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# IOT-Based Household Equipment Control System Using Laser-LDR Pair

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***Abstract:***
*The fast development of smart home tech has made it necessary to create smart systems that can control home appliances automatically, making energy use more efficient and life more convenient. This project is about making an automatic system to control home equipment using IoT technology. The system is made to watch whether people are present and what the environment is like, so that electrical devices in the house only work when needed. To know when someone enters or leaves a room, a Laser-LDR pair is used. When the laser beam hits the LDR, and then gets blocked, the system knows someone has passed through the door. Based on this, the system decides if someone has come in or gone out and then turns lights or fans on or off. This helps use less power when it's not needed and improves how energy is managed. Along with detecting people, the system also uses sensors to check conditions like temperature and air quality. These sensors take data from the surroundings and send it to the main controller. Based on this data, the system can automatically manage devices like fans or air conditioners to keep the inside of the house comfortable. The main part of this system is the Raspberry Pi Pico W, which has enough power to handle the tasks and also has built-in Wi-Fi. Through Wi-Fi, the device can send data to an IoT platform for real-time checking and remote control. The whole system is made to be cost-effective, easy to use, and can be expanded with common parts. By combining automatic control of appliances, environmental checks, and IoT features, this solution gives a real and user-friendly way to build smart home systems that are efficient.*

***Keywords:*** *Internet of Things (IoT), Home Automation, Laser-LDR Pair, Raspberry Pi Pico W, Energy Efficiency, Smart Home Security, Environmental Monitoring.*

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## I. Introduction

In recent years, the number of Internet of Things (IoT) devices has grown quickly around the world, leading to the creation of smarter and more connected living spaces [1]. Homes are slowly becoming intelligent environments where electronic devices and appliances can talk to each other and work on their own [3]. Smart home automation is a big part of this change, as it lets people control different home functions using digital tools [4]. These systems make life more comfortable, convenient, and efficient by letting users manage appliances through connected technology [2].

Along with making things easier, security has become a big worry for many homes. There have been more cases of theft and unwanted access, showing how important it is to have strong and smart monitoring systems [2]. Old security methods often need people to be there all the time and use them manually, which isn't always practical [6]. New smart security systems solve these problems by letting homeowners watch and control their homes from a distance using devices like smartphones or computers [4]. This ability to access things remotely helps people stay more aware and in control of their homes [3].

The proposed system offers a complete smart home solution that brings together security and automated appliance control [4]. It has password-protected locks and alarm systems to stop people from entering without permission [3]. Also, the system uses sensors to find movement and check the environment. Based on the information these sensors gather, home appliances can be turned on or off automatically to save energy and keep things comfortable [5]. By combining security, automation, and IoT connections, this system gives a simple and effective way to manage a smart home [6].

## II. Literature Survey

Several studies have investigated technologies for home automation and remote monitoring. Initially, systems primarily used manual switches or infrared (IR) remote controls to operate household devices. Subsequent advancements introduced communication-based solutions, sending notifications about home activities via mobile networks. Some research shifted from SMS-based alerts to internet-based communication to

enhance efficiency and minimize reliance on GSM hardware. More recent approaches employ Wireless Sensor Networks (WSNs) and cloud platforms to gather and process environmental data from various sensors in a home.

Despite these improvements, many existing systems still encounter limitations such as limited control range, higher operational costs, and increased system complexity. Solutions that rely heavily on extensive sensor networks and cloud infrastructure may also be costly and challenging to implement in small residential settings.

The proposed system addresses these challenges by integrating IoT connectivity with occupancy and environmental sensors to automatically manage household appliances. This approach provides a cost-effective, scalable, and user-friendly solution for efficient smart home automation.

## III. Proposed System / Methodology

The proposed system employs a touchless method for managing household appliances through a Laser-LDR detection mechanism. In this setup, a laser beam is directed onto a Light Dependent Resistor (LDR), and any interruption of the beam is detected, prompting the system to initiate the corresponding appliance action. This approach enables the automatic control of devices such as lights or fans without requiring physical contact, resulting in a simple, efficient, and cost-effective solution for smart home setups. The main controller in the system is the Raspberry Pi Pico W, which processes sensor inputs and manages the connected appliances.

Within the system architecture (fig 3.1), components like the Laser-LDR pair, environmental sensors, and the controller are interconnected to form a unified automation system. The Raspberry Pi Pico W gathers data from the sensors and processes it to determine the necessary actions. In terms of data flow, sensor signals are transmitted to the controller for analysis before triggering appliance control. Furthermore, the system communicates with a Telegram bot via Wi-Fi, enabling users to receive real-time updates and remotely monitor or adjust the system as needed.

