DATA TRANSMISSION THROUGH LIFI USING ARDUINO

KALYANI GOVERNMENT ENGINEERING COLLEGE - 102

TOPIC NAME - DATA TRANSMISSION THROUGH LIFI USING ARDUINO

(Mini Project- EC681)

GROUP NO. – 12

NAME OF THE STUDENTS –

- **AKASH PODDAR (10200322044)**
- **PRANTIK ROY (10200322077)**
- **RITIKA PRIYA (10200322083)**
- **SOUMALI SAU (10200323070)**

STREAM: ELECTRONICS & COMMUNICATION ENGINEERING

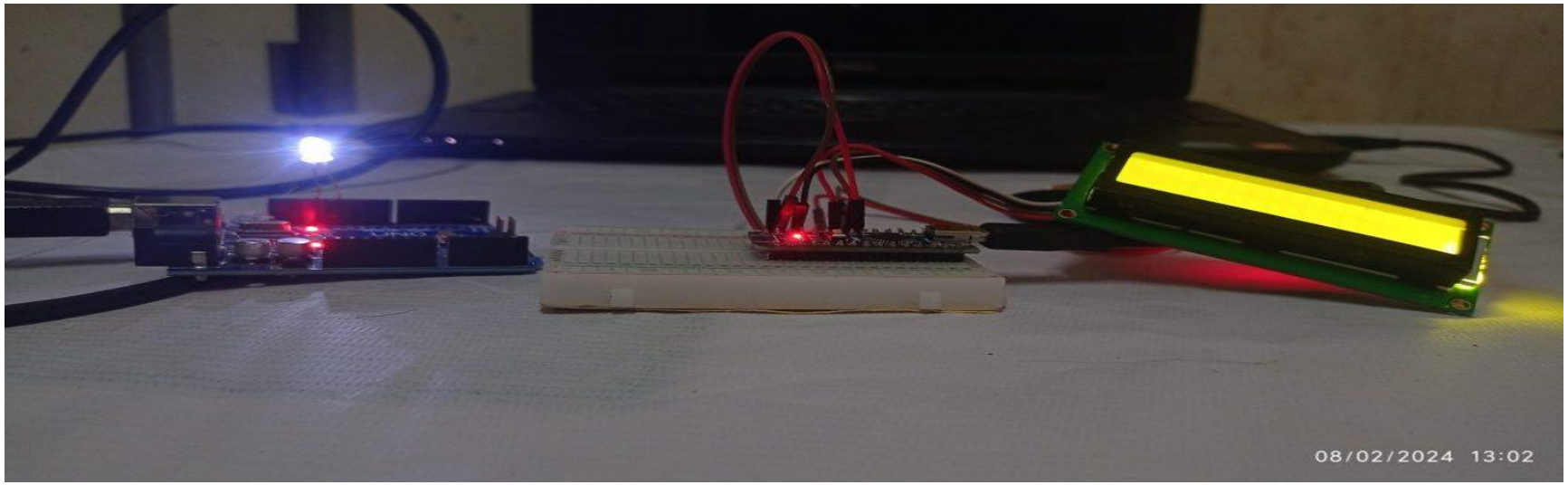
SEMESTER: 6th

YEAR: 3rd

Table of contents

Overview

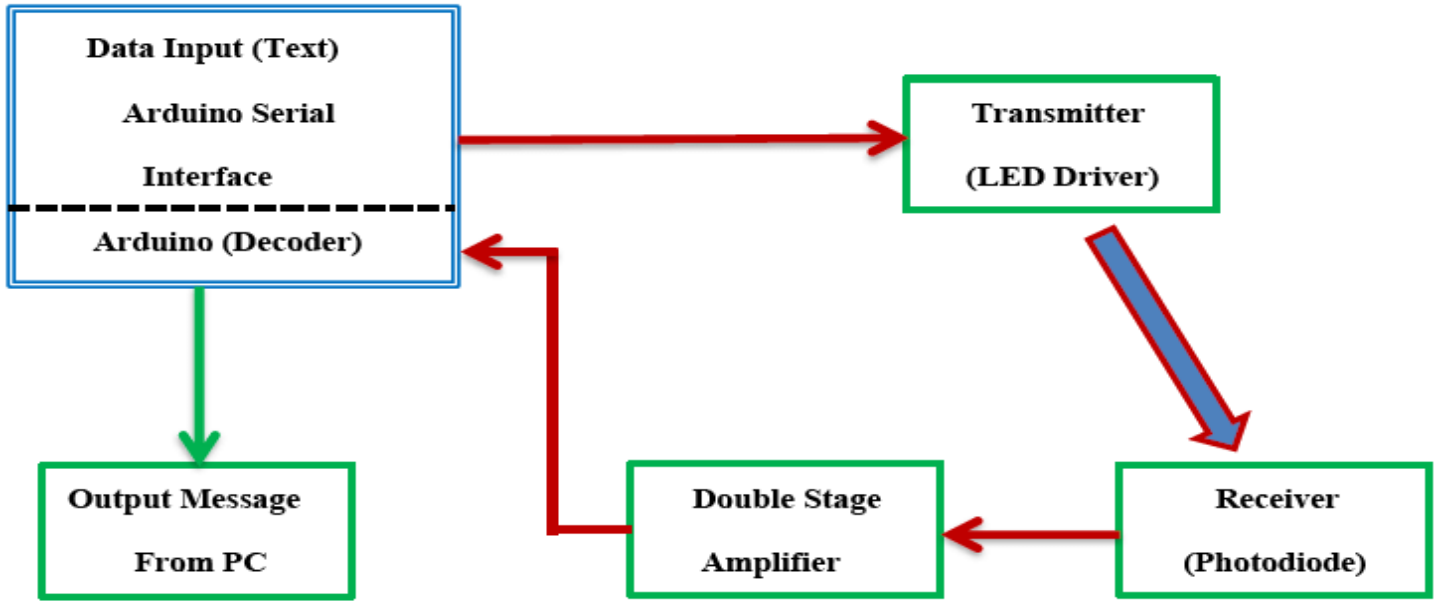
- **Li-Fi (Light Fidelity) uses visible light to wirelessly transmit data. With Arduino, an LED acts as the transmitter by blinking to encode data, while a light sensor on another Arduino decodes the light pulses.**
- **This setup offers high-speed data transfer, immunity to electromagnetic interference, and added security. It's a low-cost, efficient method ideal for educational and practical wireless communication projects.**



Img1: Basic lifi image

Introduction

- In the digital age, where data transmission is at the heart of connectivity, innovative technologies constantly emerge to enhance efficiency and reliability.
