A

PROJECT REPORT

ON

"Numerical Data Transfer by Li-Fi"

OR

"Li-Fi Based Text Communication"

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UNDER THE GUIDANCE OF

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Academic Year 2021-22

Semester-II

CERTIFICATE

This is to certify that, the Project report entitled

"Numerical Data Transfer by Li-Fi"

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As the partial fulfillment of the Engineering Exploration Lab

For the academic year 2021-22, Sem-II

This project is a record of student's own work, carried out by them under our supervision and guidance.

Mrs. V. V. Khiste **Ms. M. M. Baswade** **Mr. S. D. Kulkarni** **Dr. S. S. Gajre**

ACKNOWLEDGEMENT

For all the efforts behind the project work, we first & foremost would like to express our sincere appreciation to the staff of the Department of Engineering Exploration Lab, for their extended help & suggestions at every stage of this project.

It is with a great sense of gratitude that we acknowledge the support, time to time suggestions are highly indebted to our guide.

Finally, we pay our sincere thanks to all those who indirectly and directly helped us towards the successful completion of this project report.

Abstract

Whether you're using wireless internet in a coffee shop, stealing it from the guy next door, or competing for bandwidth at a conference, you've probably gotten frustrated at the slow speeds you face when more than one device is tapped into the network. As more and more people and their many devices access wireless internet, clogged airwaves are going to make it increasingly difficult to latch onto a reliable signal. But radio waves are just one part of the spectrum that can carry our data. What if we could use other waves to surf the internet? One German physicist, DR. Harald Haas, has come up with a solution he calls "Data Through Illumination"-taking the fiber out of fiber optics by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. It's the same idea behind infrared remote controls, but far more powerful. Haas says his invention, which he calls D-light, can produce data rates faster than 10 megabits per second, which is speedier than your average broadband connection. He envisions a future where data for laptops, smartphones, and tablets is transmitted through the light in a room. And security would be a snap- if you can't see the light, you can't access the data.

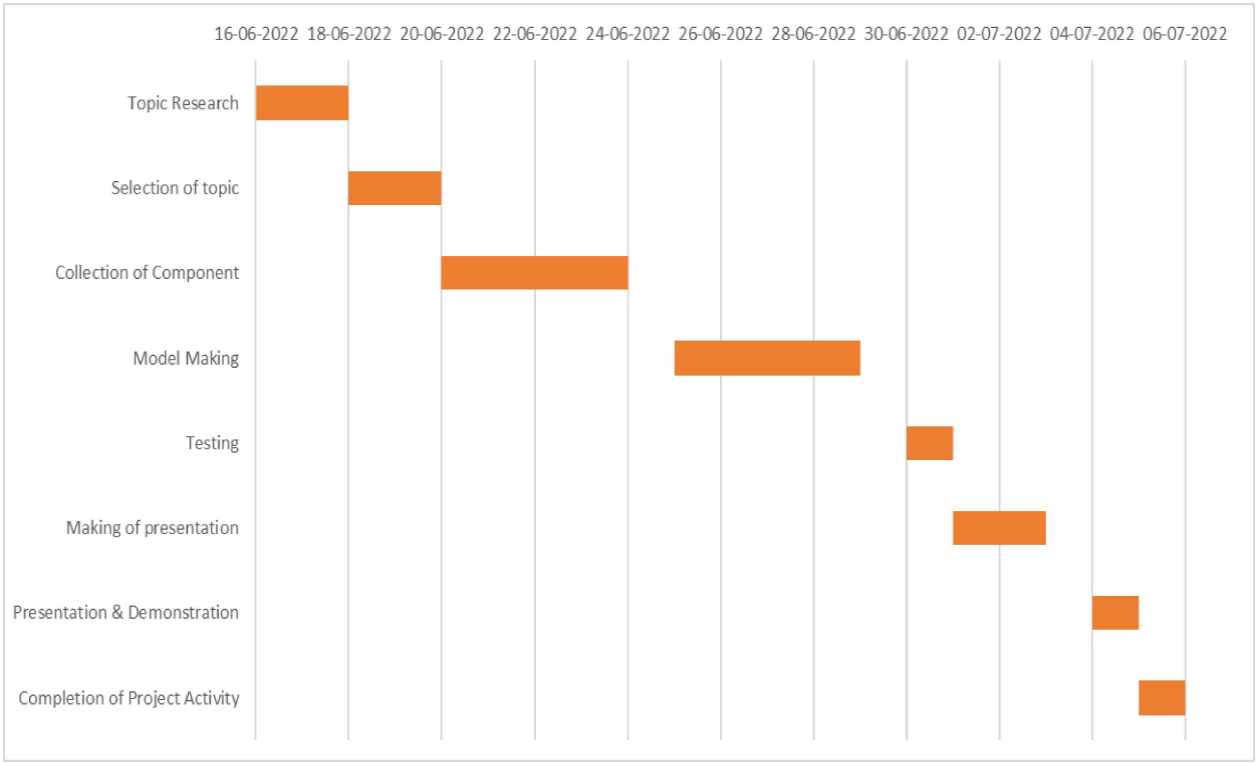
Li-Fi is a VLC, visible light communication, technology developed by a team of scientists including Dr Gordon Povey, Prof. Harald Haas and Dr Mostafa Afgani at the University of Edinburgh. The term Li-Fi was coined by Prof. Haas when he amazed people by streaming high-definition video from a standard LED lamp, at TED Global in July 2011. Li-Fi is now part of the Visible Light Communications (VLC) PAN IEEE 802.15.7 standard. "Li-Fi is typically implemented using white LED light bulbs. These devices are normally used for illumination by applying a constant current through the LED. However, by fast and subtle variations of the current, the optical output can be made to vary at extremely high speeds. Unseen by the human eye, this variation is used to carry high-speed data," says Dr Povey, , Product Manager of the University of Edinburgh's Li-Fi Program 'D-Light Project'

