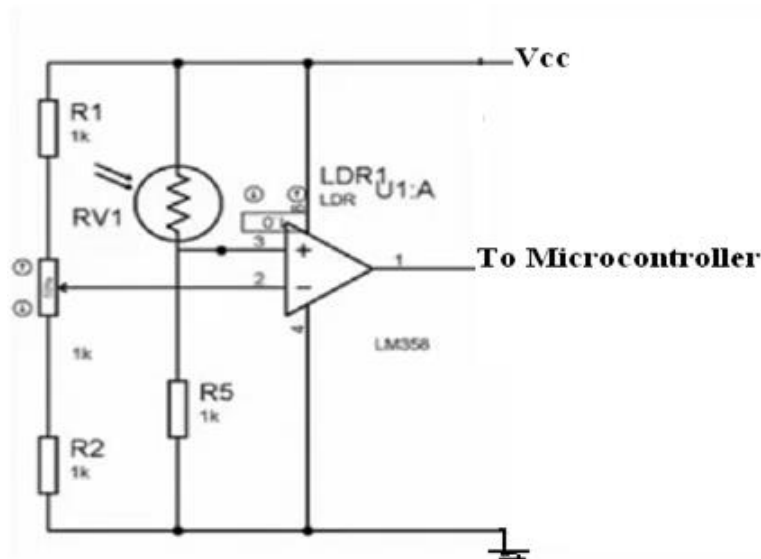
Commonsense heartbeat Sensor models are Heart Rate Sensor (Product No PC-3147). It comprises of an infrared drive and a LDR inserted onto a clasp like construction. The another model is TCRT1000, having 4 pins-

Pin1: To give supply voltage to the LED

Pin2 and 3 are grounded. Pin 4 is the yield. Pin 1 is additionally the empower pin and pulling it high turns the LED on and the sensor begins working. It is inserted on a wearable gadget which can be worn on the wrist and the yield can be sent remotely (through Bluetooth) to the PC for preparing.

Requests Develop your own Sensor System Development

The basic segments such as ldr, IC LM258 and microcontroller can also be used to construct a critical heartbeat sensor system.



As portrayed above in regards to the guideline of heart beat sensor, when the finger tissue or the ear cartilage tissue is enlightened utilizing a light source, the light is communicated subsequent to getting regulated for example a section getting consumed by the blood and the rest being sent. This adjusted light is gotten by the light indicator. Here a comparator is utilized which looks at the yield voltage from the LDR to that of the limit voltage. The limit voltage is the voltage drop across the LDR when the light with fixed force, from the light source falls straightforwardly on it. At the point when a human tissue is enlightened utilizing the light source, the power of the light diminishes. As this decreased light power falls on the LDR, the opposition increments and accordingly the voltage drop increments. At the point when the voltage drop across the LDR or the non-upsetting information surpasses that of the transforming input, a rationale high sign is created at the yield of the comparator and in the event that voltage drop being lesser a rationale low yield is created. Consequently the yield is a progression of heartbeats. These heartbeats can be taken care of to the Microcontroller which likewise measures the data to get the heart beat rate and this is shown on the Display interfaced to the Microcontroller.

## 5.6. Micro-electromechanical systems (MEMS)

Micro-electromechanical systems (MEMS) is an innovation that consolidates PCs with minuscule mechanical gadgets like sensors, valves, pinion wheels, mirrors, and actuators inserted in semiconductor chips. MEMS or what he calls relationship processing will be "the primary innovation of the following decade." MEMS is additionally now and MEMS are now utilized as accelerometers in auto air-packs. They've supplanted a less dependable gadget at lower cost and show guarantee of having the option to swell a sack based on detected deceleration as well as based on the size of the individual they are ensuring. Essentially, a MEMS gadget contains miniature hardware on a small silicon chip into which some mechanical gadget, for example, a mirror or a sensor has been fabricated. Possibly, such chips can be implicit enormous amounts easily, making them practical for some employments.

