

Text-Based Data Transmission Using Li-Fi

A Mini Project Presentation Presented by
The Tri-Factor

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Introduction

What is Li-Fi?:

- In today's world of overcrowded data communication, Li-Fi (Light Fidelity) offers a revolutionary way to transmit data wirelessly—using LED light.
- With the number of internet-connected devices increasing rapidly, traditional wireless networks (like Wi-Fi) often become slow and congested due to limited bandwidth. This is where Li-Fi steps in.

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- Unlike Wi-Fi, which relies on radio waves, Li-Fi uses the visible light spectrum, a much broader and less utilized part of the electromagnetic spectrum. The basic idea is simple: by rapidly varying the intensity of LED light (faster than the human eye can detect), data can be transmitted and received.

Why LI-FI?

- Higher bandwidth – Up to 400 THz compared to Wi-Fi's 300 GHz.
- Faster speeds – As light can carry more data at higher rates.
- Health-safe – Uses visible light, avoiding the potential risks of radio waves.
- Ideal for sensitive environments – Like hospitals or military zones, where RF signals are restricted.

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Table I : Comparison of Speed for Different Wireless Technologies

<i>Technology</i>	<i>Speed</i>
<i>Li-Fi</i>	~1 Gbps
<i>Wi-Fi – IEEE 802.11n</i>	~150 Mbps
<i>IrDA</i>	~4 Mbps
<i>Bluetooth</i>	~3 Mbps
<i>NFC</i>	~424 Kbps

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Table 2 : Comparison between Lifi and Wifi

<i>Parameter</i>	<i>Li-Fi</i>	<i>Wi-Fi</i>
<i>Spectrum Used</i>	Visible Light	RF
<i>Standard</i>	IEEE 802.15.7	IEEE 802.11
<i>Range</i>	Based on Light Intensity (< 10m)	Based on Radio propagation & interference (< 300 m)
<i>Data Transfer Rate*</i>	Very high (~1 Gbps)	Low (100 Mbps-1 Gbps)
<i>Power consumption</i>	Low	High
<i>Cost</i>	Low	High
<i>Bandwidth</i>	Unlimited	Limited

Our Objective

The main objectives of this mini project are:

- To demonstrate text-based data transfer using Li-Fi technology.
- To explore Visible Light Communication (VLC) as a secure and efficient alternative to traditional wireless communication methods.
- Design a low-cost prototype that enables data transmission through LED light.

Component Used

Transmitter Side:

- Laptop (for typing message)
- Arduino Nano
- LED
- Resistor ($1K\Omega$ for LED)
- Jumper wires

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Receiver Side:

- Arduino Nano
- LDR (Light Dependent Resistor)
- Resistor (For voltage divider)
- Laptop (to receive and display decoded message)
- Jumper Wires