Gantt Chart

Task	START DATE	END DATE	DURATION
Topic Research	16-06-2022	18-06-2022	2
Selection of topic	18-06-2022	20-06-2022	2
Collection of Component	20-06-2022	24-06-2022	4
Model Making	25-06-2022	29-06-2022	4
Testing	30-06-2022	01-07-2022	1
Making of presentation	01-07-2022	03-07-2022	2
Presentation & Demonstration	04-07-2022	05-07-2022	1
Completion of Project Activity	05-07-2022	06-07-2022	1

Table 1

Graph of Gantt chart



Pugh Chart

DESIGN CRITERION	WEIGHT AGE	USB TRANSFER	BLUETOOTH	WI-FI	FIBRE CABLE	LI-FI
COST	2	D	+	+	-	-
SECURITY	3	A	_	+	+++	+++
SPEED	3	T	_ _	++	++	+++
CAPACITY	2	U	_ _	0	+	+++
EASE OF USE	3	M	+	++	0	++
HARDWARE REQUIREMENT	1		_ _	_ _ _	+++++	_ _
	+		5	17	22	32
	-		0	2	1	0
	0		15	3	2	2
	TOTAL		-10	14	20	30

Table 2

Pairwise Comparison Chart

	use of visible light	security	cost	safety	Ecological Impact	Device to Device connectivity	High Speed	Efficiency	Total
Use of Visible Light	-	1	1	1	1	1	1	1	7
Security	0	-	1	0	1	1	0	1	3
Cost	0	0	-	0	0	1	1	1	3
Safety	0	1	1	-	1	1	1	1	6
Ecological Impact	0	0	1	0	-	0	0	0	1
Device to Device Connectivity	0	0	0	0	1	-	0	1	2
High Speed	0	1	0	0	1	1	-	1	4
Efficiency	0	0	0	0	1	0	0	-	1

Table 3

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List of Abbreviations

Li-Fi	- Light Fidelity
Is	- Input String
Os	- Output String

Chapter 1

Introduction

Overview :

In simple terms, Li-Fi can be thought of as a light-based Wi-Fi. That is, it uses light instead of radio waves to transmit information. And instead of Wi-Fi modems, Li-Fi would use transceiver-fitted LED lamps that can light a room as well as transmit and receive information. Since simple light bulbs are used, there can technically be any number of access points.

