Li-Fi DATA TRANSFER SYSTEM

A project report submitted in partial fulfillment of the requirements for the award of the Degree

of

BACHELOR OF TECHNOLOGY

In

ELECTRONICS AND COMMUNICATION ENGINEERING

Submitted By

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CERTIFICATE

This is to certify that the project work entitled "**LI-FI DATA TRANSFER SYSTEM**" is a bonafide work carried out by **A.Aditya Koushik (221910401001), C.Rishitha Reddy (221910401008), S.Ashish (221910401041), T.Sohith (221910401044)** submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in **Electronics and Communication Engineering**, GITAM School of Technology, GITAM (Deemed to be University), Hyderabad during the academic year 2022-2023.

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DECLARATION

We hereby declare that the project work entitled "**LI-FI DATA TRANSFER SYSTEM**" is an original work done in the Department of Electrical, Electronics and Communication Engineering, GITAM School of Technology, GITAM (Deemed to be University) submitted in partial fulfillment of the requirements for the award of the degree of **B.Tech. in Electronics and Communication Engineering**. The work has not been submitted to any other college or university for the award of any degree or diploma.

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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 with 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. It would be easy, if we could use other waves to surf the internet.So,Scientists came up with a solution and named it "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.

Li-Fi technology utilizes led for transmitting data. It is a subsidiary of optical remote communication technology utilizing light from Led to convey rapid communication. Apparently light communication works by turning the Led now and again at exceptionally high velocity; it can’t be seen by the human eye.

The system makes use of a LDR sensor module along with Atmega Microcontroller, LCD display, basic electronics components, power supply and PCB board to develop this system. The system allows us to use the LI-FI medium for data transfer. We make use of a Li-Fi transmitter android app to demonstrate this concept. The app converts written text messages into light flash data for transmission. The user needs to start the app and type the message to be a transmitter.

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CHAPTER 1

INTRODUCTION

1.1 History of wi-fi (wireless fidelity)

A prototype test bed for a wireless local area network(WLAN) was developed in 1992 by researchers from the Radio physics Division of the CSIRO(Commonwealth Scientific and Industrial Research Organisation) in Australia

A wireless or wi-fi network uses a radio frequency signal instead of wires to connect your devices, such as computers, printers and smartphones to the Internet and each other. The wi-fi signal can be picked up by any wireless-capable device such as a laptop or tablet within a certain distance in all directions. On the technical side, the IEEE 802.11 standard defines the protocols that enable communications with current Wi-Fi-enabled wireless devices, including wireless routers and wireless access points. Wireless access points support different IEEE standards.

Wireless routers integrate a Wireless Access Point, Ethernet switch, and internal router firmware application that provides IP routing, NAT, and DNS forwarding through an integrated WAN-interface. A wireless router allows wired and wireless Ethernet LAN devices to connect to a (usually) single WAN device such as a cable modem, DSL modem, or optical modem. A wireless router allows all three devices, mainly the access point and router, to be configured through one central utility. This utility is usually an integrated web server that is accessible to wired and wireless LAN clients and often optionally to WAN clients. This utility may also be an application that is run on a computer, as is the case with as Apple's AirPort, which is managed with the AirPort Utility on macOS and iOS

Wi-Fi technology may be used to provide local network and Internet access to devices that are within Wi-Fi range of one or more routers that are connected to the Internet. The coverage of one or more interconnected access points (*hotspots*) can extend from an area as small as a few rooms to as large as many square kilometers (miles). Coverage in the larger area may require a group of access points with overlapping coverage.

Increasingly in the last few years (particularly as of 2007), embedded Wi-Fi modules have become available that incorporate a real-time operating system and provide a simple means of wirelessly enabling any device that can communicate via a serial port. This allows the design of simple monitoring devices. An example is a portable ECG device monitoring a patient at home. This Wi-Fi-enabled device can communicate via the Internet

1.2 Wi-Fi drawbacks

1. Security Concerns

Most of the open Wi-Fi networks are unsafe to connect with since you don't know the type of users connected with that network. FYI, public Wi-Fi networks are most vulnerable to hacking. Hackers may impersonate their Id as the network Id, which might also cost you or your business. Therefore, it is best advised to conduct your business on a private or business network only.

2. Limited Range – Disadvantages of Wi-Fi

The second most common of the disadvantages of Wireless LAN is range issues. Since the building has multi-storeyed structures. The usual Wi-Fi range in a building is about 100 to 150 feet. The range and strength of a Wi-Fi device would weaken as you move further from the access point location. If you are not well within the network range, you won't be able to connect to your network which may disturb your workflow.

3. Signal Interference

The common frequency that a Wi-Fi device operates on is 2.4 GHz, which can be disturbed or hindered due to the presence of other electromagnetic devices or walls between you and the Wi-Fi source. This signal trouble may cause connectivity issues or may result in weak signal strength downing your speed. Transferring large files over the network gets risky at such times. The data is more likely to get corrupted during transfer in such scenarios.

4. Bandwidth Usage

The number of devices connected is inversely proportional to the bandwidth. That means, the more devices are connected to a single Wi-Fi network, the weaker the bandwidth gets. This is also one of the known disadvantages of Wi-Fi in the workplace. More users mean, restricted speed limit and slow pace of workflow.

5. Slower in contrast to LAN

Wireless LAN is slower than a wired network at the workplace or home. Most of the wireless signal is either distributed or dissipated because of other devices or due to external EMF sources. However, it is not so in the case of wired networks. A study named "Wi-Fi in the Home" in 2011 also found that Wi-Fi Internet connections can be up to 30% slower than a wired network.

6. Effects of Wi-Fi on Health

According to recent findings published in, Wi-Fi causes oxidative stress and neuro psychiatric effects on human health. Other Wi-Fi health hazards include Apoptosis, cellular DNA damage, endocrine changes, and calcium overload. These effects are the same as caused by EMFs (Microwave Frequency).

1.3 Li-Fi Technology

Li-Fi known as light fidelity was introduced for the first time by Prof. Harald Haas in July 2011 at TED Global Talk. Li-Fi is based on Visual Light Communication (VLC) that uses light emitting diodes (LEDs) to fully networked wireless systems. Li-Fi enables the electronic device to connect to the internet with no wire. In order to make a communication line between nodes, a Li-Fi will need a transceiver to transmit and receive the data. This transceiver will have a modulation technique to make the LED enable to carry the data using the light. The emergence of Li-Fi is to overcome the shortage of the current technology. We all know that right now Wi-Fi is the most used technology to connect many devices to the internet. As time comes by, the use of internet based devices has increased. This increased the capacity of Wi-Fi is reduced due to the limitation of radio frequency resources.