- One such groundbreaking innovation is Li-Fi, poised to revolutionize data transmission through light. This introduction delves into the realm of Li-Fi, shedding light on its principles, applications, and potential impact on the future of connectivity.



IMG 2 ; lifi BASIC BLOCK DIAGRAM

Components

Serial number	Component used	Quantity
1	Arduino Nano	1
2	Arduino Uno	1
3	LED'S	3
4	TRANSISTOR	1
5	Mini solar panel	1
6	Connecting Wires	some

Transmitter Side:

Components

- Arduino Uno
- Registers
- Leds
- Transistor

Receiver Side:

Components

- Arduino Nano
- 16*2 LCD Display.
- LCD module
- Solar panel(30mA,5v)
- Jumpers

Data Transmission & Display and Output:

Data Transmission:

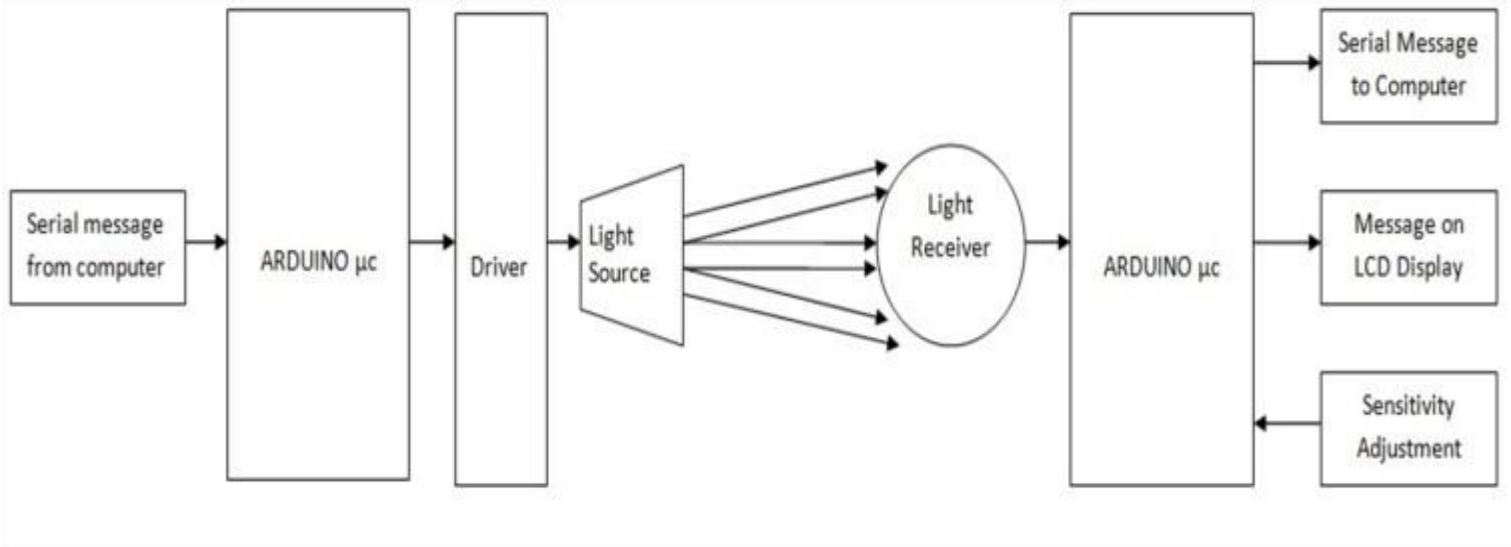
- The transmitter Arduino encodes data into light pulses by modulating the LED's intensity.
- The receiver Arduino captures the light pulses using the solar panel
- The received light signals are decoded by the receiver Arduino, converting them back into binary data.