This technology uses a part of the electromagnetic spectrum that is still not greatly utilized- The Visible Light Spectrum. Light is in fact very much part of our lives for millions and millions of years and does not have any major ill effect. Moreover there is 10,000 times more space available in this spectrum and just counting on the bulbs in use, it also multiplies to 10,000 times more availability as an infrastructure, globally.

It is possible to encode data in the light by varying the rate at which the LEDS flicker on and off to give different strings of Is and Os. The LED intensity is modulated so rapidly that human eyes cannot notice, so the output appears constant.

Working :

As we know Li-Fi means light fidelity . It consist of two parts or sections

1.Receiver section

2.And Transmitter section

In general , when we input the data on transmitter side it convert that data in the form of current pulse . The same pulse is then transmitted to light source which emits a light of unique intensity .

The same light is received on receiver side which is converted into numerical data from the data is associated with the unique light intensity . That data is then displayed with the help oof lcd screen.

For light transfer here we are using a light wave of unique intensity which transferring the data with the speed of light so our data transfer is faster the any of traditional data transferring system like wi-fi , Bluetooth , wired data transfer etc.

In our system model we are transferring single digit numerical data with the help of light on small level. In the same way we can improve / modify our system that it can be transfer the various types of data in the same way.

Behind the idea of Li-Fi there is need of high speed data transfer , which can not be fulfilled by our traditional methods.

li-Fi (Light Fidelity) is an advanced technology that allows transferring data using optical communication such as visible light. Li-Fi data can travel through the light and then interpreted on the receiver side using any light-sensitive device like LDR or photodiode. Li-Fi communication can be 100 times faster than Wi-Fi.

Here in this project, we will be demonstrating Li-Fi communication using two Arduino. Here the text data is transmitted using LED and 4x4 keypad. And it is decoded on the receiver side using LDR. We previously explained Li-Fi in detail and used Li-Fi to transfer audio signals.

Chapter 2

Literature Survey

➢ HISTORY

Harald Haas, a professor at the University of Edinburgh who began his research in the field in 2004, gave a debut demonstration of what he called a Li-Fi prototype at the TED Global conference in Edinburgh on 12th July 2011. He used a table lamp with an LED bulb to transmit a video of clouds onto a laptop connected to the prototype.

During the event he periodically blocked the light from lamp to prove that the lamp was indeed the source of incoming data. At TED Global, Haas demonstrated a data rate of transmission of around 10Mbps -- comparable to a fairly good UK broadband connection. Two months later he achieved 123Mbps.

➢ WHY VISIBLE LIGHT COMMUNICATION?

The frequency spectrum that is available to us in the atmosphere consists of many wave regions like X-rays, gamma rays, ultraviolet region, infrared region, visible light rays, radio waves, etc. Anyone of the above waves can be used in the upcoming communication technologies but why the Visible Light part is chosen? The reason behind this is the easy availability and lesser harmful effects that occur due to these rays of light. VLC uses the visible light between 400 THz (780 nm) and 800 THz (375 nm) as medium which are less dangerous for high-power applications and also humans can easily perceive it and protect themselves from the harmful effects whereas the other wave regions have following disadvantages:

Radio waves are expensive (due to spectrum charges) and less secure (due to interference and possible interception etc.)

Gamma rays are harmful because it could be dangerous dealing with it, by the human beings due to their proven adverse effects on human health.

X-rays have health issues, similar to the Gamma Rays.

Ultraviolet light can be considered for communication technology purposes at place without people, otherwise they can also be dangerous for the human body when exposed continuously.