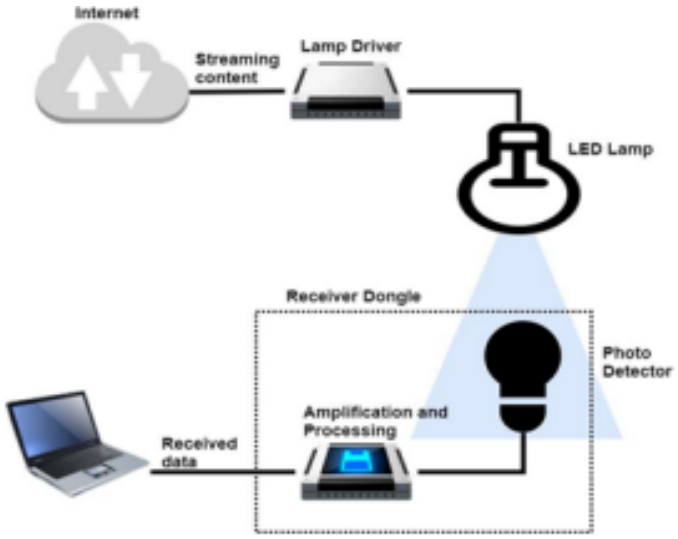


Figure 1. Basic Concept Diagram Li-Fi

According to figure 1, Li-Fi technology consists of LED Lamp as the media transmission and photo-detector as a receiver of transmitted data. Lamp driver is needed to make the LED work properly. While amplification and processing are responsible to manage the signal that comes from the photo-detector.

Basic concepts for working principle in Li-Fi Technology are pointing into: Transceiver and Light as a media transmission. This basic concept indicates a duplex communication. The rate of Li-Fi is 14 GBPS using three off- the- shelf laser diodes (red, green, and blue) and predict the rate until 100 GBPS when the whole visible spectrum is used. Li-Fi and VLC use a similar medium as data communication that is light. The difference between Li-Fi and VLC is that VLC has a unidirectional, point-to-point light communication at low data rates.

1.5 Li-Fi vs Wi-Fi

S.no.	On the basis of	Wi-fi	Li-fi
1.	**Stands for**	Wi-fi stands for Wireless fidelity.	Li-fi stands for Light fidelity.
2.	**Operation**	It is used to transmit data via radio waves using a wi-fi router.	It is used to transmit data via LED signals using LED bulbs.
3.	**Invented by**	Wi-fi was invented in 1991 by NCR corporation.	Li-fi was invented in 2011 by Prof. Harald Hass.
4.	**Data transfer speed**	The range of data transfer speed of wi-fi is from 150 Mbps to 2 GBPS.	The range of data transfer speed of li-fi is about 1 GBPS.
5.	**Area coverage**	The area coverage of wi-fi is up-to 32 meters.	The area coverage of li-fi is about 10 meters.
6.	**Working environment**	Wi-fi works in a less dense environment because of interference related issues.	It works in a high dense environment.
7.	**Privacy**	In wi-fi, the radio frequency signals pass through the walls, so there is a need to use more secure techniques to protect data.	In Li-fi, data is protected and more secure because there is a use of light that is blocked by the walls.
8.	**Components**	The components of wi-fi are routers, modems, and access points.	The components of the lifi are the LED bulb, LED driver, and photodetector.

Table 1

CHAPTER 2

OVERVIEW OF DEVICES USED

2.1 Arduino

2.1.1 Arduino hardware

An Arduino is an open hardware development board that can be used by tinkerers, hobbyists, and makers to design and build devices that interact with the real world.

While Arduino refers to a specific type of board design, it can also be used to refer to a company which manufactures a specific implementation of these boards, and is typically also used to describe the community around compatible boards made by other people or companies which function in a similar way. Arduino board designs use a variety of microprocessors and controllers.

The boards are equipped with sets of digital and Analog input/output (I/O) pins that may be interfaced to various expansion boards ('shields') or breadboards (for prototyping) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs.

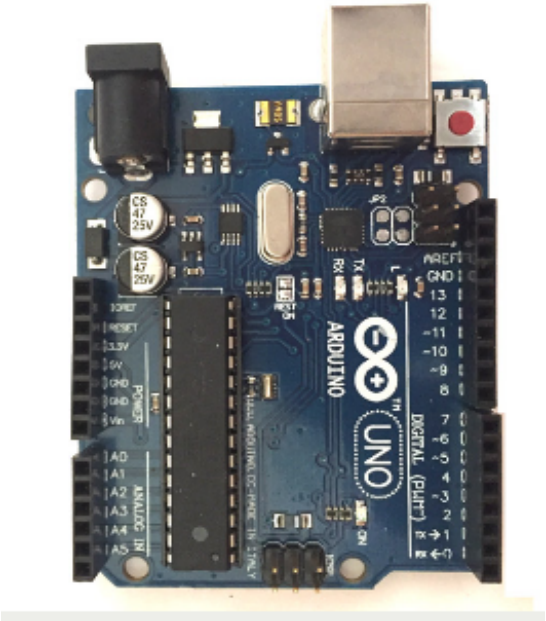


Figure 2 Arduino Uno

The microcontrollers can be programmed using the C and C++programming languages, using a standard API which is also known as the Arduino language, inspired by the Processing language and used with a modified version of the Processing IDE. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) and a command line tool developed in Go.

The Arduino project began in 2005 as a tool for students at the Interaction Design Institute Ivrea, Italy, aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats and motion detectors.

Figure 3. Symbol of Arduino

2.1.2 Pinout Configuration

Pin Category	Pin Name	Details
Power	Vin, 3.3V, 5V, GND	Vin: Input voltage to Arduino when using an external power source. 5V: Regulated power supply used to power microcontroller and other components on the board. 3.3V: 3.3V supply generated by on-board voltage regulator. Maximum current draw is 50mA. GND: ground pins.
Reset	Reset	Resets the microcontroller.
Analog Pins	A0 – A5	Used to provide analog input in the range of 0-5V
Input/Output Pins	Digital Pins 0 - 13	Can be used as input or output pins.
Serial	0(Rx), 1(Tx)	Used to receive and transmit TTL serial data.
External Interrupts	2, 3	To trigger an interrupt.
PWM	3, 5, 6, 9, 11	Provides 8-bit PWM output.
SPI	10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK)	Used for SPI communication.
Inbuilt LED	13	To turn on the inbuilt LED.
TWI	A4 (SDA), A5 (SCA)	Used for TWI communication.

Table 2

2.1.3 Specifications

- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- In/out Voltage (limit): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- PWM Digital I/O Pins: 6
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC current for 3.3V Pin: 50 mA
- Flash Memory:32 KB (ATmega328P) of which 0.5 KB used by bootloader
- SRAM: 2 KB(ATmega328P)
- EEPROM: 1 KB (ATmega328P)
- Clock Speed: 16 MHz
- LED_BUILTIN: 13
- Length: 68.6 mm
- Width: 58.4 mm
- Weight: 25 g

2.1.4 Features of Arduino

The Arduino Uno has been a huge hit with electronics enthusiasts from beginner hobbyists to professional programmers. It is an open-source platform, meaning the boards and software are readily available and anyone can modify and optimize the boards for better functionality. The software used for Arduino devices is called IDE (Integrated Development Environment) which is free to use and requires some basic skills to learn it. It can be programmed using C and C++ language.