**System Architecture:**

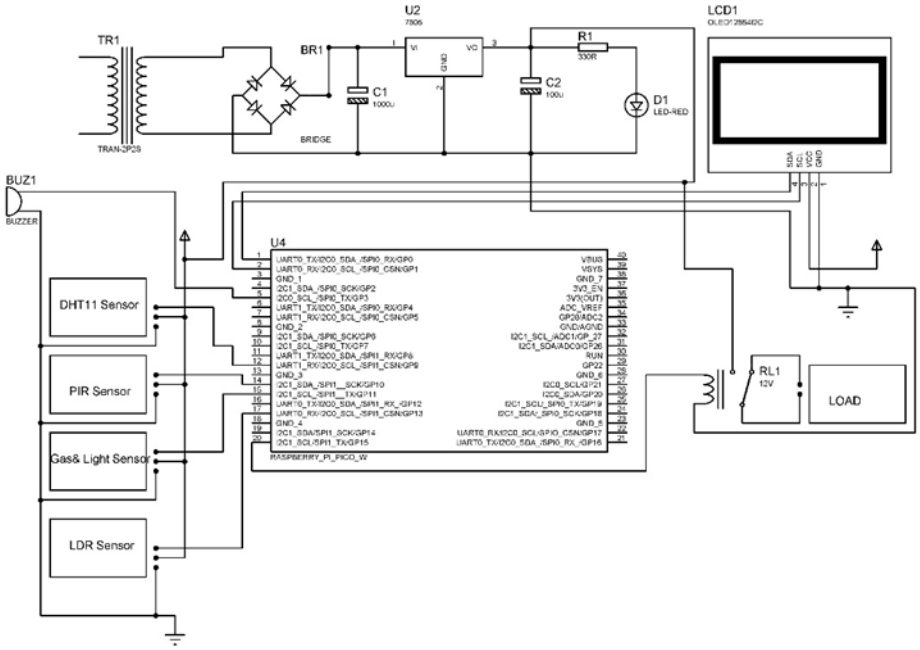


Fig:3 System Architecture of IOT-Based Household equipment control system using LASER-LDR pair

**Hardware Components:**

- Microcontroller
- DHT11 Sensors
- PIR sensor
- Gas Sensor
- LDR Sensor
- OLED
- Driver Circuit
- Load
- Buzzer

**Software Platform:**
- Python
- Thonny IDE
- Circuit Python

## IV. System Design / Implementation

**Block Diagram**

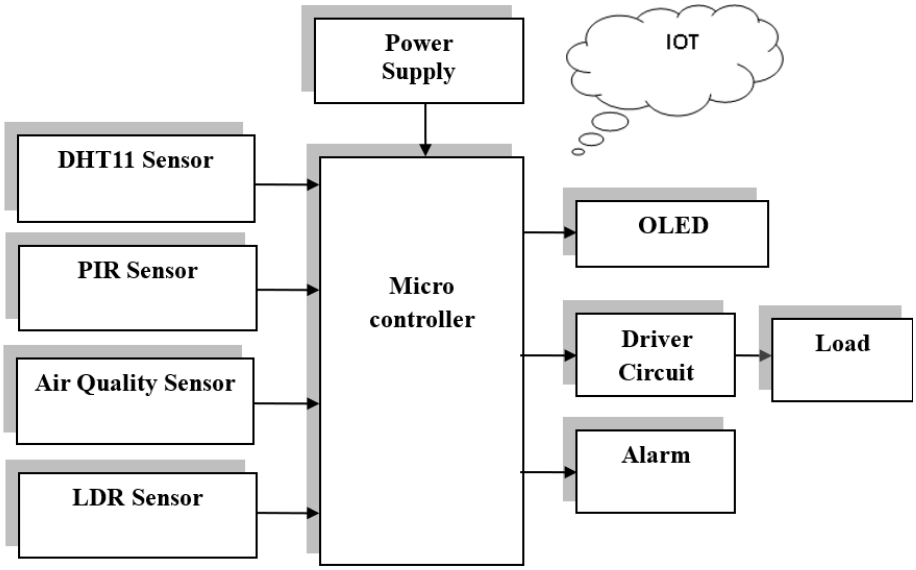


Fig.4.1. Block diagram of IOT-Based Household equipment control system using LASER-LDR pair

**Working Model:**

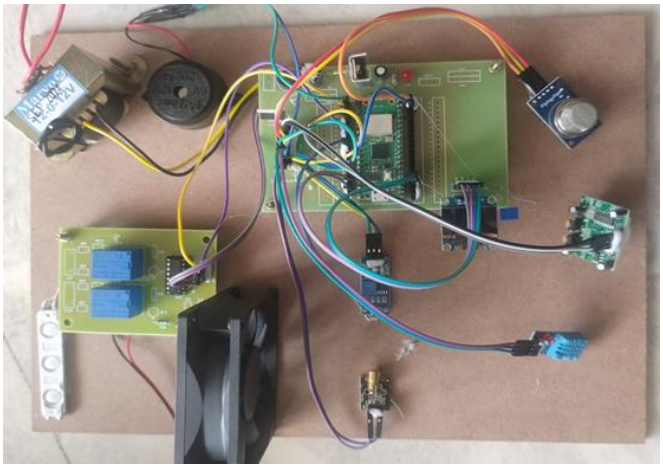

Fig. 4.2. Working Model of IOT-Based Household equipment control system using LASER-LDR pair

**Working Principle:**

The project kit works by using sensors, a small computer chip, and internet access to automatically control and keep track of home devices. The main computer in this setup is called the Raspberry Pi Pico W. It reads information from different sensors and then tells the connected devices what to do.