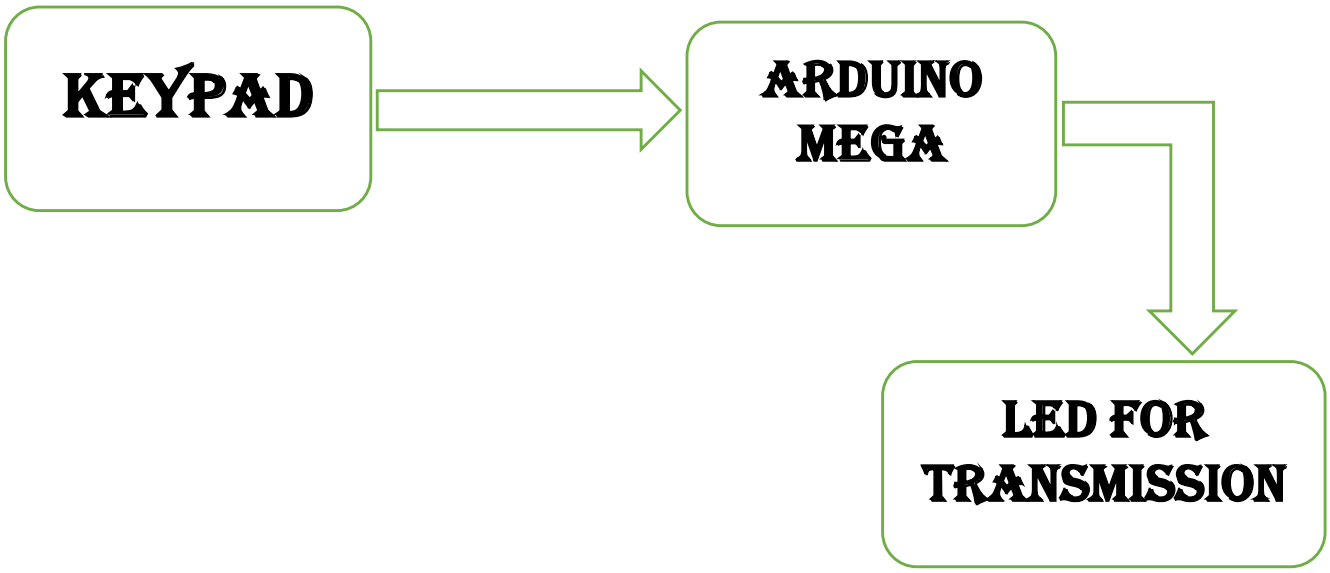
Infrared, due to high safety regulation, can only be used with low power.

Hence the Visible light portion (from red to blue) of the electromagnetic spectrum does not cause any harm to the people as visible rays are safe to use, provide larger bandwidth and also have a promising future in the communication field.