More frequency and number of instructions per cycle: Atmega328 microcontroller is placed on the board that comes with a number of features like timers, counters, interrupts, PWM, CPU, I/O pins and based on a 16MHz clock that helps in producing more frequency and number of instructions/cycle.

Some of the features are listed below.

1. **Built-in regulation**: This board comes with a built-in regulation feature which keeps the voltage under control when the device is connected to the external device.

2. **Flexibility & Ease of use**: There are 14 I/O digital and 6 Analog pins incorporated in the board that allows the external connection with any circuit with the board. These pins provide the flexibility and ease of use to the external devices that can be connected through these pins.

3. **Configurable pins:** The 6 Analog pins are marked as A0 to A5 and come with a resolution of 10 bits. These pins measure from 0 to 5V, however, they can be configured to the high range using Analog Reference () function and AREF pin.

4. **Quick Start:** Reset pin is available in the board that reset the whole board and takes the running program in the initial stage. This pin is useful when the board hangs up in the middle of the running program; pushing this pin will clear everything up in the program and start the program right from the beginning.

5. **Greater Flash Memory:**13KB of flash memory is used to store the number of instructions in the form of code.

6. **Low Voltage Requirement:** Only 5 V is required to turn the board on, which can be achieved directly using USB port or external adapter, however, it can support external power sources up to 12 V which can be regulated and limited to 5 V or 3.3 V based on the requirement of the project.

7. **Plug & Play:** There is no hard and fast interface required to connect the devices to the board. Simply plug the external device into the pins of the board that are laid out on the board in the form of the header.

8. **USB interface:** Arduino Uno comes with USB interface i.e. A USB port is added on the board to develop serial communication with the computer.

9. **Power alternatives:** Apart from USB, battery or AC to DC adapter can also be used to power the board.

10. **More Storage:** There is a provision of Micro SD cards to be used in the boards to make them store more information.

2.1.5 Basic terminologies

1-Analog to digital converter (ADC)

An Analog to Digital Converter (ADC) is a very useful feature that converts an Analog voltage on a pin to a digital number. By converting from the Analog world to the digital world, we can begin to use electronics to interface to the Analog world around us.

Not every pin on a microcontroller has the ability to do Analog to digital conversions. On the Arduino board, these pins have an 'A' in front of their label (A0 through A5) to indicate these pins can read Analog voltages. The way an ADC works is fairly complex.

There are a few different ways to achieve this feat, but one of the most common techniques uses the Analog voltage to charge up an internal capacitor and then measure the time it takes to discharge across an internal resistor.

2-Pulse width modulation (PWM)

Pulse Width Modulation, or PWM, is a technique for getting analog results with digital means. Digital control is used to create a square wave, a signal switched between on and off. This on-off pattern can simulate voltages in between the full Vcc of the board (e.g., 5 V on Uno, 3.3 V on a MKR board) and off (0 Volts) by changing the portion of the time the signal spends on versus the time that the signal spends off.

The duration of "on time" is called the pulse width. To get varying analog values, you change, or modulate, that pulse width.

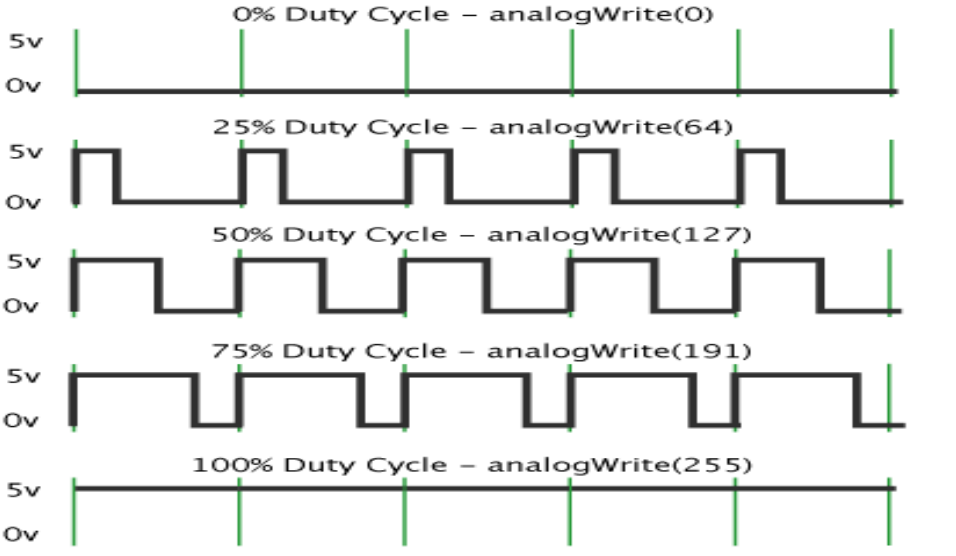


Figure 3. Pulse Width Modulation

2.1.6 Arduino uno in Li-fi Technology

Arduino Li-Fi Receiver:

In the Li-Fi receiver side, Arduino UNO is interfaced with an LDR sensor as shown in the circuit diagram. Here the LDR sensor is connected in series with a resistor to form a voltage divider circuit and the Analog voltage output from the sensor is fed to Arduino as an input signal.

Here we are using an I2C module with LCD to reduce no. of connections with Arduino as this module requires only 2 data pins SCL/SDA and 2 power pins. Start the code by including all the required library files in the code like w*ire h* for I2C communication, *Liquid Crystal_I2C.h* for LCD, etc. These libraries would be pre-installed with Arduino.

One computer acts as a data transmitter, while another computer's act as the data receiver. Data between two pc are transmitted using light that is send by Arduino's transmitter using an LED and is captured by Arduino's receiver using a photodiode

Li-Fi Transmitter and Receiver using Arduino

After uploading the complete code in both the Arduino's, press any button on the keypad at the receiver side and the same digit will be displayed on 16x2 LCD at the receiver side.This is how Li-Fi can be used to transmit data through light. Hope you enjoyed the article and learned something new out of it

2.2. LDR Module

LDR sensor module is a low-cost digital sensor as well as Analog sensor module, which is capable to measure and detect light intensity. This sensor also is known as the Photo-resistor sensor. This sensor has an onboard LDR (Light Dependent Resistor), that helps it to detect light. This sensor module comes with 4 terminals. Where the "DO" pin is a digital output pin and the "AO" pin is an Analog output pin. The output of the module goes high in the absence of light and it becomes low in the presence of light. The sensitivity of the sensor can be adjusted using the onboard potentiometer.