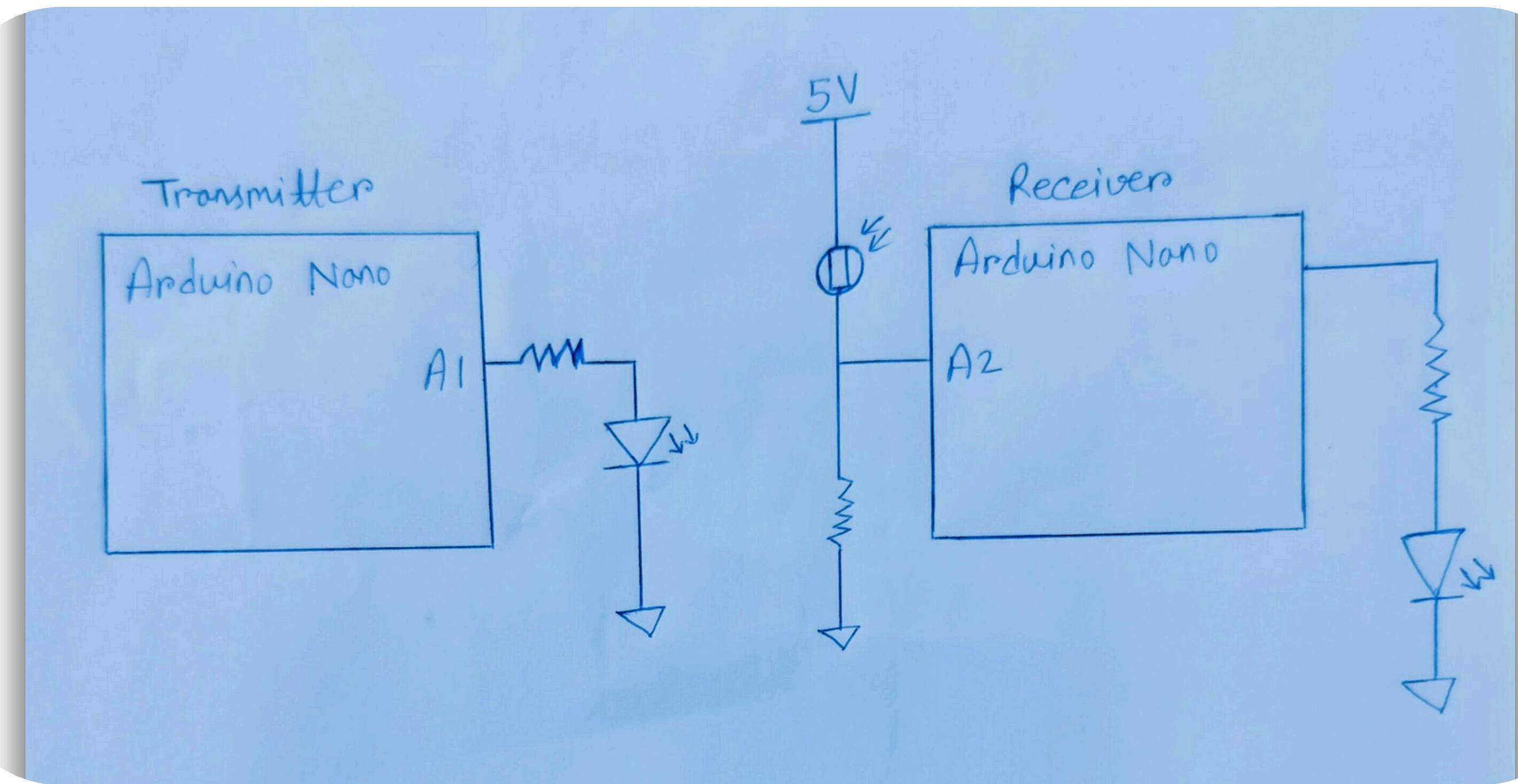
Working Principle

- Message typed on Serial Monitor → Converted to binary by Arduino.
- Each bit of data is transmitted using LED blinking (ON = 1, OFF = 0).
- At the receiver end, LDR senses light changes and converts them into voltage variations.
- Arduino interprets the voltage into binary → Reconstructs the original character.