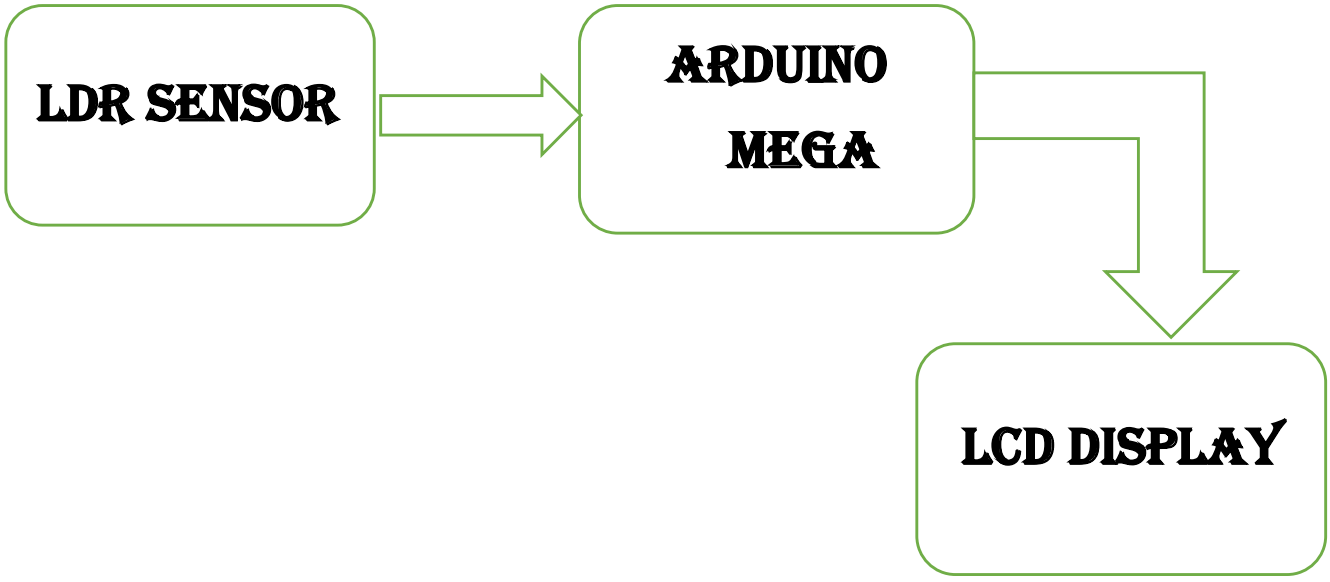
Chapter 3

Block Diagram

- **Transmitter section : -**



- **Receiver Section :-**

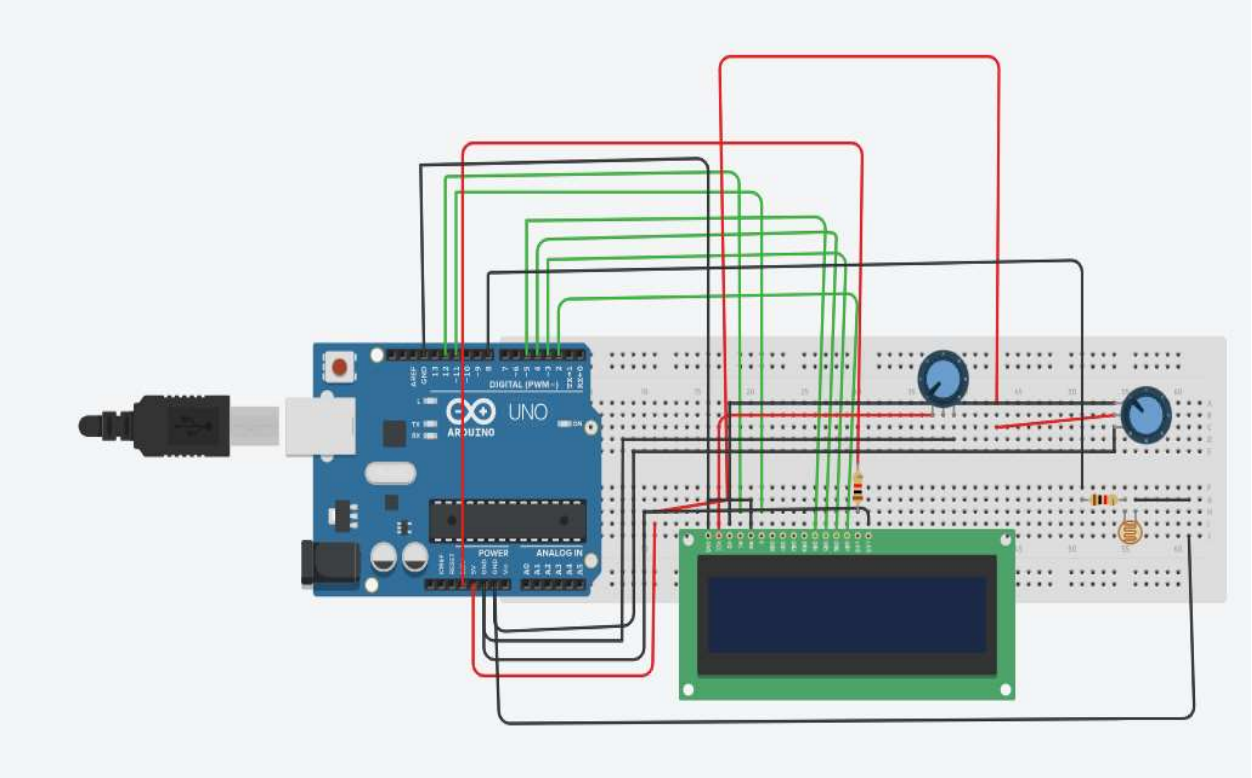


Chapter 4

System Design

4.1 Overview of Design :

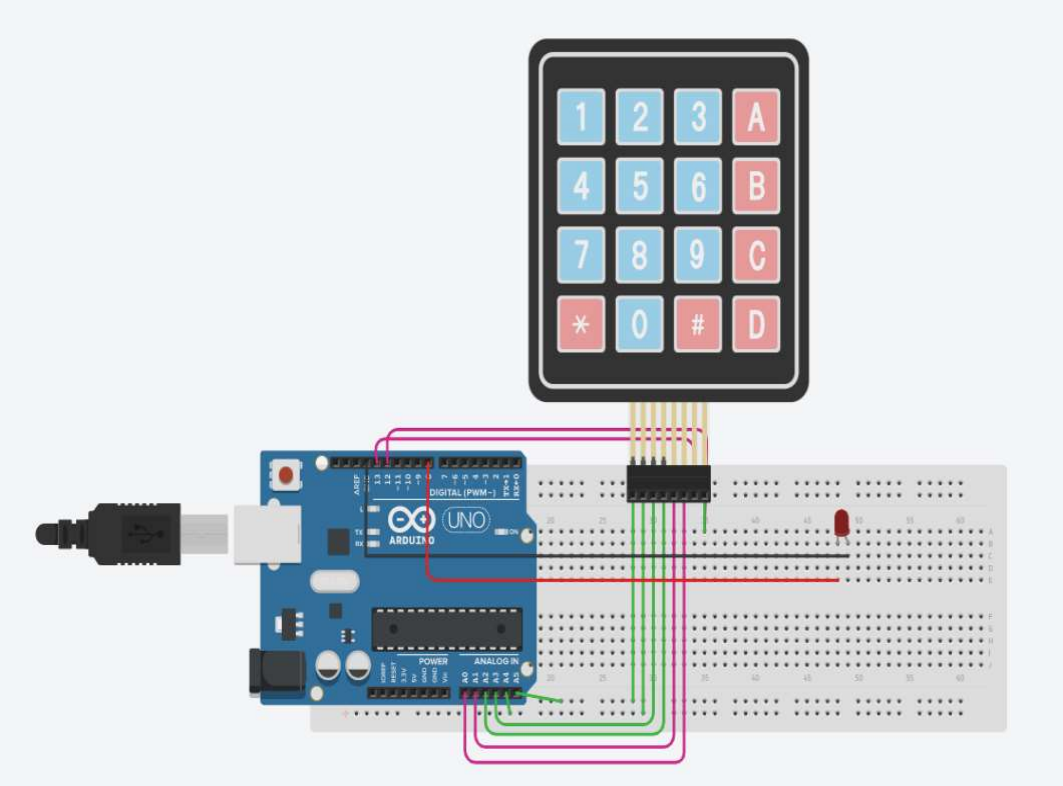
Our system consists of two sections as transmitter and receiver section .Receiver section includes output device, control unit and receiver device known as LDR (light dependent resistor). It includes connections of LDR, resistor , Arduino and LCD display. It has connections as following circuit diagram.



Receiver Section Of Li-Fi

4.1

It has another part known as transmitter section . it includes the LED of 5mm attached to the control unit (Arduino), which is parallely assembled with the input device known as keypad. It consists of connections as shown in following circuit diagram. The both the sections of our system has same amount of importance. They both are necessary for working of our system. Both the control units has it's own necessary code for it's working.