2.2.1 Pinout of LDR Module

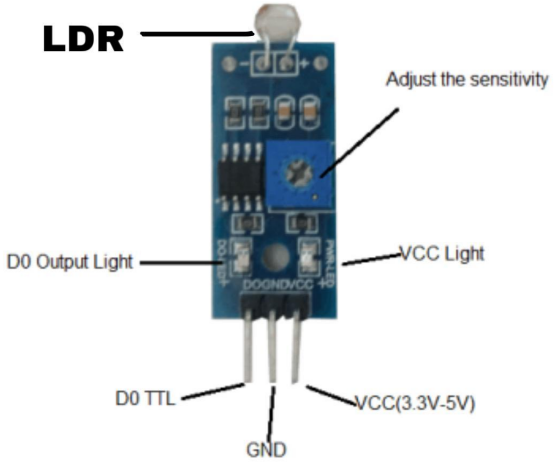


Figure 5. Pin/Out of LDR sensor module

1.LDR or Light Dependent Resistor

LDR or Light Dependent Resistor is one type of variable resistor. It is also known as a photoresistor. The Light Dependent Resistor (LDR) works on the principle of "Photoconductivity". The LDR resistance is changed according to the light intensity falling on the LDR. When light intensity increases on the LDR surface, then the LDR resistance will decrease and the element conductivity will increase. When light intensity decreases on the LDR surface, then the LDR resistance will increase and the element conductivity will decrease.

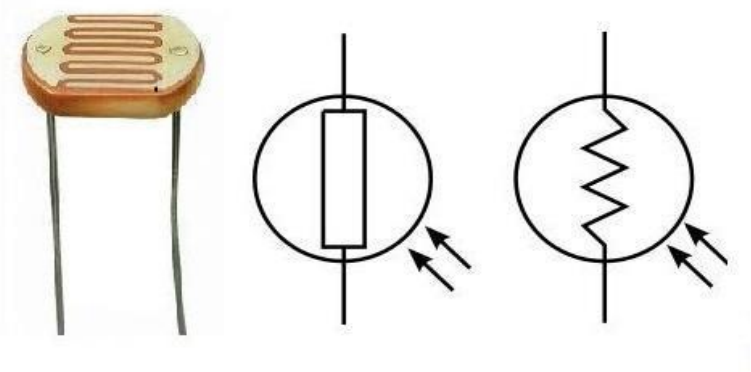


Figure 6. LDR and Symbol

2.Variable Resistor (Trim pot)

The LDR sensor module has an onboard variable resistor or potentiometer, this variable resistor is a 10k preset. It is used to set the sensitivity of this LDR sensor. Rotate the preset knob to adjust the sensitivity of the light intensity detection. If we will rotate the preset knob in the clockwise direction, the sensitivity of the light intensity detection will increase. If it rotated counterclockwise direction, the sensitivity of the light intensity detection will decrease**.**

3. Power LED

This onboard LED indicates the LDR sensor module power supply is ON or OFF. When we turn on the sensor power supply this Green LED is also turned on.

4. Output LED

When the LDR sensor detects the light, the green LED is turned on. When the LDR sensor detects darkness, the green LED is turned off.

Pin No	Pin Name	Description
1	**VCC**	+5 v power supply Input Pin
2	**GND**	Ground (-) power supply Input Pin
3	**DO**	Digital Output Pin
4	**AO**	Analog Output Pin

Table 3

2.2.2 Features:

- Able to detect ambient brightness and light intensity
- Adjustable sensitivity (via blue digital potentiometer adjustment)
- Operating voltage 3.3V-5V
- Digital switching outputs (0 and 1) -D0
- With fixed bolt hole for easy installation
- Small board PCB size: 3cm * 1.6cm
- Power indicator (Red) and the digital switch output indicator (Green)
- Features wide range voltage comparator LM393

2.2.3 LDR Advantages

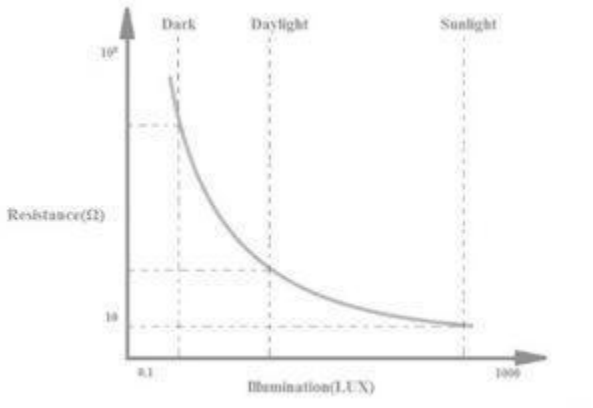
- Sensitivity is High
- Simple & Small devices
- Easily used
- Inexpensive
- There is no union potential.
- The light-dark resistance ratio is high.
- Its connection is simple

2.2.4 LDR Disadvantages

- Spectral response is narrow
- Hysteresis effect
- Temperature stability is low for the best materials
- In stable materials, it responds very slowly
- The use of LDR is limited where the light signal changes very quickly
- It is not so much a responsive device.
- It provides incorrect result once working temperature alters

2.2.5 **Characteristics of LDR**

The light-dependent resistor is very responsive to light. When the light is stronger, then the resistance is lower which means, when the light intensity increases then the value of resistance for the LDR will be decreased drastically to below 1K.



LDR Characteristics

When the light drops on LDR, the resistance will be decreased and when the resistor is placed in the dark then the resistance will be increased which is called dark resistance. If any device absorbs light then its resistance will be reduced radically. If a stable voltage is given to it, the light intensity will be increased & the flow of current starts increasing. So, the following diagram represents the characteristics between resistance & illumination for a specific LDR.

LDRs are not linear devices and their sensitivity changes through the light's wavelength which drops on them. Some kinds of photocells are not at all sensitive to a specific range of wavelengths because it depends on the used material.

2.3 LCD Module

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

2.3.1 Pinout of LCD Module

- Pin1 (Ground/Source Pin): This is a GND pin of display, used to connect the GND terminal of the microcontroller unit or power source.
- Pin2 (VCC/Source Pin): This is the voltage supply pin of the display, used to connect the supply pin of the power source.
- Pin3 (V0/VEE/Control Pin): This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V.
- Pin4 (Register Select/Control Pin): This pin toggles among the command or data register, used to connect a microcontroller unit pin and obtains either 0 or 1(0 = data mode, and 1 = command mode).
- Pin5 (Read/Write/Control Pin): This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).
- Pin 6 (Enable/Control Pin): This pin should be held high to execute the Read/Write process, and it is connected to the microcontroller unit & constantly held high.
- Pins 7-14 (Data Pins): These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to microcontroller units like 0 to 7.
- Pin15 (+ve pin of the LED): This pin is connected to +5V
- Pin 16 (-ve pin of the LED): This pin is connected to GND.

