SMART MOTION ACTIVATED APPLIANCE CONTROL SYSTEM

DESIGN THINKING REPORT

Submitted in partial fulfilment of the requirements for the award of

Bachelor of Engineering Degree in Electronics and Communication Engineering

by

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SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited with Grade "A++" by NAAC
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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **SOWMIYA.P(42130465), SRINIDHI.M.R(42130470), SUJITRA.R(42130480)** and who carried out the project entitled "**SMART MOTION ACTIVATED APPLIANCE CONTROL SYSTEM**" under our supervision from July 2023 to Oct 2023.

Mentor

Dr.S.JAYAPRAKASH, M.E., Ph.D.,

Head of the Department

Dr. T. RAVI, M.E., Ph.D.,

Submitted for Viva voce Examination held on_____

Internal Examiner **External Examiner**

DECLARATION

We **SOWMIYA.P(42130465), SRINIDHI.M.R(42130470)** and **SUJITRA.R (42130480)** hereby declare that the Project Report entitled "**SMART MOTION ACTIVATED APPLIANCE CONTROL SYSTEM**" is done by us under the guidance of **Dr.S.JAYAPRAKASH, M.E., Ph.D.,** is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in **Electronics and Communication Engineering.**

SIGNATURE OF THE CANDIDATES

DATE: 01.11.2023

1.

PLACE: Chennai

2.

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ABSTRACT

The Smart Motion-Activated Control System represents an innovative solution designed to enhance energy efficiency, convenience, and security in various environments. This system employs advanced sensor technologies and intelligent algorithms to detect human motion and subsequently trigger control actions in a variety of applications. The system incorporates motion sensor called passive infrared (PIR) to accurately detect human movement within its coverage area. By turning off or dimming lights, adjusting thermostat settings, or controlling other appliances when no motion is detected, the system contributes significantly to energy conservation, reducing utility costs and environmental impact. Users can customize and program the system to suit their specific needs and preferences, defining motion-triggered actions and response times. the Smart Motion-Activated Control System represents a versatile and adaptable solution that has the potential to transform the way we interact with our surroundings, promoting sustainability, comfort, and safety. Its applications span residential, commercial, industrial, and public spaces, offering benefits for both individuals and organizations alike.

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CHAPTER 1
INTRODUCTION

The Smart Motion-Activated Control System emerges as a cutting-edge innovation designed to address these challenges. This advanced technology leverages the power of motion sensors and intelligent control algorithms to create a seamless and responsive environment in various settings, from homes and offices to public spaces and industrial facilities.

Traditional control systems often rely on manual inputs or preset schedules, resulting in energy wastage, inconvenience, and sometimes even security vulnerabilities. The Smart Motion-Activated Control System seeks to revolutionize this paradigm by introducing a dynamic, motion-driven approach to automation and control.

At its core, this system employs a range of sophisticated motion sensors, including passive infrared (PIR), ultrasonic, and computer vision-based cameras, to accurately detect human movement within its designated areas. Once motion is detected, the system triggers a series of predefined actions, seamlessly integrating with lighting, HVAC, security, and other control systems. The result is a hands-free and intuitive interaction with our environment, where lights turn on when needed, heating or cooling adjusts based on occupancy, and security measures activate in response to potential threats.

CHAPTER 2
LITERATURE SURVEY

A literature survey on the Smart Motion-Activated Control System reveals a growing body of research and development in this field. Researchers and engineers are exploring various aspects of this technology, including its applications, benefits, challenges, and advancements. Here's an overview of key findings from the literature:

2.1 **Soyoung Hwang et al.,2012** proposed a remote monitoring and control system which is based on ZigBee network. Real time monitoring is implemented with JMF. It is multimedia extension API of java

2.2 **Richu Sam Alex et al.,2013** proposed a system which reduce the power consumption of the street light system about 30% compared to older design. This system is fully automated. It also uses Zigbee so that control station also analyses all the performance of the system

2.3 **Abidin et al.,2013** revealed that U.S. colleges—Boston University worked on the sustainability development of university campuses. They had adopted the installation of occupancy sensors as part of energy efficiency initiatives. Prior studies on power reduction via control systems can be summarized as follows.

2.4 **Daeho Kim et al.,2015** conducted studies on monitoring systems, design, performance improvements energy usage analysis and comparison, building operations and energy feedback based on IOT (Internet of Things) for reducing energy usage in universities.