Display and Output:

- The decoded data is displayed on the 16*2 LCD connected to the receiver Arduino.

Block Diagram of data transmission through li-fi using Arduino

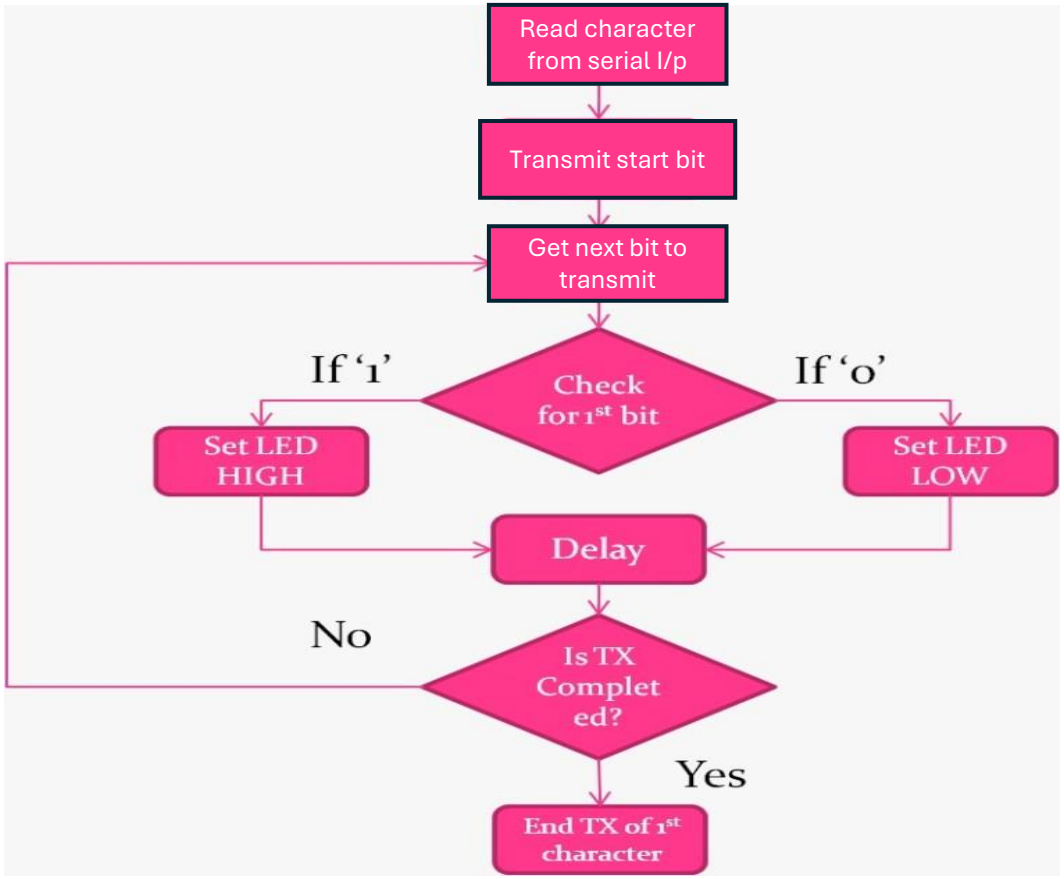
- **Below is a block diagram explanation of the data transmission through Li-Fi using Arduino and LED in the transmitter, and a 16*2 LCD and Arduino in the receiver.**