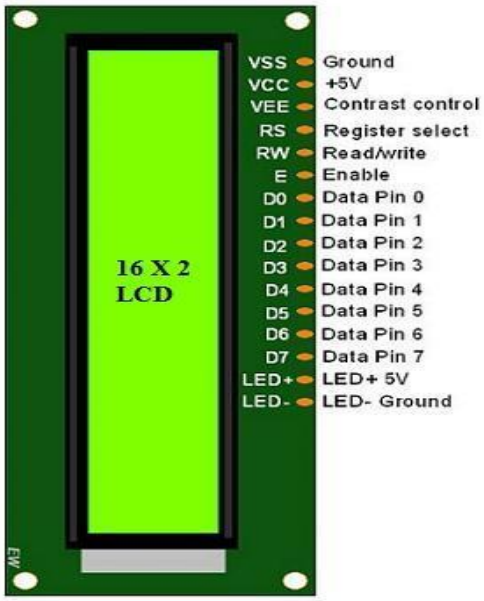


Figure 6 16 x 2 LCD display

2.3.2 Features of LCD16x2

- The operating voltage of this LCD is 4.7V-5.3V
- It includes two rows where each row can produce 16-characters.
- The utilization of current is 1mA with no backlight
- Every character can be built with a 5×8 pixel box
- The alphanumeric LCDs alphabets & numbers
- These are obtainable in Blue & Green Backlight

2.4 App used in Project

The App we used in this project is a Pre-existed one.This app is useful for sending the data via light. This app is the transmitter part of our project.

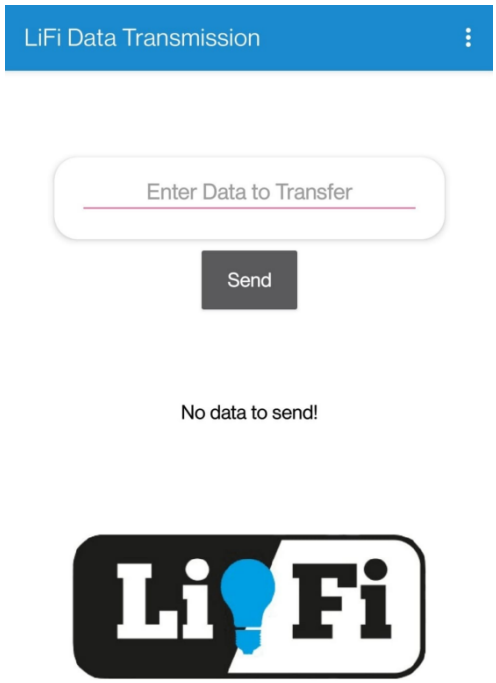


Figure 8 front view of App

This was Created with kodular.io. In this we can design any App for use. Our App is design in such a way that it can perform only single Operation

The front view of App is Mentioned as LiFi Data Transmission and The App name is Li-Fi

This app consists of a space where we should enter our data (mentioned as Enter Data to Transfer) and has a send option below it. This app has some predefined Data that we can send like hi, hello, I am fine etc..

This is internally Connected to the flashlight of our Mobile Phone.Which help us to send data

This app can be installed from the Package installer and It asks for the Camera Permissions

The system allows us to use the LI-FI medium for data transfer. We make use of a Li-Fi transmitter android app to demonstrate this concept. The app converts written text messages into light flash data for transmission. The user needs to start the app and type the message to be transmitter

On sending the message the app controls the mobile phone flashlight to transmit the message. The phone encodes the message into a series of flashes and transmits this data using the mobile torch light. This light message as it falls on the LDR receiver.

CHAPTER 3

SYSTEM DESIGN

3.1 Integration

LI-FI technology is used for the development of the entire project. LDR module and Arduino uno, LCD Display are the main components used in this project

The system makes use of basic electronics components, power supply and PCB board to develop this system. The system allows us to use the LI-FI medium for data transfer.

We make use of a Li-Fi transmitter android app to demonstrate this concept. The app converts written text messages into light flash data for transmission. The user needs to start the app and type the message to be transmitted.

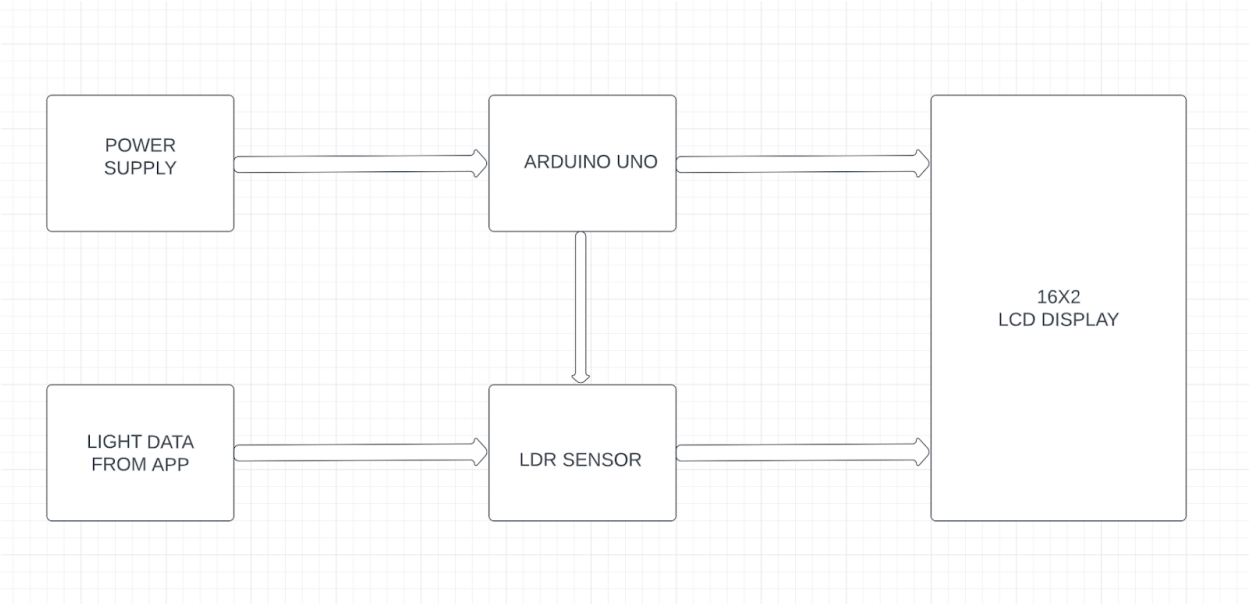


Figure 9 Block Diagram

Step 1: Collect all the Required Components For implementing the module

Step 2: Take a Breadboard and place 16 x 2 LCD display and LDR module on it

Step 3: Make use of Jumper wires to connect the LDR sensor module and LCD Display with Arduino Board

Step 4: Connect digital pins of Arduino board(4,~5,~6,7,) with LCD display on pins(D4,D5,D6,D7) respectively

Step 5: Connect digital pins of Arduino board(2,~3) with LCD display on Pins E(enable),RS(register select) respectively