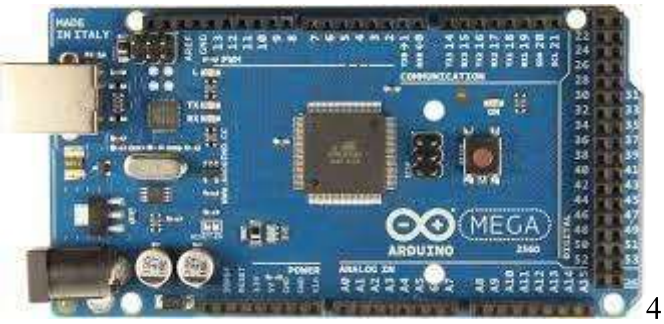
Transmitter Section Of Li-Fi

4.2

Our system is made up using the following components . A brief overview of the working and use of them is given below :

4.2 Components Used :

a)Arduino Mega



4.2.a

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a

AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila

b)LED

4.2b

A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons LEDs have many advantages over incandescent light sources, including lower power consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. In exchange for these generally favorable attributes, disadvantages of LEDs include electrical limitations to low voltage and generally to DC (not AC) power, inability to provide steady illumination from a pulsing DC or an AC electrical supply source, and lesser maximum operating temperature and storage temperature. In contrast to LEDs, incandescent lamps can be made to intrinsically run at virtually any supply voltage, can utilize either AC or DC current interchangeably, and will provide steady illumination when powered by AC or pulsing DC even at a frequency as low as 50 Hz. LEDs usually need electronic support components to function, while an incandescent bulb can and usually does operate directly from an unregulated DC or AC power source.

c)LCD

4.2c

LCD 16×2, the term LCD stands for Liquid Crystal Display that uses a plane panel display technology, used in screens of computer monitors & TVs, smartphones, tablets, mobile devices, etc. Both the displays like LCD & CRTs look the same but their operation is different. Instead of electrons diffraction at a glass display, a liquid crystal display has a backlight that provides light to each pixel that is arranged in a rectangular network. An electronic device that is used to display data and the message is known as LCD 16×2. As the name suggests, it includes 16 Columns & 2 Rows so it can display 32 characters (16×2=32) in total & every character will be made with 5×8 (40) Pixel Dots. So the total pixels within this LCD can be calculated as 32 x 40 otherwise 1280 pixels.

d)Keypad 4*4

4.2d

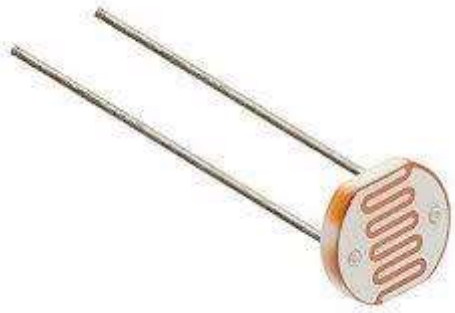
The Basics of a 4x4 Matrix Keypad

The 4x4 matrix keypad is a simple mechanism that resembles the numeric input on your computer keyboard, except that it has an additional '*,' '#' and 4 other auxiliary buttons that can be used for various functions in the application. The keypad is usually made of plastic materials and is relatively cheap compared to touchscreen displays.

A 4x4 matrix keypad can be implemented separately or within the physical product itself, such as a security access controller, where it is used for PIN identifications. Either way, the mechanism of the mechanical keypad remains the same when hardware and firmware designers are concerned.

If you've never designed with a 4x4 mechanical keypad, the best way to visualize the internal mechanism is a matrix of push-button switches. A 4x4 keypad has a total of 8 connections, where 4 of them are connected to the column and the remaining rows of the matrix of switches.

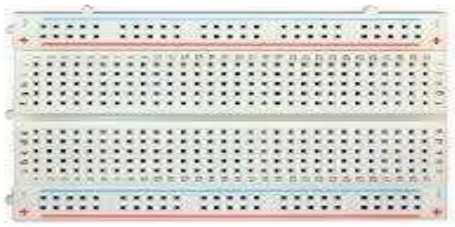
e)LDR



4.2e

LDR or light dependent resistor is also known as photo resistor, photocell, photoconductor. It is a one type of resistor whose resistance varies depending on the amount of light falling on its surface. When the light falls on the resistor, then the resistance changes. These resistors are often used in many circuits where it is required to sense the presence of light. These resistors have a variety of functions and resistance. For instance, when the LDR is in darkness, then it can be used to turn ON a light or to turn OFF a light when it is in the light. A typical light dependent resistor has a resistance in the darkness of 1MOhm, and in the brightness a resistance of a couple of KOhm.