Img3: Block diagram explanation of the data transmission through LiFi using Arduino and LED

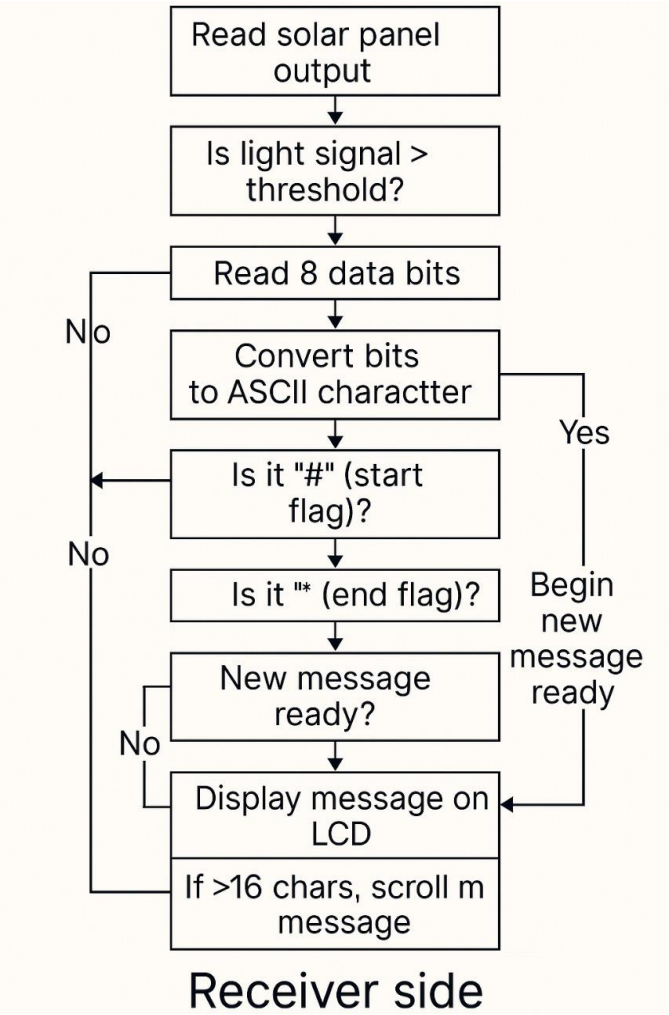
Flow chart

- **Flow Chart Transmitter side**



Img 4 : Flow chart of the transmitter side of data transmission through LiFi using Arduino.

- **Flow Chart Receiver side:**

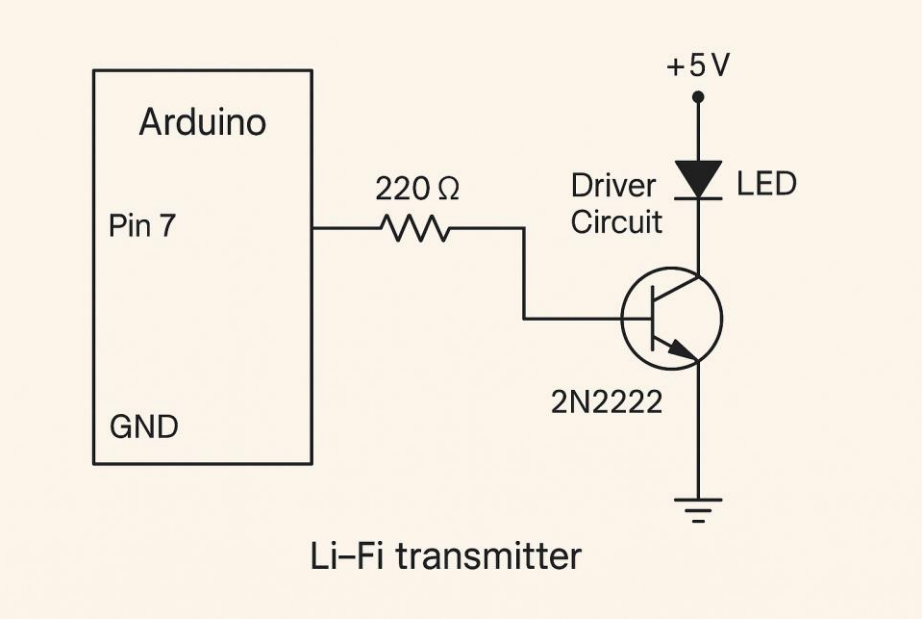


Img 5 : Flow chart of the transmitter side of data transmission through LiFi using Arduino.