Step 5: Connect digital pin 8 with the digital output pin of LDR module

Step 6: Connect V0 of LCD Display with one end of Resistor

Step 7: Connect VSS of LCD Display with other end of Resistor

Step 8: Connect Power of Arduino with other components

Step 9: For the External Supply of power , connect any source of power to Arduino (connect to Laptop)

Connects are given as per circuit diagram

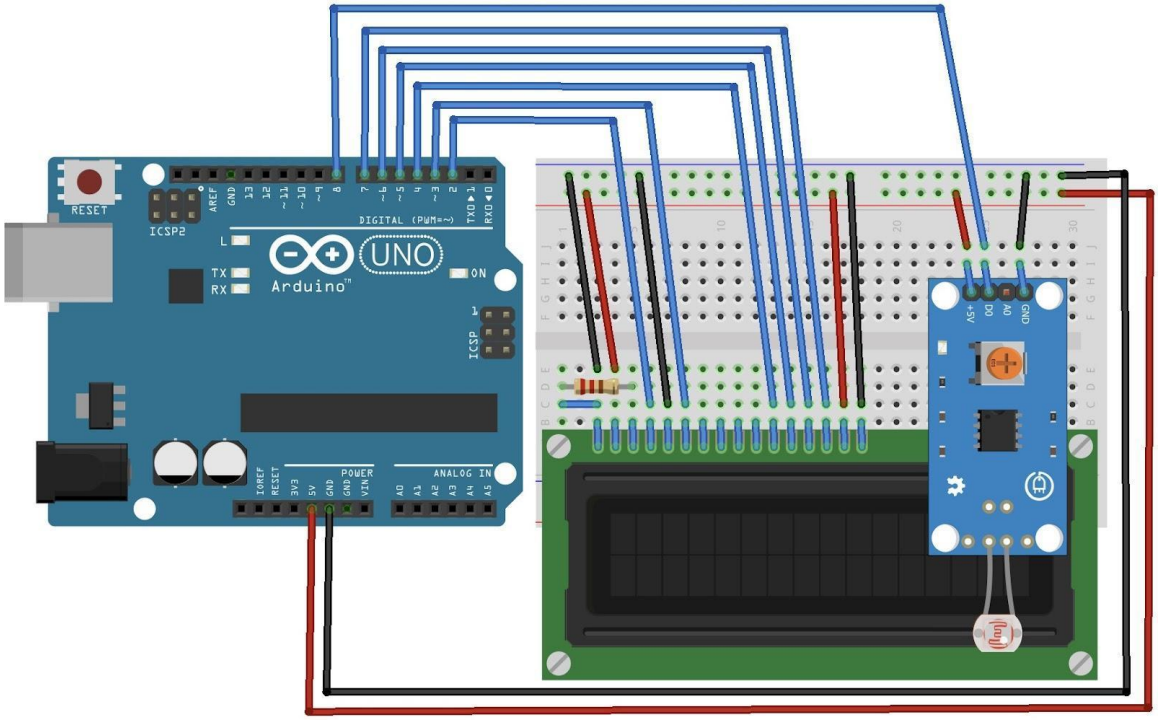


Figure 10 Schematic Circuit

The Following code should be dumped into the Arduino uno board which consists of Basic commands for working on our Project.

Code is written in Embedded C language and Arduino IDE is used to dump the code

CODE:

```
#include<dfdLiquidCrystal.h>
LiquidCrystal lcd (2, 3, 4, 5, 6, 7);
#define ldr 8
int val;
int val2;
String duration;
void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);
  pinMode(ldr, INPUT_PULLUP);
  lcd.begin(16,2);
  lcd.clear();
  lcd.print("LiFi Project");
  delay(3000);
  lcd.clear();
  lcd.print("Send any message");
  lcd.setCursor(0,1);
  lcd.print("from LiFi App..");
  delay(3000);
}
void loop() {
  // put your main code here, to run repeatedly:
  int val = digitalRead(ldr);
  while(val == 0)
  {
    int val2 = digitalRead(ldr);
    duration += val2;
    if(duration == "001")
    {
      Serial.println("Received message: hi");
```

```
  lcd.clear();
  lcd.print("hi");
}
if(duration == "0001")
{
  Serial.println("Received message: hello");
  lcd.clear();
  lcd.print("hello");
}
if(duration == "00001")
{
  Serial.println("Received message: how are you?");
  lcd.clear();
  lcd.print("how are you?");
}
if(duration == "000001")
{
  Serial.println("Received message: I am fine");
  lcd.clear();
  lcd.print("I am fine");
}
if(duration == "0000001")
{
  Serial.println("Received message: ok");
  lcd.clear();
  lcd.print("ok");
}
if(duration == "00000001")
{
  Serial.println("Received message: good morning");
  lcd.clear();
  lcd.print("good morning");
}
if(duration == "000000001")
{
  Serial.println("Received message: good afternoon");
  lcd.clear();
  lcd.print("good afternoon");
}
if(duration == "0000000001")
```

```
    {
     Serial.println("Received message: good evening");
     lcd.clear();
     lcd.print("good evening");
    }
    if(duration == "00000000001")
    {
     Serial.println("Received message: thank you");
     lcd.clear();
     lcd.print("thank you");
    }
    if(duration == "000000000001")
    {
     Serial.println("Received message: sorry");
     lcd.clear();
     lcd.print("sorry");
    }
    if(val2 == 1)
    {
     duration = "";
     break;
    }
    delay(200);
  }
}
```

3.2 WORKING

The system makes use of a LDR sensor module along with Atmega Microcontroller, LCD display, basic electronics components, power supply and PCB board to develop this system. The system allows us to use the LI-FI medium for data transfer. We make use of a LiFi transmitter android app to demonstrate this concept. The app converts written text messages into light flash data for transmission. The user needs to start the app and type the message to be transmitted.

On sending the message the app controls the mobile phone flashlight to transmit the message. The phone encodes the message into a series of flashes and transmits this data using the mobile torch light. This light message as it falls on the LDR receiver, is decoded and sent to the microcontroller for processing. The ATmega microcontroller decodes and processes the message sent and then displays it over an LCD display to complete the data transmission.

The practical implementation of the project consists of the following separate parts:

1) Data packaging and encoding: This is done by the Arduino connected to the transmitter. It converts the text to bits and sends sequentially as a Low or High voltage signal.
2) Hardware control
3) Transmission synchronization
4) Transmission decoding: This is done by the photodiode which converts the light signal to an analogue signal of varying magnitude and then passes it to the amplifier for amplification and differentiation of the bits.
5) Error handling: This is performed by the automatic gain controller, which is immediately after the photodiode. It ensures that a “1” is clearly differentiated from a “0” bit.