A laser and an LDR sensor are used together as the main way to control things. The laser sends a light beam that hits the LDR. When something blocks the beam, like a hand or a person walking by, the LDR's resistance changes. The Raspberry Pi Pico W notices this change and uses it as a signal to turn on or off things like lights or alarms through a special circuit and a relay.

Other sensors, such as PIR, DHT11, and air quality sensors, help check for movement, temperature, humidity, and air quality. The Raspberry Pi Pico W processes all this data and shows it on a screen called an OLED. It also shares the data over Wi-Fi so it can be monitored from anywhere.

If something unusual happens or a specific condition is met, the system can sound an alarm or send a message over the internet. This kit is a touch-free, affordable way to make your home smarter, safer, and more energy-efficient.

**Algorithm / Program Flow:**

Step-1: Start
- Power ON the system.
- Initialize the "Raspberry Pi Pico W" microcontroller.

Step-2: Initialize Components
Configure GPIO pins for:
- Laser–LDR sensor
- PIR sensor
- DHT11 sensor
- Gas sensor
- Relay/Driver circuit
- Buzzer
- OLED display
- Connect to "Wi-Fi network".
- Initialize "Telegram Bot / IoT communication".

Step-3: Read Sensor Values
- Continuously read input from:
- LDR sensor (laser beam detection)
- PIR sensor (motion detection)
- DHT11 (temperature & humidity)
- Gas sensor (air quality)

Step-4: Laser–LDR Detection
- Check the LDR value.
- If laser beam is interrupted:
- Detect entry/exit of a person.
- Trigger the required appliance (light, fan, etc.).
- Send notification through Telegram bot.

Step-5: Motion Detection
- Check PIR sensor output.
- If motion detected:
- Activate alarm or buzzer.
- Send alert notification.

Step-6: Environmental Monitoring
- Read "temperature and humidity from DHT11".
- Read "gas sensor values".
- Display values on "OLED display".

Step-7: Control Appliances
Based on sensor conditions:
- Turn relay "ON/OFF" to control home appliances.
- Maintain proper room conditions automatically.

Step-8: Send IoT Updates
- Send sensor data and system status to "Telegram bot / IoT platform".

Step-9: Repeat Monitoring
- Continuously repeat steps "3 to 8" for real-time monitoring and control.

Step-10: Stop
- System stops only when power is turned OFF.

## V. Results And Discussion


Fig. 5 Thingspeak results of IOT-Based Household equipment control system using LASER-LDR pair

## VI. Advantages And Applications

**Advantages:**

- The proposed system improves energy efficiency by making sure electrical appliances work only when needed, which helps reduce wasted power.
- It helps lower running costs by making the most efficient use of energy.
- The touchless control method makes it cleaner and lessens the need to touch switches physically.
- Using affordable and easy-to-get sensors makes the system cost-effective.
- The simple design makes it easy to install, use, and keep in working order.
- The system offers better convenience by allowing smart and automatic control of devices.

**Applications:**

- The system can be used well in homes for smart home automation.
- It works well in industrial settings, especially for gas leak detection and safety systems.
- The design helps people who are older by making it easier for them to use appliances with less effort.
- It offers better access for people with disabilities through simpler control options.
- The system is useful in hospitals to keep things clean by using touch-free operation.
- It can be used in offices and public places for better energy use.
- The solution can also be adapted for security and monitoring systems that need automatic responses.

## VII. Conclusion

This project introduces a design and setup for an interactive system that uses IoT technology to help manage household tasks and improve security. It combines automatic recognition with ongoing monitoring of the environment to create a home that can respond and adjust to changes. The system boosts safety by identifying environmental shifts and makes life easier by automatically controlling devices, which lessens the need for manual work. The design focuses on being simple, dependable, and affordable, making it ideal for everyday use. Switching from traditional manual methods to an automated system marks a big step forward in creating smarter, more energy-efficient living spaces. Overall, the solution helps increase comfort, use resources more effectively, and supports the creation of sustainable, user-friendly smart homes.

## VIII. Future Scope

Future improvements can make the system smarter and more flexible. Using machine learning methods would let the system understand what users like and guess when they will use things, leading to better energy use. This helps save unnecessary electricity and makes the experience more comfortable for users. Also, making the system part of a Level-5 or Level-6 IoT network would allow it to connect with many different devices. This ability to grow makes it work well in bigger places, like multi-story buildings and factories. Having a central controller in the cloud would make it easy to watch over and manage everything, leading to better teamwork, quicker reactions, and a more effective system overall.

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