Circuit Diagram

Circuit Diagram Transmitter Side

- **Below is a simple circuit diagram for the transmitter side of data transmission through Li-Fi using Arduino, with the LEDs connected to pin number 7 through a transistors and resistors**

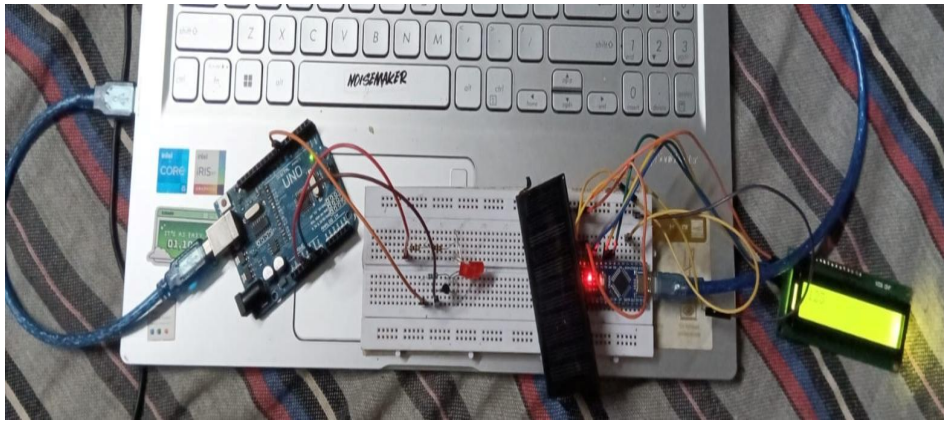


img 6 : Circuit diagram for the transmitter side of data transmission through Li-Fi using Arduino.

Circuit explanation:

In this circuit:

- The Arduino is powered by connecting its +5V (VCC) pin
- Its GND pin to the ground (GND).
- The LEDS(3LED) is connected to digital pin 7 (Pin 12) of the Arduino through transistor and resistance.

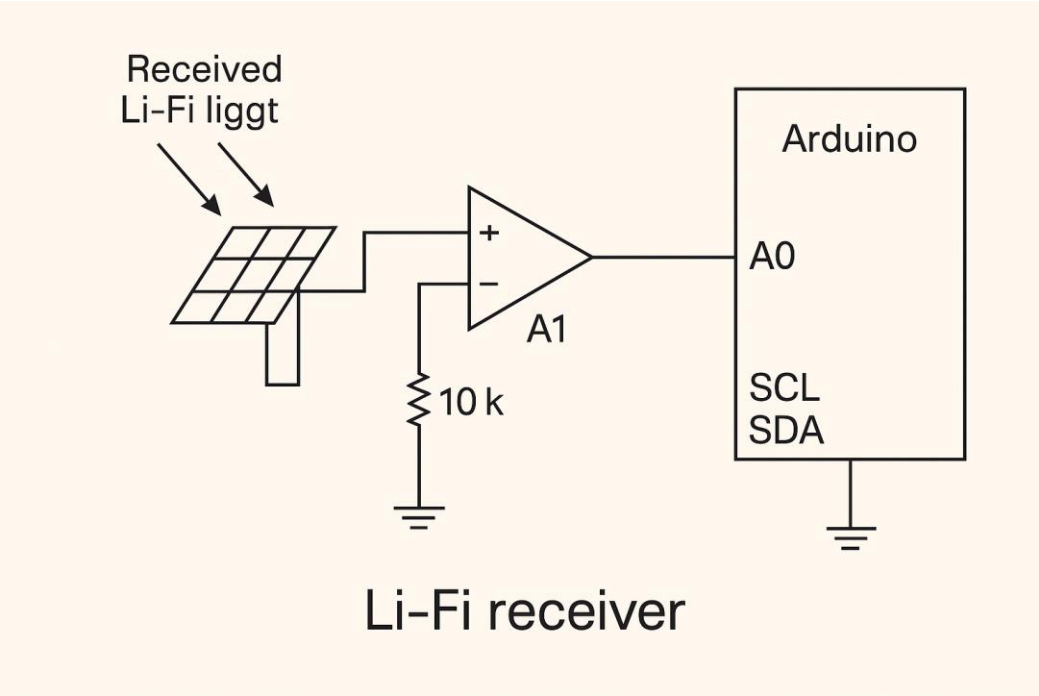


Img7 : Lifi receving side using Arduino and Led

Circuit Diagram Receiver Side

- **Below is the circuit diagram for the receiver side of data transmission through Li-Fi**

using Arduino, including a solar panel for power and a 16*2 LCD display connected via I2C.