Circuit Diagram

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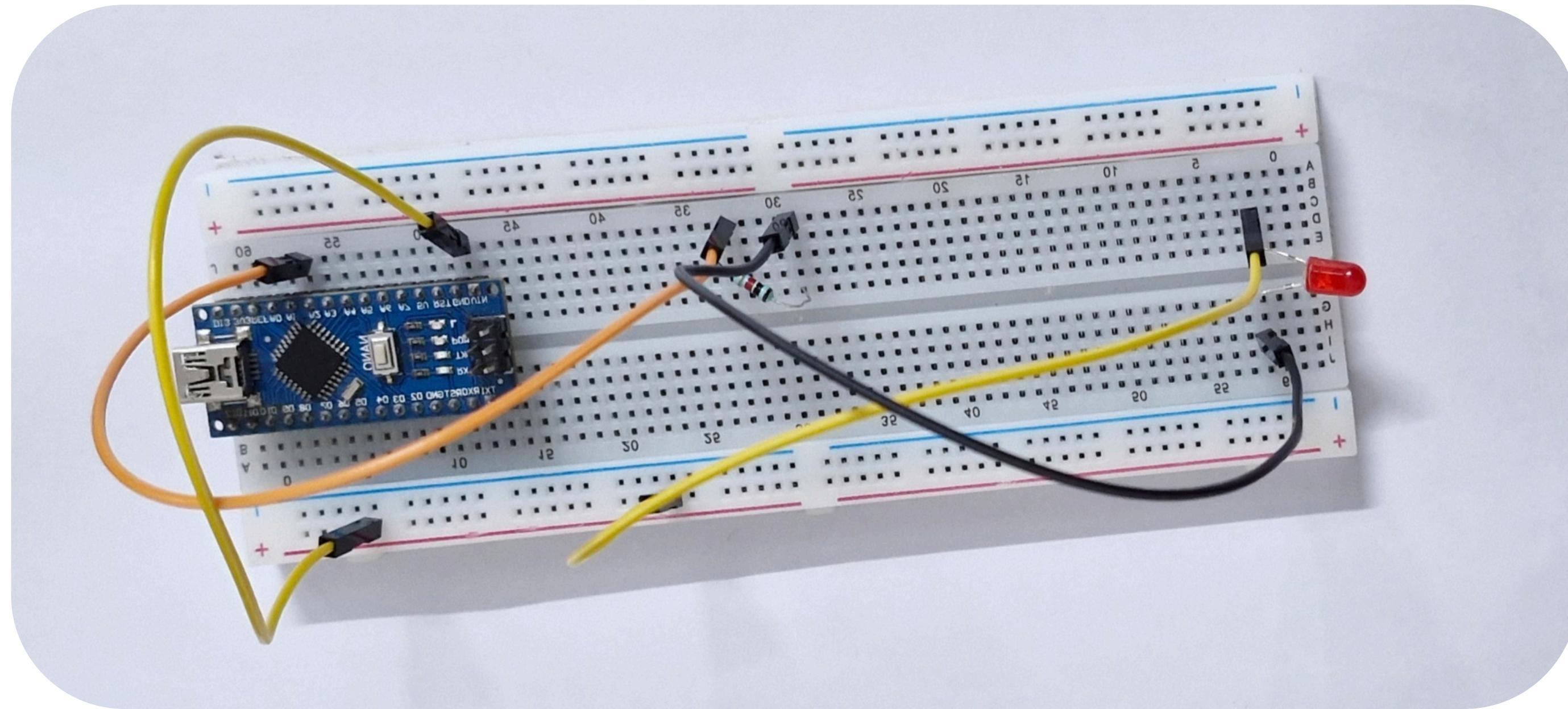
Schematic Diagram of Li-Fi Project:



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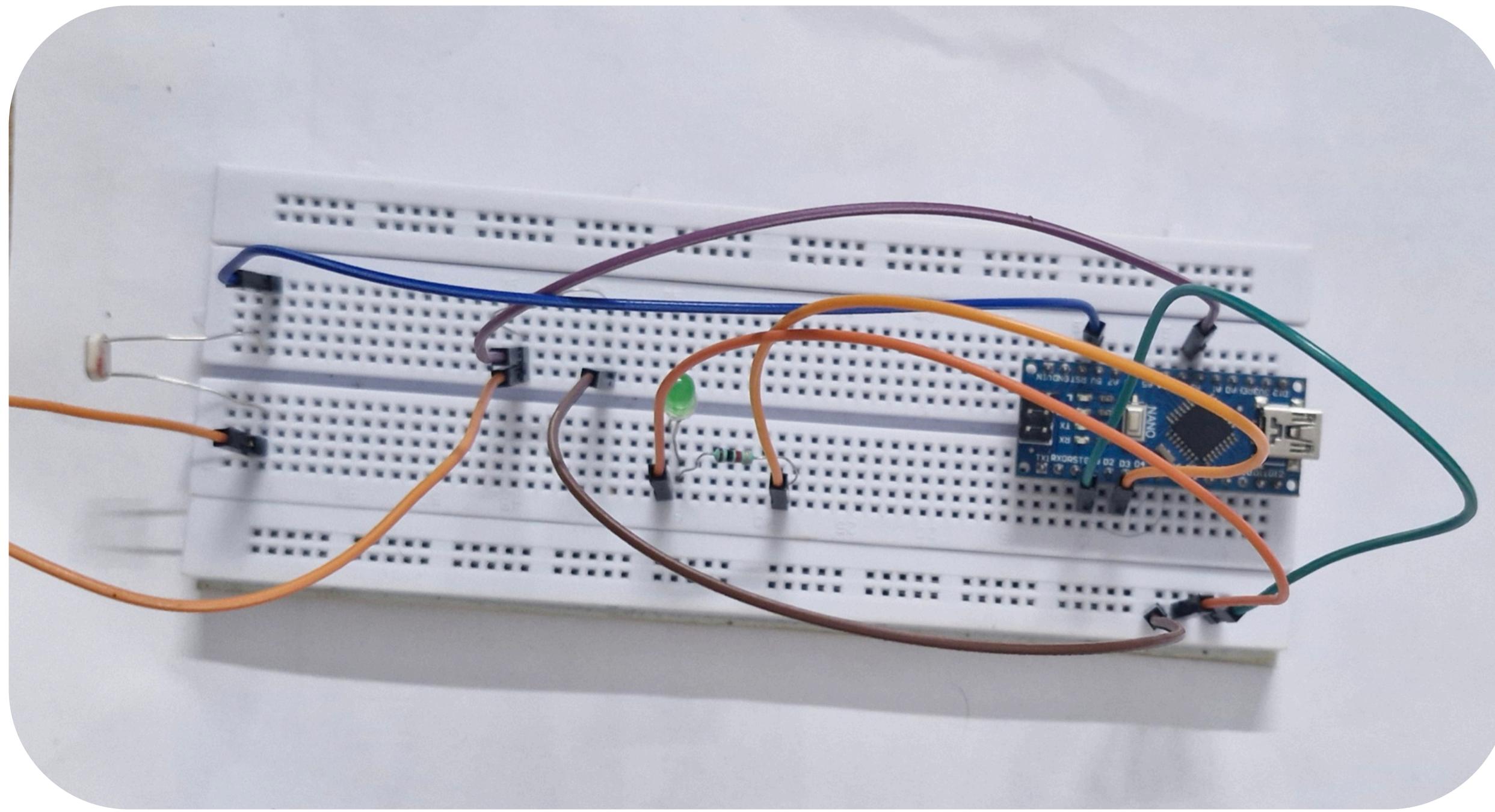
Transmitter Side:



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Reciever Side:



Arduino Nano Code

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Arduino Code Logic:-

Transmitter Code:

- Takes input from Serial Monitor
- Converts each character into bits
- Transmits bits via LED

Receiver Code:

- Continuously reads analog value from LDR
- Converts bit sequence to a character
- Displays result on Serial Monitor

Applications of Li-Fi

- I. Education Systems

Li-Fi can provide ultra-fast internet speeds, making it ideal for schools, colleges, and corporate offices—either as a replacement or a supplement to Wi-Fi.

- 2. Medical Applications

Wi-Fi is often restricted in operation theatres (OTs) due to interference with critical medical equipment. Li-Fi, being radiation-free, can provide safe and reliable internet access for tasks like robotic surgeries and real-time monitoring.

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- 3. In-Flight Connectivity

Wi-Fi is limited or expensive on airplanes due to interference risks. Li-Fi can utilize overhead LED lights to provide high-speed, affordable internet to passengers without affecting navigational systems.