Whenever a user wants to send data, the following steps will take place:

1) We have type the message in app and click on send
2) After successfully sending the message, The mobile phone Flashlight will flash the data in form of light
3) We have to arrange in a way that flash should fall on the LDR
4) On receiving data, the RX led will glow on the arduino uno board
4) The received text is then displayed on LCD Display
5) It is a conformation that data is received

CHAPTER-4

ADVANTAGES AND DISADVANTAGES

4.1 Advantages and Disadvantages of Li-Fi

4.1.1 Advantages:

1.Quicker Data Transmission than Wi-Fi – An essential selling purpose of Li-Fi innovation is that it has a quicker information transmission rate than Wi-Fi. Noticeable light range has a transmission capacity that is multiple times bigger than whole radio recurrence and microwave range. Analysts at the University of Oxford have asserted that they effectively tried a trial Li-Fi application with a bi-directional speed of 224 gigabits for each second.

2.Simple and Inexpensive to Deploy – Recall that the current operational ideas and trial utilization of Li-Fi innovation focus on the utilization of LED lights. This implies that a Li-Fi organization can be incorporated effectively with existing LED lighting frameworks. Basically, any place there is a light source, there can be admittance to the Internet. It is additionally worth referencing that LED lights are reasonable to deliver and their market cost is moderately moderate.

3.Security Due to the Limitations of Light – Another remarkable advantage or preferred position of Li-Fi is that it is safer than Wi-Fi. Remote correspondence innovations dependent on radio recurrence and microwaves are more helpless against snooping, signal capturing or unapproved interference, beast power assaults, and spontaneous organization associations. Recollect that light waves can't enter through dividers and entryways.

4.Safe From Electromagnetic Interferences – Moreover, Li-Fi additionally has a bit of leeway of being insusceptible from electromagnetic impedances that influence radio-based remote correspondence advancements. The innovation is likewise helpful in territories that are electromagnetically delicate, for example, airplane lodges, clinics, and atomic force plants, among others since it doesn't cause electromagnetic obstructions.

5.Sweeping Future Applications – The advancement of additional availability is another bit of leeway of Li-Fi innovation. The way that it offers quicker information move rates implies that it can propel the mainstream sending of the Internet of Things or IoT which require huge amounts of information and a compelling and effective network.

4.1.2 Disadvantages:

1.Restricted Range and Connectivity – The impediments of the noticeable light furnish Li-Fi with a security advantage over Wi-Fi. Be that as it may, these constraints likewise make burdens. Actual boundaries, for example, dividers and entryways limit the operational extent of a Li-Fi-empowered LED light.

2.Inaccessibility of Compatible Technologies – It will take a long time for Li-Fi to turn out to be more reasonable than Wi-Fi. Current gadgets, for example, PCs, cell phones, and tablet PCs actually use equipment for Wi-Fi organizing. These gadgets would not promptly work with a Li-Fi network since they don't have the essential equipment details. Li-Fi isn't promptly reverse viable.

3.Light Interference and Light Pollution – Different burdens of Li-Fi are powerlessness to light obstruction and advancement of light contamination. Observe that despite the fact that this innovation is invulnerable to electromagnetic impedances, different wellsprings of light may meddle with sign. Daylight can meddle with light signals created by a Li-Fi-empowered LED light.

4.Conceivable Cost Implications – Sending Li-Fi is hypothetically reasonable due to the little expense related with creation of LED lights. In any case, establishment costs can be more costly than Wi-Fi sending due to innovation being generally new and the interest stays low and concentrated experts are as yet not many. The way that a solitary home requires a few Li-Fi switches to grow the extent of the organization and accessibility of Internet availability could likewise mean extra buy and establishment costs. Observe that a solitary Wi-Fi switch is sufficient for a normal measured house.

4.1.3 Applications

1. Li-Fi and Live Streaming

According to a Go-Globe report, 82% of consumers prefer to watch live videos from a brand rather than posts, 80% of brand audiences prefer to watch live video from a brand rather than read a blog and live videos are watched three times longer than videos that are not live anymore. Because of the rapid rates Li-Fi can reach, it can be made available in big shopping malls, sports stadiums, street lights, airplanes, trains including underground, train stations, airports and hence. This allows any user to consume rich content media like videos as well as live streaming from their smartphones or other mobile devices nearly anywhere they are like in stadiums, trains and planes provided they are exposed to Li-Fi enabled LEDs.

2. Li-Fi in Hospitals

Because of the non-interference of Li-Fi with radiofrequency devices, Li-Fi can be safely used in many hospital applications. For example, in corridors, waiting rooms, patient rooms and operating theaters, Li-Fi technology will allow a light communication network, which will remove electromagnetic interference issues from smartphones and the use of Wi-Fi in hospitals. Li-Fi can be used for real-time monitoring and report of patient movement and vital signs without the need for wires. Li-Fi can also enable patients on their beds connecting to internet news, emails, video games and social media platforms through their smartphones. This helps them pass the time during their stay.

3. Li-Fi in Pharmacies and the Pharmaceutical Industry

In hospital pharmacies and specifically in aseptic manufacturing sites, Li-Fi could be used by pharmacists for receiving and screening electronically approved prescriptions directly in the unit. Li-Fi can be used for real-time tracking of prescribed aseptic drugs like cytotoxic drugs, Parenteral drugs and centralized intravenous additive services (CIVAS) in the unit and nurses and other healthcare professionals from the ward can check the status without the need of calling or going directly to the aseptic unit.

4.**Li-Fi in Schools**

The right wireless network is a crucial component to provide new learning experiences by connecting students and teachers to smart technology, enabling learning applications on any mobile device. Li-Fi can also provide seamless network connectivity and security throughout the whole school, from the classroom through to university dorms. Some schools have even started trialing Li-Fi technology in classrooms.

5. Li-Fi and Airplanes

According to a report carried by Inmarsat, 67% of passengers would be more likely to rebook with an airline if inflight internet connectivity were available. 70% of passengers would be likely to recommend inflight connectivity having tried it previously. 66% believe inflight connectivity is necessary. 65% of passengers that have had access to inflight internet connectivity in the last year used it, and 54% of passengers agreed that if only poor-quality Wi-Fi was on offer, they would prefer not to have it at all.

6.Li-Fi and Military

The Military industry has developed an interest in the applications of Li-Fi in military operations. Frank Murphy, an engineer on EMSD's System Development and Engineering Team, has been researching the use of Li-Fi in a tactical environment as the physical characteristics appear to solve many issues facing wired and wireless field command post network systems.

7.Underwater application

underwater remotely operated vehicles use larger cables for supplying power and to send and receive data for operations, but the cables used are not long enough and make the operation limited to a point. Here Li-Fi can be used to make the exploration much more. Li-Fi can also be used in many underwater military operations where Wi-Fi fails.

CHAPTER-5

RESULTS AND FUTURE SCOPE

4.2 RESULTS

Li-fi technology uses LED for transmitting data,it is a derivative of optical wireless communication Technology using light from LED to deliver high speed and effective Communication.