Among the as of now accessible employments of MEMS or those under examination are:

- Worldwide position framework sensors that can be incorporated with messenger packages for consistent following and that can likewise detect bundle treatment in transit
- Sensors incorporated into the texture of a plane wing so it can detect and respond to wind current by changing the wing surface obstruction; adequately making a horde of little wing folds
- Optical exchanging gadgets that can switch light signals over various ways at 20-nanosecond exchanging speeds
- Sensor-driven warming and cooling frameworks that significantly improve energy reserve funds
- Building upholds with imbedded sensors that can adjust the adaptability properties of a material dependent on environmental pressure detecting

**Applications:**

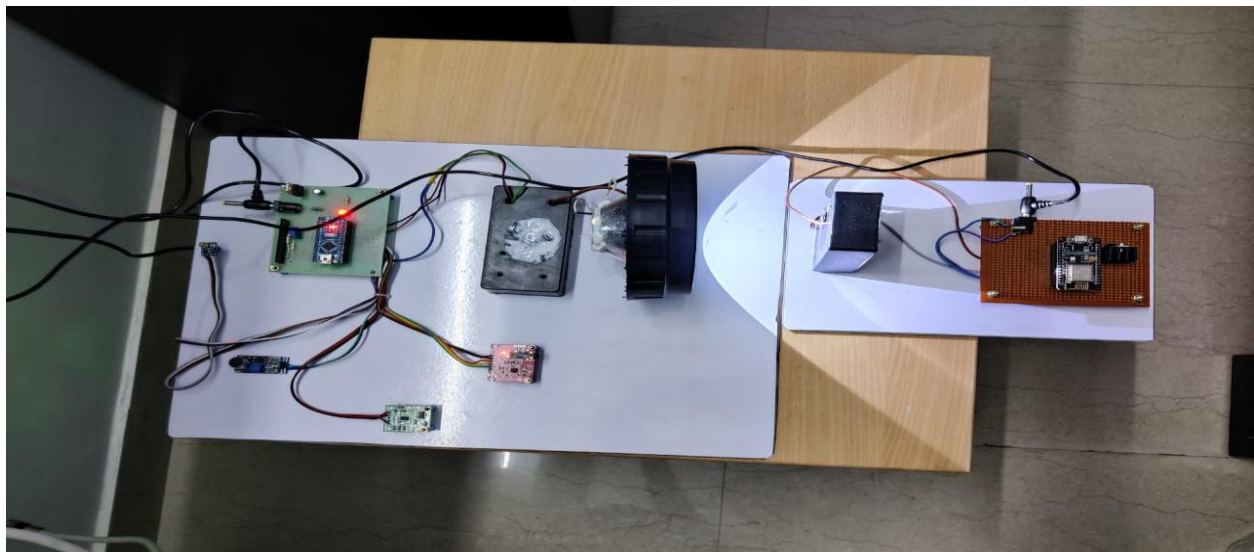
- Vibrations estimation and Tilt tendency (to change revolution speed, electrical switch security, flaw forecast),
- Expert and homegrown Alarms
- Upkeep the board and Asset Tracking for stuns observing
- Alert and Anti Tamper work