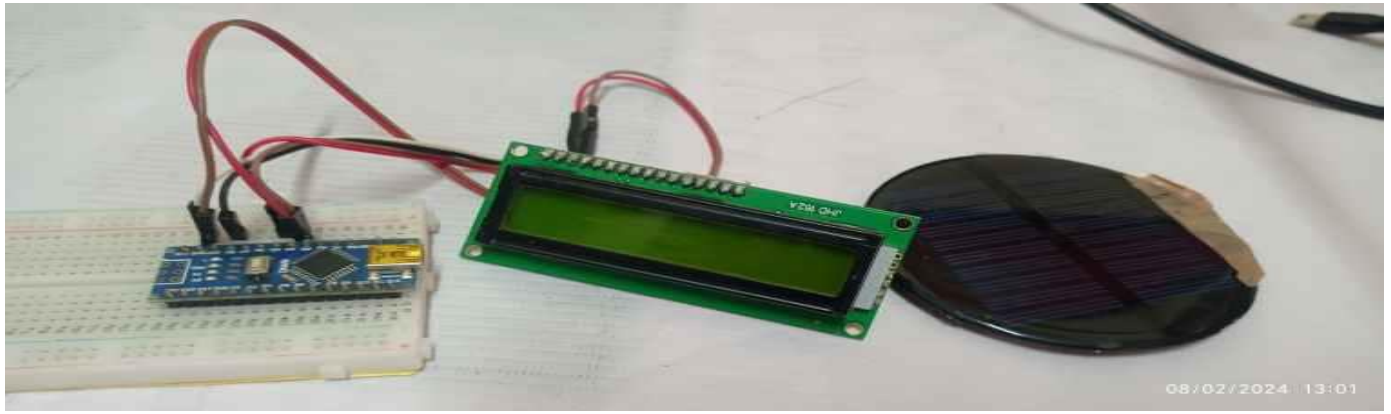


Img 8 :circuit diagram of receiver side through Arduino Nano and Lcd Display and solar panel

Circuit explanation of receiver side

In this circuit:

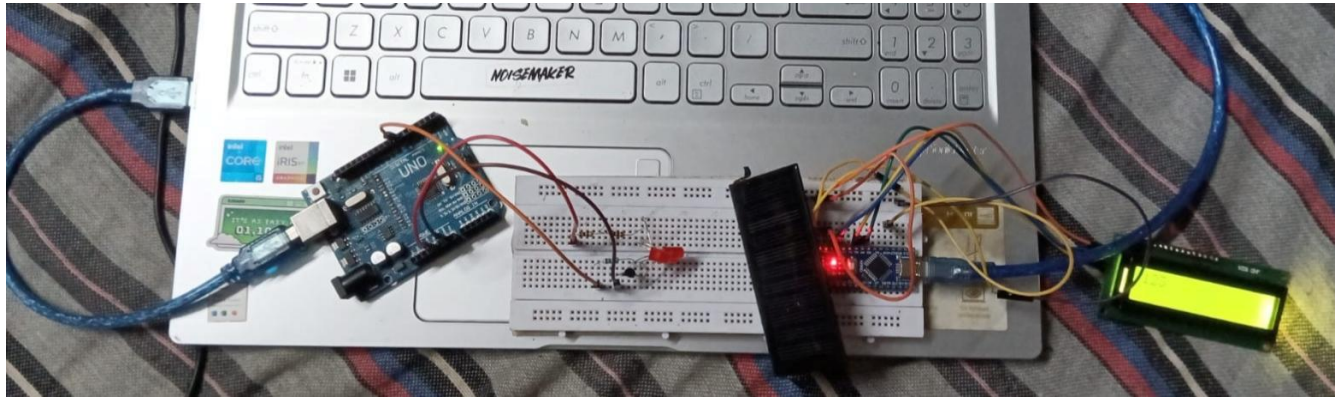
- **The Arduino is powered by connecting its +5V (VCC) pin .**
- **The positive (+) terminal of the solar panel is connected to A3, and the negative (-) terminal is connected to the ground (GND) of the Arduino.**
- **The 16*2 LCD display is connected to the Arduino using the I2C protocol.**
- **The VCC pin of the LCD is connected to +5V (VCC) of the Arduino, the GND pin is connected to GND, the SDA pin is connected to analog pin A4 (SDA), and the SCL pin is connected to analog pin A5 (SCL).**



Img 9 : Connection diagram for the receiver side of data transmission through Li-Fi using Arduino.