After integrating and building the data transfer circuit system, we used the Li-Fi data transfer application to transmit the data which we desired to transfer.The app uses the mobile flash as the visible light communication medium to transfer the binary bits at very high speed which cannot be noticed by the human eye.

Figure 11 Output on LCD display

This is the final output of the project. As we typed the data that had to be transmitted in the li-fi

application and when we click send the data will get transmitted i n binary form via visible light communication medium and the photosensitive LDR module will receive the signal and converts it into data form through the code we dumped in the Arduino and the data will be Shown on LCD display.

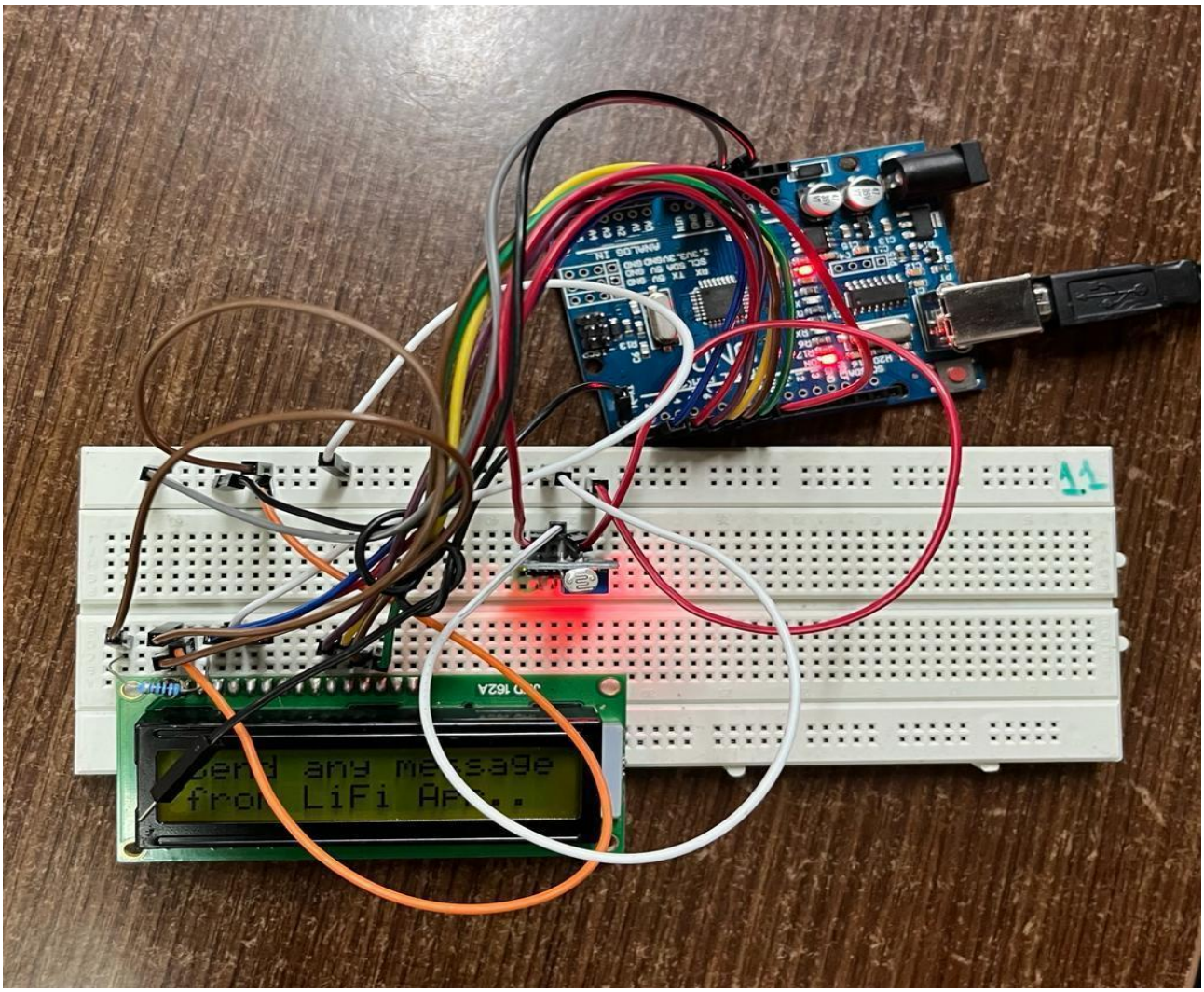


Figure 12 Prototype

4.3 Future Scope

Li-Fi is purely a technology of the future. It has the potential to take over the entire internet market on its own. The main points to be noted here are as follows:

* With the advancement of Li-Fi technology, it will become more portable, taking its rightful place in our phones and laptops.
* It will give the field of IOT a considerable boost as more and more devices will be able to connect and interact with each other through Li-Fi.
* We will also be able to access the internet in places like Hospitals and Airplanes where traditional network systems can never be used.
* Underwater communication will become much easier with the use of Li-Fi.
* In the future, it may be possible that we will have an internet with a speed of several gigabits per second.
* With Li-Fi, we will also be moving towards a much more secure network, which will be safeguarding us from unwanted hackers.
* Depletion of Environment due to increased use of radio frequencies will also decrease, as the Li-Fi technology uses the visible spectrum of light to transmit data.
* Installation will also not be an issue with Li-Fi.
* Multi user support of Li-Fi will ensure that every individual is getting a high speed of internet.

And these points will probably keep increasing as we will be moving forward towards the future.

As light is everywhere and free to use, there is a great scope for the use and evolution of LiFi technology. If this technology becomes mature, a cache Li- Fi bulb can be used to transmit wireless data. As Li-Fi Technology becomes popular, it will lead to cleaner, greener, safer communications and have a bright future and environment. The concept of Li-Fi is attracting many people as it is free (requires no license) and faster means of data transfer. If it evolves faster, people will use this technology more and more.

CHAPTER-6

CONCLUSION

We have successfully implemented a Li-Fi system capable of transmitting data through visible light. Data transmission by serial is successful with no bit errors. In the case of parallelism, the error is increased as the distance is increased. A drawback of this system is that the receiver must be in the line of sight for successful retrieval of bits. The bit rate of the system can be increased by varying the intensity of LED by using PWM. Also, selection of phototransistors sensitive to a visible light wavelength is crucial for this system. Although there's still a long way to go to make this technology a commercial success, it promises a great potential in the field of wireless internet. A significant number of researchers and companies are currently working on this concept, which promises to solve the problem of lack of radio spectrum, space and low internet connection speed. By deployment of this technology, we can migrate to greener, cleaner, safer communication networks. The very concept of Li-Fi promises to solve issues such as, shortage of radio-frequency bandwidth and eliminates the disadvantages of Radio communication technologies. Li-Fi is the upcoming and growing technology acting as catalyst for various other developing and new inventions/technologies. Therefore, 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.

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