## CHAPTER 6

### RESULT

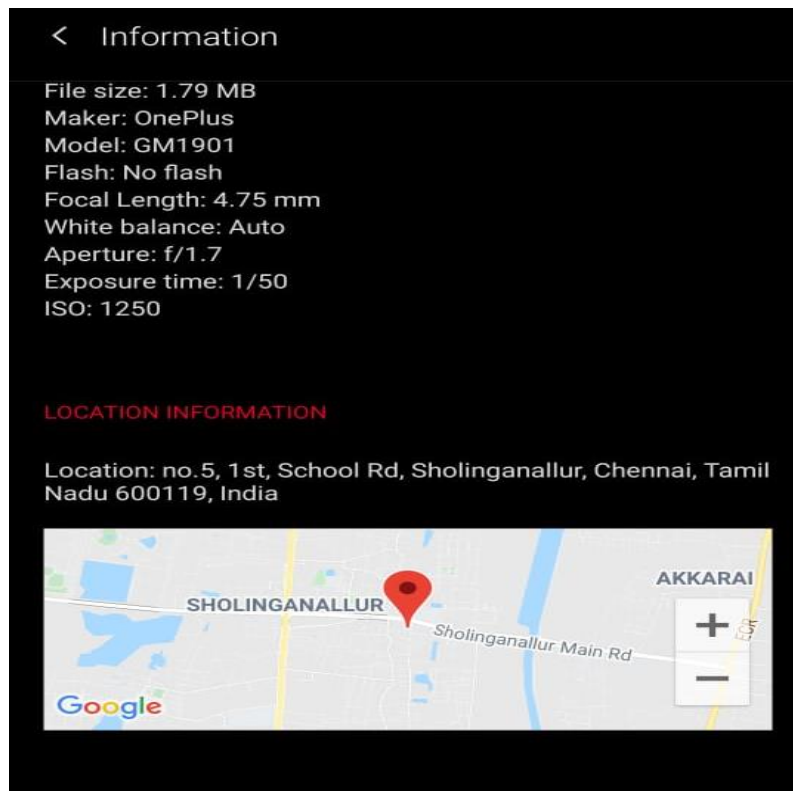
The standard of activity is very straightforward. Two dry sensors are utilized to distinguish and channel the EEG signals. The sensor tip identifies electrical signs from the temple of the mind. Simultaneously, the sensor gets encompassing produced by human muscle, PCs, lights, electrical attachments and other electrical gadgets. The subsequent sensor, ear cut, is a grounds and reference, which permits Think Gear chip to sift through the electrical. The gadget estimates the crude sign, power range (alpha, beta, delta, gamma, theta), consideration level, intercession level and flicker location. The crude EEG information got at a pace of 512 Hz. Other estimated values are made each second. Thusly, crude EEG information is a fundamental wellspring of data on EEG signals utilizing Mind Wave MW001.

In the Robot segment we can peruse the estimation of crude ECG signal with the most extreme recurrence of 512 Hz. Examining recurrence is determined to 512 Hz, and we control time delays in testing. The estimation of the sign and time are kept in touch with the exhibit information. The information which are put away in cluster will be contrasted and the limit focuses given by the client.