Working Principle

- **Circuit explanation:**



Img10 : data transmission through LiFi using Arduino

- **In our Li-Fi system, we have implemented the RS232 standard for data transmission, ensuring reliable communication between the transmitter and receiver.**
- **Let us assume we are transmitting the data “hello world,” each character is converted into its respective ASCII code and then into binary representation .**
- **The binary data is stored in a register and left rotation is performed.**

Circuit explanation:

1. **Transmitter Side**: **Text input from the serial monitor is converted to binary, then transmitted via 3 LEDs modulated using a transistor for amplification.**

2. **Modulation Logic**: **Each character is sent as a start bit, 8 data bits, and a stop bit by toggling the LEDs ON/OFF for fixed durations.**

3. **Receiver Side: A solar panel detects light intensity changes and sends analog voltage to the Arduino Nano, which reads and decodes the binary data.**

4. **Display: The decoded characters are printed to the serial monitor or displayed on an LCD using the I2C module for real-time message viewing.**

Program or Source code Transmitter side:

```
// Final Transmitter Code
const int ledPin = 7;
int dotDuration = 10; // Duration for each bit in ms
void setup() {
 pinMode(ledPin, OUTPUT);
 Serial.begin(9600);
 Serial.println("Enter text to transmit via Li-Fi:");
}void loop() {
 if (Serial.available()) {
  String message = Serial.readStringUntil('\n');
  transmitMessage(message);
  Serial.println("Message Sent!"); }.  }
void transmitMessage(String msg) {
 for (int i = 0; i < msg.length(); i++) {
  transmitChar(msg[i]);
```

```
void transmitChar(char c) {
 // Send start bit (HIGH)
 digitalWrite(ledPin, HIGH);
 delay(dotDuration);
 // Send 8 data bits
 for (int i = 7; i >= 0; i--) {
  int bitValue = bitRead(c, i);
  digitalWrite(ledPin, bitValue);
  delay(dotDuration);
 }
 // Send stop bit (LOW)
 digitalWrite(ledPin, LOW);
 delay(dotDuration);
}
```

Program or Source code
Receiver side Program


```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
// Initialize the LCD (Address: 0x27, 16 columns, 2 rows)
LiquidCrystal_I2C lcd(0x27, 16, 2);
const int sensorPin = A0;
int threshold = 175; // Adjust based on your sensor's output
int dotDuration = 10; // Must match transmitter
String receivedMessage = ""; // Store current message
bool receivingMessage = false; // Flag to track message reception
bool newMessageReady = false; // Flag to trigger display
void setup() {
 Serial.begin(9600);
 lcd.init();
 lcd.backlight();
 lcd.setCursor(0, 0);
 lcd.print("Listening...");
}
void loop() {
 if (detectStartBit()) {
  char receivedChar = receiveChar();
  if (isPrintable(receivedChar)) {
   if (receivedChar == '#') { // Start of message flag
    receivedMessage = ""; // Clear old message
    receivingMessage = true;
   } else if (receivedChar == '*') { // End of message flag
    receivingMessage = false; // Message complete
    newMessageReady = true; // Ready to display
   } else if (receivingMessage) { // Only store characters between flags
    receivedMessage += receivedChar;
   }
  }
 }
 if (newMessageReady) {
  Serial.println(receivedMessage);
  lcd.clear();
  if (receivedMessage.length() <= 16) {
   lcd.setCursor(0, 0);
   lcd.print(receivedMessage);
  } else {
   scrollMessage(receivedMessage);
  }
  newMessageReady = false; // Message displayed,
 wait for next
 }
}
```

```
bool detectStartBit() {
  int value = analogRead(sensorPin);
  if (value > threshold) { // Detected a
    HIGH start bit
   delay(dotDuration / 2); // Center
    timing on the first data bit
   return true;}
  return false;}
char receiveChar() {
  byte receivedByte = 0; // Read 8 data
    bits
  for (int i = 7; i >= 0; i--) {
   delay(dotDuration);
   int value = analogRead(sensorPin);
   if (value > threshold) {
bitWrite(receivedByte, i, 1);}  }
 else {
    bitWrite(receivedByte, i, 0);
  }
 }
```

```
// Read stop bit (optional)
 delay(dotDuration);

 return char(receivedByte);
}
bool isPrintable(char c) {
 return (c >= 32 && c <= 126); // Accept only standard printable
   ASCII characters
}
void scrollMessage(String msg) {
 int messageLength = msg.length();
 String displayString = msg + "   "; // Add spacing for smooth
   scrolling

 for (int pos = 0; pos <= displayString.length() - 16; pos++) {
  lcd.setCursor(0, 0);
  lcd.print(displayString.substring(pos, pos + 16));
  delay(300); // Scroll speed (adjustable)
 }
}
```