2.5 **Abdullahi Arabo et al.,2015** formed parts of the research to analyse implications and challenges of cybersecurity to smart devices in smart connected homes. They presented some related background and motivation seen on the development and demand for seamless interconnectivity of smart devices to provide various functionality and abilities to users. The paper highlighted the fact that while these devices provide more features and functionality, they also introduce new risks. Subsequently, current cybersecurity issues related to smart devices within connected homes were discussed and analysed.

2.6 **M. Colotta et al.,2015** proposed a logic based mechanism that determine the sleeping time of field devices in a home automation environment based on BLE. The proposed FLC determines the sleeping time of field devices according to the battery level and to the ratio of Throughput to Workload (Th/Wl). Simulation results reveal that using the proposed approach the device lifetime is increased by 30% with respect to the use of fixed sleeping time.

2.7 **Martin Boldt et al.,2015** analysed the risks related to the use and potential misuse of information about homes, partners, and end-users, as well as, forming methods for integrating security-enhancing measures in the design is not straightforward and thus requires substantial investigation. A risk analysis was applied on a smart home automation system developed in a research project involving leading industrial persons was conducted.

2.8 **Won-Hwa-Hong et al.,2016** proposed an intelligent indoor lighting control system using daylight and detecting occupancy to reduce electrical energy use by up to 65.2%. In order to reduce they conducted an experiment where they attached a PIR sensor to a classroom's lighting fixtures and achieved a 10% reduction rate.

2.9 **Robert Sarfi et al.,2016** analysed all papers related to the topics of Smart Grids and Distribution. Because of the novelty of the concept, the results validated the expectation of an empirical approach in papers using case studies to simulate or conduct pilot runs of the technologies before their massive implementations. Strategies are mostly driven by the USA, while other countries focused on quality improvements of the already strategized initiatives with an efficiency-related goal in mind.

2.10 **Vaishnavi S. Gunge et al.,2016** proposed papers regarding Smart home automation that uses Wi-Fi technology. The application has been developed based on the android system. An interface card was developed to assure communication between the remote user, server, raspberry pi card and the home Appliances. The Bluetooth board had I/O ports and relays were used for interfacing with the devices which are to be controlled and monitor. The Bluetooth was password protected to ensure that the system was secure from intruders. The Bluetooth had a range of 10 to 100.

2.11 **Wen-Jye Shyr et al.,2018** founded that an energy management system via the Internet of Things provided significant energy savings by eliminating standby consumption by adapting the behaviour of appliances to real environmental conditions.

2.12 **Noor Zaman et al.,2018** considered smart home as an essential domain in Internet of Things (IoT) applications. It was an interconnected home where all types of things interact with each other via the Internet. It raised a great concern of the privacy and security for the users due to its capability to be controlled remotely. This research analysed smart home approaches, challenges and suggested possible solutions for them and illustrate open issues that was still needed to be addressed.

2.13 **Daeho Kim et al.,2019** worked on smart LED light system by using Infrared and Ultrasonic sensor. They proposed a model which continuously track human motion. Output was based on human tracking data which was obtained by these sensors were responsible for determining the On-Off control of the LED light.

2.14 **Jeong, Seo et al.,2020** proposed an energy-saving system that used an occupancy sensor with a PIR sensor (passive infrared sensor which detects movement of the human body in a certain section at an acute angle of 9 to 12 degrees through a Fresnel lens) and a smart plug capable of measuring current consumption, resulting in savings of about 34% of electrical energy by cutting off power to unnecessarily operated appliances.

2.15 **Yoon et al.,2020** published a study that derived and typified the influencing factors based on monthly energy consumption data for the energy management of university buildings in Seoul, Korea, concluding that energy management guidelines should be different for each building type.

CHAPTER 3
AIM AND SCOPE OF THE PROJECT

This project aims to create an innovative and efficient solution for managing household appliances by controlling motion detection technology. It helps to minimize energy consumption by controlling appliances based on occupancy, reducing utility costs and environmental impact. By using motion detection technology, these systems automatically regulate household appliances based on the presence or absence of occupants. Lights are switched off when rooms are vacant, thermostats adjust to comfort levels only when someone is present, and appliances operate in a manner that minimizes energy wastage. The ultimate goal here is to significantly reduce energy consumption, resulting in lower utility bills and a reduced environmental footprint.