**Fig. 6.0.1. Demonstration**

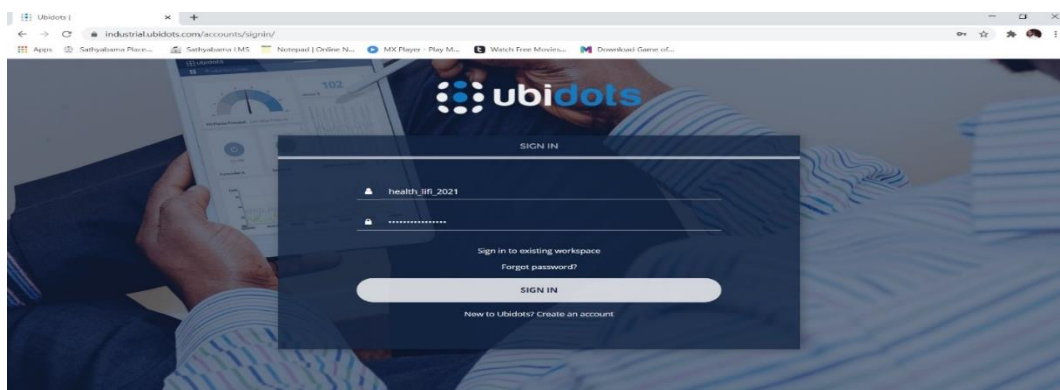
**Geotagged location:**



**Fig 6.0.2. Geotag location**

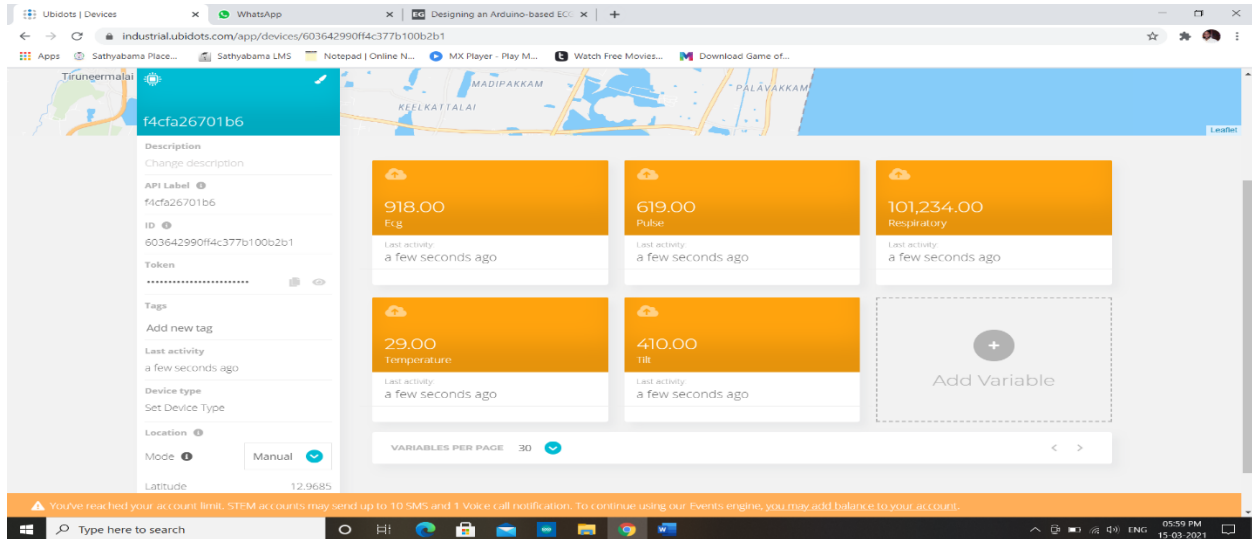
## **6.1. Ubidots Cloud:**

**Step 1:** We need to open ubidots and login using user name and password given by a doctor.



**Fig.6.1.1. Login Page**

**Step 2:** We need to open a device in a cloud, there we can see the readings of a patient. By clicking on each sensors we will get the readings and the graphs of the patient.



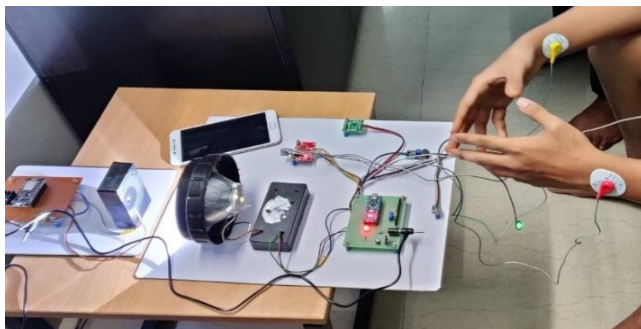
**Fig 6.1.2. Cloud**

## 6.2. Sensors

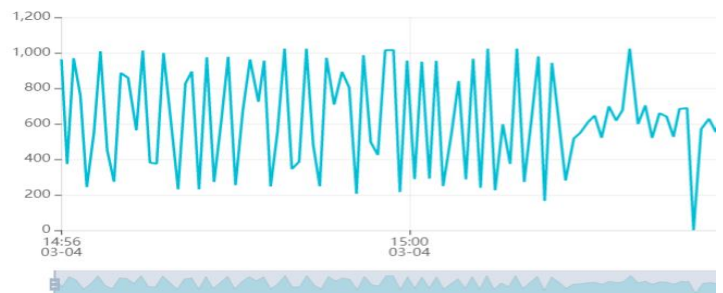
### ECG Monitoring:

The AD8232 is a perfect chip used to measure the heart's electric activity. It can be diagramed as an ECG or Electrocardiogram for this electrical operation.

It comprises of 3 pins that was associated with a patient to screen a patient's Heart rate as charts. The pins are associated with a patient as demonstrated in fig 6.2.1 and the yield waveform is appeared in fig 6.2.2



**Fig. 6.2.1. ECG Sensor connection**

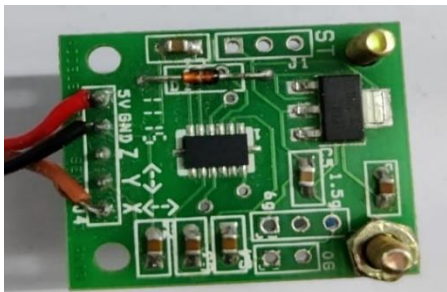


**Fig. 6.2.2. ECG Output Waveform**

### **MEMS Sensor/ Tilt Sensor:**

A MEMS/Tilt Sensor is an electronic gadget that distinguishes the direction of an item and gives its yield High or Low in like manner.

