# “Smart Li-Fi: High-Accuracy Wireless Data Transmission Using Raspberry Pi”

# INTRODUCTION

- traditional methods like Wi-Fi face challenges such as network congestion, interference and security risks.
- This is where Li-Fi (Light Fidelity) comes in—a technology that uses light instead of radio waves to transmit data.
- works by rapidly blinking an LED to send data, which is then picked up by a receiver like a photodiode.
- It's faster, more secure and interference-free.
- In this project, we explore how Raspberry Pi can be used to build a simple Li-Fi communication system. To make the data transfer more reliable, we implement Manchester Encoding

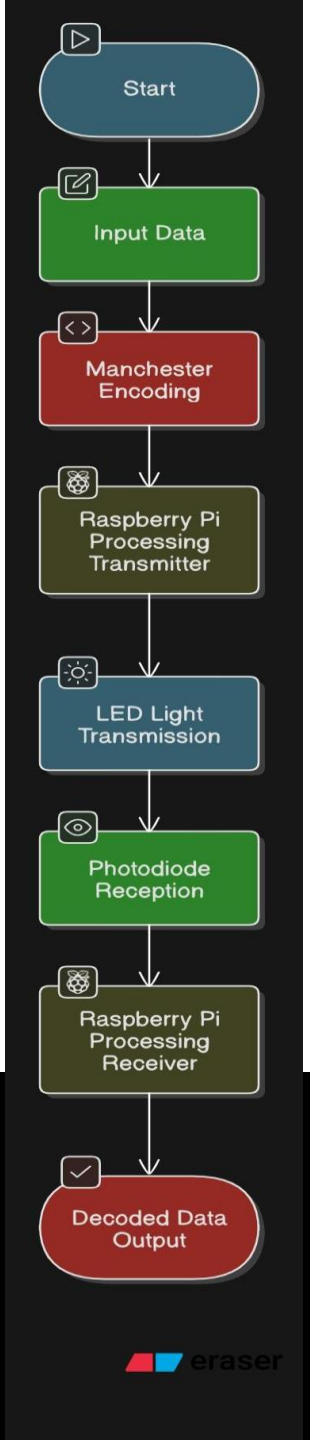
# LITRATURE SURVEY

| Serial No. | TITLE | Year of Publishing | Summary | Advantages | Disadvantages |
|---|---|---|---|---|---|
| 1 | Light Fidelity (Li-Fi) Prototype with Raspberry Pi | 2016 | • This dissertation discusses the research, construction, and testing of a Light Fidelity (Li-Fi) prototype using Raspberry Pi.<br>• The prototype aims to demonstrate the principle of VLC using accessible components. | The prototype is compact, low cost, and uses accessible components. | LEDs are not suitable in transmission for high-speed applications due to their communication limitations. |
| 2 | Utilizing a Raspberry Pi for Transmitting Image using Li-Fi Transceiver | 2020 | • Using of VLC with On-Off Keying (OOK) modulation to transmit color images from a Raspberry Pi.<br>• Designing a Li-Fi transceiver using Arduino for transmitting digital data using VLC.<br>• Viability of using Python for coding and SPI for data transfer in a Li-Fi prototype. | Application of Li-Fi for Image Transmission & Utilization of Open-Source Tools like Python | Li-Fi technology faces challenges like:<br>• Line-of-sight requirement<br>• Limited range<br>• Sensitivity to ambient light interference |
| 3 | LiFi-Based Visible Light Communication and Modulation Techniques | 2021 | • This article discusses LiFi (Light Fidelity) technology as a high-speed communication network, focusing on its use for short-distance and local intranet communication.<br>• The article also introduces a new modulation method using Morse code, which significantly improves decoding speed and reduces bandwidth requirements. | • LiFi has a band frequency of 200,000 GHz, which is 100 times faster than Wi-Fi.<br>• safe in areas susceptible to electromagnetic interference | • It will take a long time for LiFi to become more affordable than Wi-Fi.<br>• LiFi has a limited range of approximately 100 meters. |

# PROBLEM STATEMENT

- Traditional wireless communication systems relying on radio frequencies face challenges such as bandwidth congestion, interference, and security vulnerabilities.
- There is a need for an alternative communication technology that offers higher speed, better security, and reduced interference.
- Existing visible light communication (VLC) systems often struggle with synchronization issues and data transmission errors, affecting their reliability and efficiency.

# FLOW CHART


Start
Input Data
Manchester Encoding
Raspberry Pi Processing Transmitter
LED Light Transmission
Photodiode Reception
Raspberry Pi Processing Receiver
Decoded Data Output
eraser

# PROJECT EXECUTION STEPS

- Define the challenges of traditional wireless communication
- Study existing research on Li-Fi communication and Manchester Encoding for improved data accuracy.
- Hardware used- Raspberry Pi, LED (transmitter), Photodiode (receiver), Resistors, Transistors.
- Software used- Python for encoding, decoding, and GPIO control.
- Design the transmitter circuit, design the receiver circuit and stimulate using circuit design tools before implementation
- Convert input data to Manchester Encoding and use Raspberry Pi's GPIO to blink LED according to encoded data.

- Photodiode detects LED blinks and sends data to Raspberry Pi. Decode Manchester-encoded signals to reconstruct original data.
- Test for accuracy, range, and environmental interference. Adjust LED brightness, GPIO timing, and filtering techniques
- Record circuit diagrams, Python code, and test results.

# COMPONENTS REQUIRED AND COST ESTIMATE

- Transmitter Side-

High-Brightness LED, resistors, transistor

- Receiver Side-

Photodiode, resistors, capacitors, op-amp

- Common Components & Accessories-

Breadboard, jumper wires, power supply

- Processing Unit-

Raspberry Pi

| Component | Quantity | Estimated Cost (INR) |
|---|---|---|
| High-Brightness LED | 1-2 | ₹20 - ₹50 |
| Photodiode | 1 | ₹30 - ₹80 |
| Resistors (220Ω, 10kΩ, etc.) | 3-5 | ₹10 - ₹20 |
| Transistor | 1 | ₹10 - ₹15 |
| Capacitors (10µF, 100nF, etc.) | 2-3 | ₹10 - ₹20 |
| Breadboard | 1 | ₹0 |
| Jumper Wires | 4-5 | ₹0 |
| Power Supply | 1 | ₹0 |
| Raspberry Pi | 1 | ₹0 |

# REFERENCES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