f)Breadboard



4.2f

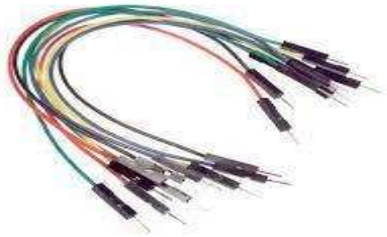
breadboard is used to build and test circuits quickly before finalizing any circuit design. The breadboard has many holes into which circuit components like resistors can be inserted. The bread board has strips of metal which run underneath the board and connect the holes on the top of the board. The metal strips are laid out as shown below. Note that the top and bottom rows of holes are connected horizontally while the remaining holes are connected vertically.

g) Potentiometer

4.2g

A potentiometer (also known as a pot or potmeter) is defined as a 3 terminal variable resistor in which the resistance is manually varied to control the flow of electric current. A potentiometer acts as an adjustable voltage divider. A potentiometer is a passive electronic component. Potentiometers work by varying the position of a sliding contact across a uniform resistance. In a potentiometer, the entire input voltage is applied across the whole length of the resistor, and the output voltage is the voltage drop between the fixed and sliding contact.

h) Jumper wire



4.2h

A jump wire (also known as jumper, jumper wire, DuPont wire) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering. Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

Chapter 5

Applications

A. Health Technologies:

Your Wi-Fi emits radio waves which are very harmful for the patients and the radio waves interpreting the actual medical instruments. Thus you can use internet in running rooms by Li-Fi technology. For no longer time period, now medical technology would lag behind those other entire wireless world. Till now operating rooms did not facilitate Wi-Fi over radiation concerns, and there was also a complete lack of dedicated selection.

B. Airlines:

In Airlines passengers concur to pay additional quantity of cash for the dial up service within the crafts. Li-Fi might simply introduce "high-speed" transmission service which might be interruption free and differs from alternative wireless signals on the board.

Li-Fi uses light rather than radio frequency signals.

Under water in sea Wi-Fi does not work at where Li-Fi will work

There are around 19 billion bulbs worldwide, they simply should be supplanted with LED ones that transmit data, we reckon VLC is at a factor of ten, cheaper than Wi-Fi. Security is another benefit, since light does not penetrate through walls.

C. Street Light:

Cars have semiconductor diode primarily based headlights, semiconductor diode primarily based backlights, and automobile will communicate one another and stop accidents within the method that they exchange data. Traffic signal will communicate to the automobile then on.

H. Li-Fi may solve issues such as the shortage of radio frequency bandwidth.

Chapter 6

Conclusion and Future Scope

If this technology can be put into practical used, every bulb can be used something like a Wi-fi to Transmit wireless data.

It will allow internet connection where Wi-fi is banned in some places such as aircraft & operation theatres.

Li-fi is the future technology of data Transmission.

With Li-fi, we will also be moving towards a much more Secured network, which will be safeguarding us from hackers.

Li-fi can work using their headlamps. underwater where Wi-fi fails completely. Divers can communicate

Li-fi will ensure that every individual is getting a high speed of internet

The simplicity on the li-fi technology using LED lamps to transmit data, including high speed data connections that could be served from street lights could boost emergence of smart locations.

In the future, topology matters the most:

Researchers published worldwide indicate that a future network is going to be faster but capacity complications could still remain. It further reveals of which topology - the cosmetics of transmitters providing the network signal is going to be increasingly important for conference demand in densely-populated places.

Reliable communication and improved networking in a Li-Fi network:

Li-Fi is a high-speed, bi-directional and fully networked broadband wireless technology that's aimed at offloading the present Wi-Fi technology. A Li-Fi access level can serve multiple users simultaneously inside the area of it's insurance coverage, and this is called as optical at to cell.

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Datasheet