In the event that a patient is in trance state, nobody can tell when the patient will get into cognizant and it is hard to screen that patient for all day, every day ,so by utilizing this mems sensor or slant sensor we can identify the snapshot of the patient when he get into cognizant and we will get a Gmail Alert message.



**Fig.6.2.3. MEMS Sensor**



**Fig. 6.2.4. MEMS Output Waveform**

### **Pulse Sensor:**

The Heart Beat Sensor is used to determine the patient's pulse rate. To prevent any health issues relating to the patient, the pulses are quickly registered and updated in the observation room.

It is used to measure the pulse of a patient as shown in figure 6.2.5



**Fig. 6.2.5. Pulse sensor**



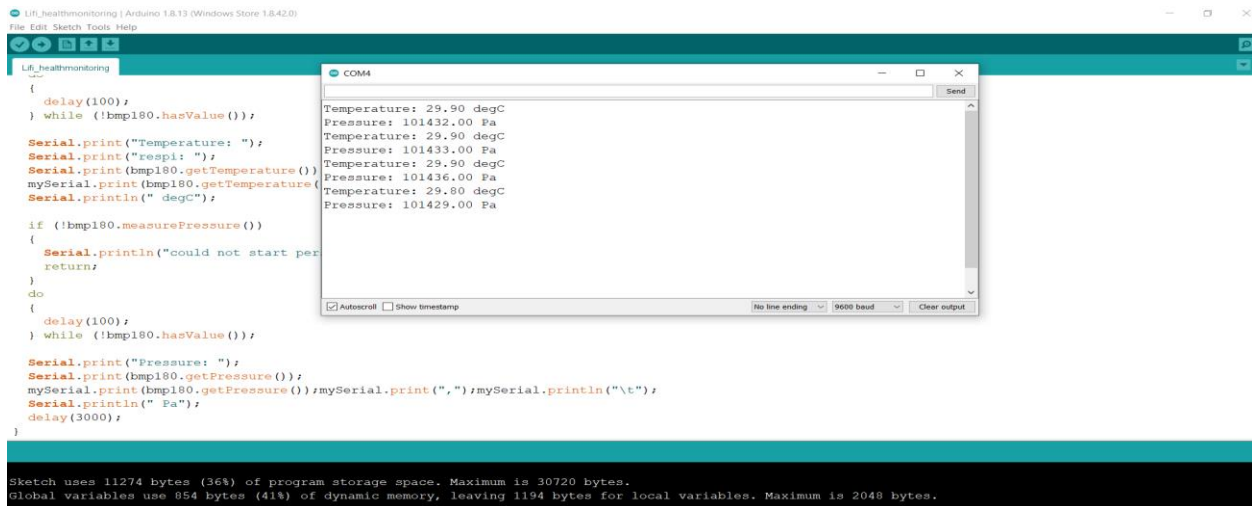
**Fig 6.2.6. Pulse values & graph**

## Temperature and Pressure Sensor:

In hospitals, where regular monitoring of the room temperature and body temperature is important, the temperature sensor plays a critical role.

It's used to keep track of the room's temperature as well as the temperature of the patient in the observation room.

It was shown on a serial monitor.



The screenshot displays the Arduino IDE interface. The main editor shows a sketch named 'Lif\_healthmonitoring' with the following code:

```
Lif_healthmonitoring | Arduino 1.8.13 (Windows Store 1.8.42.0)
File Edit Sketch Tools Help

Lif_healthmonitoring
{
  delay(100);
} while (!bmp180.hasValue());

Serial.print("Temperature: ");
Serial.print("Respi: ");
Serial.print(bmp180.getTemperature());
mySerial.print(bmp180.getTemperature());
Serial.println(" degC");

if (!bmp180.measurePressure())
{
  Serial.println("could not start per
  return;
}
do
{
  delay(100);
} while (!bmp180.hasValue());

Serial.print("Pressure: ");
Serial.print(bmp180.getPressure());
mySerial.print(bmp180.getPressure());mySerial.print(",");mySerial.println("\t");
Serial.println(" Pa");
delay(3000);
}
```