Output

Here is the output of the mini project

https://drive.google.com/drive/folders/1m8N3WvXmHl4WW3wuRABYoxVQzsRWEJsG

FUTURE SCOPE

1. High-Speed Wireless Communication
2. Applications in Hospitals and Medical Devices
3. Enhanced Security
4. Educational and Industrial Use
5. Low-Power Applications

Limitations

1. **Low Data Transfer Speed: Arduino's processing delay**
2. **Line of Sight (LOS) Required: The solar panel must be directly aligned with the LED**
3. **Low Range: Normal 3mm LEDs have a short effective range (5–30 cm).**
4. **Ambient Light Interference: Sunlight or room lights can disturb or distort the signal received by the solar panel.**
5. **One-Way Communication: In your project, data flows only from transmitter to receiver.**
6. **Limited Bit Accuracy : Solar panel + analog Read is not designed for precise binary decoding.**

Conclusion of Li-Fi Data Transmission System:

- This project demonstrated that Li-Fi can effectively transmit alphanumeric data with high speed and minimal interference, especially in electromagnetic-sensitive environments.
- The system showcases potential for real-world applications in areas like hospitals, aircraft, underwater communication, and secure data networks.
- Furthermore, by extending the system to support sound and higher data rates, Li-Fi can emerge as a sustainable and cost-effective alternative or complement to existing wireless technologies.
- Overall, the project emphasizes the viability and future scope of Li-Fi in creating faster, safer, and greener communication infrastructures.

References

1. A"Optical Wireless Communications: System and Channel Modelling with MATLAB®" Author: Z. Ghassemlooy, W. Popoola, S. Rajbhandari Publisher: CRC Press Edition: 1st Edition, 2012 ISBN: 9781466566509

2. Research Paper - Li-Fi Using Arduino https://www.ijert.org/lifi-technology-using-arduino

3. M. A. Mazidi, R. D. McKin lay, and J. G. Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education, 2nd Edition, 2006.

[Chapters on analog interfacing, sensor integration, and output control.]

4. Christoph Kottke, Jonas Hilt, Kai Habel, Jelena Vucic, and KlausDieter Langer, -1.25 Gbit/s Visible Light WDM Link based on DMT Modulation of a Single RGB LED Luminaryl, Proc. European Conference on Optical Communications (ECOC 2012), Amsterdam, The Netherlands, September 2012. https://www.scribd.com/document/705908459/Li-fi-data-transmit-using-ardunio-word

5. Datasheet: NE555 Timer IC, Texas Instruments.

[Online]. Available: https://www.ti.com/lit/ds/symlink/ne555.pdf

6. "Exploring Arduino: Tools and Techniques for Engineering Wizardry" Author: Jeremy Blum Publisher: Wiley Edition: 2nd Edition, 2019 ISBN: 9781119405375 *Project-based book that includes LED and light sensor communication.*

7. Datasheet: BT136 TRIAC, STMicroelectronics.

[Online]. Available: https://www.st.com/resource/en/datasheet/cd00004094.pdf

8.Arduino + Li-Fi Project Tutorial https://www.instructables.com/LI-FI-Data-Transfer-Using-Arduino/

9. Dominic O' Brien, Hoa Le Minha, Lubin Zeng, Grahame Faulkner and Hsir Chou, Kyungwoo Lee, Daekwang Jung, YunJe Oh, Eun Tae Won, Visible Light Communication: Recent Progress and Challenges, Wireless World Research Forum. pp. 445-446, USA, Jan. 2011.

10. G. Cossu, A. M. Khalid, P. Choudhury, R. Corsini, and E. Ciaramella, -Long distance indoor high speed visible light communication system basedon RGB LEDs, in Proc. AsiaCommun. Photon. Conf. pp. 1-3., 2012. Rajagopal, S., Roberts, R.D., Sang-Kyu Lim, "IEEE 802.15.7 visible light communication: modulation schemes and dimming support", IEEE Communications Magazine, Volume 50, Issue 3, pp. 72 - 82, March 2012

11. Madoka Nakajima, Shinichiro Haruyama, -Indoor navigation system for visually impaired people using visible light communication and compensated geomagnetic sensingl, 2012 1st IEEE International Conference on Communications in China (ICCC)

Thank you