- 4. Underwater Communication

Unlike Wi-Fi, Li-Fi can function underwater. It can enable ROVs to communicate via light, extending their reach and allowing data sharing between underwater devices—ideal for military operations and deep-sea exploration.

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- 5. Disaster Management

During natural disasters like earthquakes or hurricanes, Li-Fi can provide secure and reliable communication, especially in dead zones such as tunnels and subway stations.

- 6. Sensitive Zones (e.g., Power Plants)

Radio waves are often restricted in nuclear and thermal power plants. Li-Fi offers a safe alternative for internal communication, reducing electromagnetic interference and conserving power.

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- 7. Traffic Management

Traffic lights using Li-Fi can communicate with vehicles' LED systems, enabling real-time traffic updates, accident prevention, and smoother vehicle movement.

- Mobile & Device Connectivity inside a house

Smartphones, tablets, and laptops can connect via Li-Fi, creating short-range, high-speed, and secure networks—ideal for device-to-device communication.

Limitations of Li-Fi

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However, there are some areas where li-fi technology suffers-

- Requires Light to Work
- Line-of-Sight Dependency
- Obstruction Issues
- Limited Range
- Costly Infrastructure
- Not Yet Mass-Adopted

Future Scope of Li-Fi

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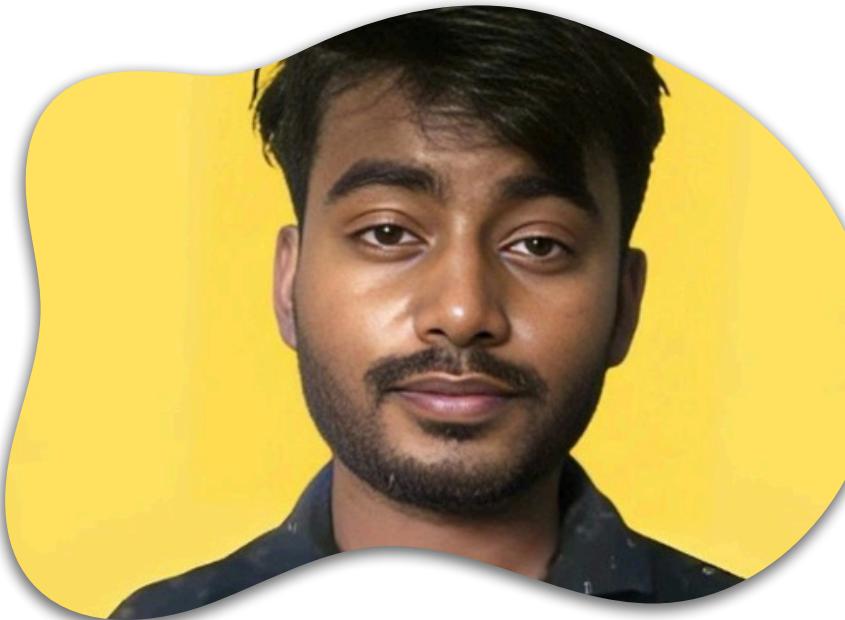
- If matured, Every Li-Fi-enabled LED bulb could become a wireless hotspot, allowing data transmission wherever light is present.
- Li-Fi operates on the visible light spectrum, which doesn't require licensing, making it a cost-effective and scalable solution.
- Li-Fi promotes a greener alternative by reducing electromagnetic pollution and energy consumption compared to radio-based systems.

Conclusion

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- Li-Fi is still in its early stages, but it holds tremendous promise for the future of wireless communication.
- As researchers and companies continue to explore its potential, Li-Fi emerges as a powerful solution to overcome the limitations of radio-based systems—like spectrum congestion, slow speeds, and security concerns.
- By enabling data transfer through visible light, Li-Fi offers a path toward greener, cleaner, and safer communication networks.
- It's not just a technology—Li-Fi is a catalyst for future innovations that could transform industries and integrate seamlessly into our everyday lives.

Our Team



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thank you