The serial monitor window, titled 'COM4', shows the following output:

```
Temperature: 29.90 degC
Pressure: 101432.00 Pa
Temperature: 29.90 degC
Pressure: 101433.00 Pa
Temperature: 29.90 degC
Pressure: 101436.00 Pa
Temperature: 29.80 degC
Pressure: 101429.00 Pa
```

At the bottom of the IDE, a status bar indicates: 'Sketch uses 11274 bytes (36%) of program storage space. Maximum is 30720 bytes. Global variables use 854 bytes (41%) of dynamic memory, leaving 1194 bytes for local variables. Maximum is 2048 bytes.'

**Fig. 6.2.7. Serial monitor output**

## **CHAPTER 7**

### **CONCLUSION**

Li-Fi is becoming a more fitting network for next-generation hospital health facilities. The implementation of Visible Light Communication (VLC) in HMS is illustrated in this document using a prototype model. The Li-Fi network can be used as a high speed, safe and accurate human body data communication device to track human body data in real time of heartbeat, blood pressure, temperature, and pressure, as well as other parameters.

The application of this technology in the field of medicine allows for faster diagnosis and internet access through radio wave-based apparatus. The proposed system is entirely automated, and if it is introduced effectively, it will be a watershed moment in the medical industry.

#### **Future Scope:**

Since light is ubiquitous and free to use, there is a lot of room for Li-Fi technology to develop and evolve. Each Li-Fi Bulb will be able to transmit data until the technology matures. As Li-Fi technology becomes more widely used, it will result in a communication system that is cleaner, greener, more cost-effective, and safer. While Li-Fi is committed to tackling problems like radio frequency bandwidth deficiencies and removing restrictions on radio communications technology.

In the medical sector, WIFI is not suitable for use in hospitals or other health-care facilities because it uses radio waves, which reach the human body. LIFI can be applied and is an excellent substitute in this industry.

## CHAPTER 8

### APPLICATIONS OF LI-FI

The communications cannot pass through walls or doors using the short wave radiation used by Li-Fi. This improves security and makes it easier to manage network access. Connection to a Li-Fi channel is restricted to devices inside the room as long as transparent materials like windows are sealed.

These are the Li-Fi Applications.

#### **Home and building automation:**

Future home and building automation is expected to be heavily reliant on Li-Fi technology for security and speed. The signal cannot be hacked from a location that is not visible through the window because light cannot pass through walls.

#### **Underwater application:**

Wired connections are used to power the majority of remotely operated underwater vehicles (ROVs). Their operating range is limited by the length of their cabling, and other factors such as the cable's weight and fragility can also be limiting. Li-Fi-based communications may provide much greater mobility because light can pass through water. The distance light can reach water limits the usefulness of Li-Fi. Significant quantities of light do not travel beyond 200 meters. There is no light above 1000 meters.

#### **Aviation:**

Effective data transmission is possible in airborne environments like commercial passenger aircraft using Li-Fi. This transfer of light-based data does not compete with aircrafts such as the radar.

#### **Hospital:**

Since several procedures now include many people, Li-Fi will be the safer way to communicate with patient details. Light waves, in addition of speed, have no impact on medical instruments. Wireless communication can be carried out by using such medical instruments without the risk of radio interference obstructing the task's performance.

**Vehicles:**

To improve road safety, Facing and backlights can enable vehicles to communicate with each other. Info on current conditions can also be given by traffic signals and street lights.

**Industrial automation:**

Li-Fi will replace, slipping contact, and short cable, such as Ethernet, wherever data needs to be transmitted in industrial areas. Li-Fi is a common industrial Wireless LAN standards due to its real-time capabilities (which are often needed for automation processes). Fraunhofer IPMS, a German research institute, claims to have created a component that is ideal for industrial involving transmission of data.

**Advertising:**

When a person walks by, street lamps used to view advertising for nearby business on cellular devices. On a customer's cellular screen, A customer coming into the shop to see new prices and deals, and passing into the front lights of the store.

**Education:**

In a Li-Fi activated classroom, students and teachers involved educational culture. Students with phones or pc's may interact with the staff or with each friends to make the learning experience more effective. Teachers and students should work together to help students appreciate the content in class.

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