The future scope of a Smart Motion-Activated Appliance Control System project is:

- Advanced Sensor Tech: Explore better sensors for accuracy.
- AI Integration: Use AI to adapt to user preferences.
- Voice/Gesture Control: Enhance user interaction.
- Cross-Platform Integration: Wider device compatibility.
- Security: Implement facial recognition and cybersecurity

CHAPTER 4
EXPERIMENTAL OR MATERIALS AND METHODS

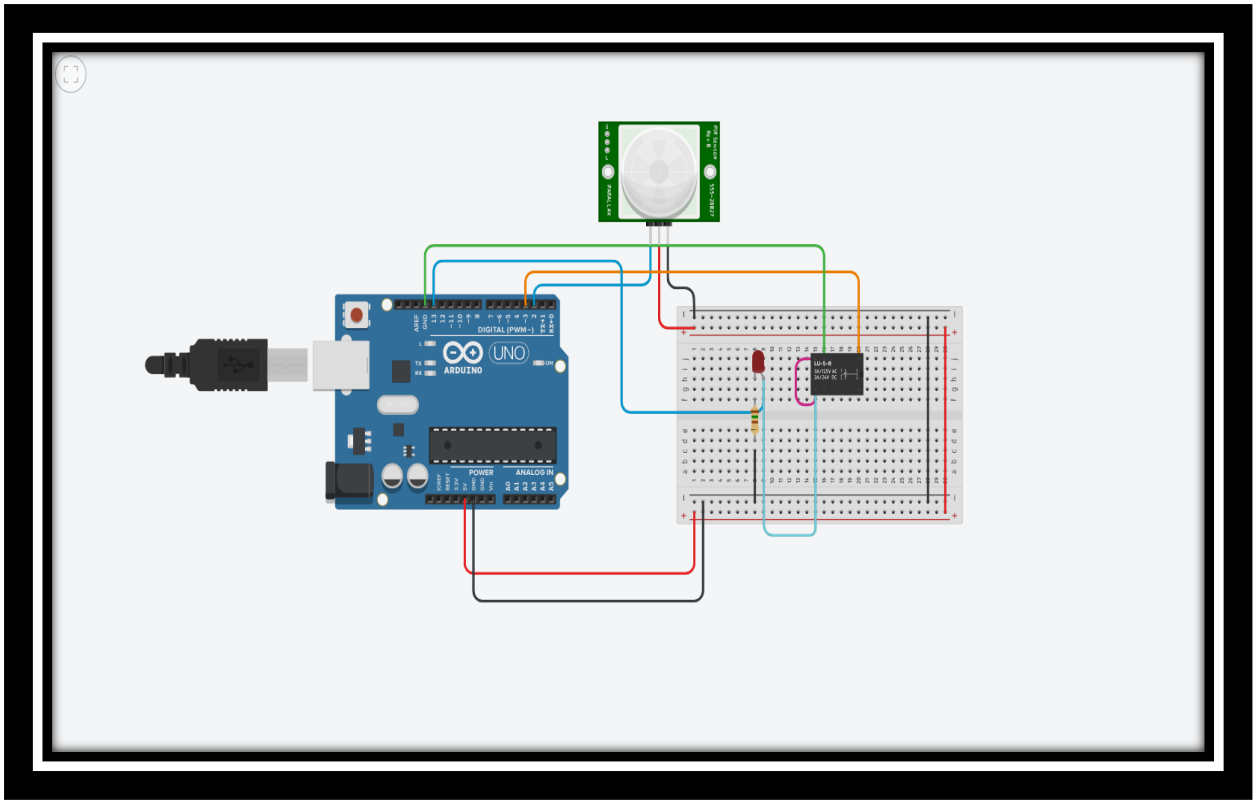
4.1 CIRCUIT DESIGN

- The PIR sensor detects motion within its range and sends a signal to the Arduino when motion is detected.
- The Arduino controls both the LED and the relay module.
- The LED is connected to a digital pin on the Arduino via a current-limiting resistor.
- The relay module is connected to a separate digital pin on the Arduino.
- When motion is detected, the Arduino turns on the LED and the relay, which can control external devices.
- When no motion is detected, the Arduino turns off the LED and the relay

4.2 CIRCUIT DESIGN TOOLS

4.2.1 ARDUINO IDE

The Arduino Integrated Development Environment (IDE) is a software platform designed for programming and developing applications for Arduino microcontroller boards. It provides a user-friendly interface that simplifies coding for both beginners and experienced developers. The IDE is based on the C and C++ programming languages and offers a vast library.



4.3 COMPONENTS REQUIRED

4.3.1 HARDWARE

- Arduino Uno (or any compatible microcontroller)
- PIR Motion Sensor
- LED or Light bulb
- Relay module
- Resistor
- Breadboard
- Jumper wires
- External power supply (for the virtual simulation)

4.3.2 SOFTWARE

- Arduino IDE
- Tinkercad

4.3.3 ARDUINO UNO

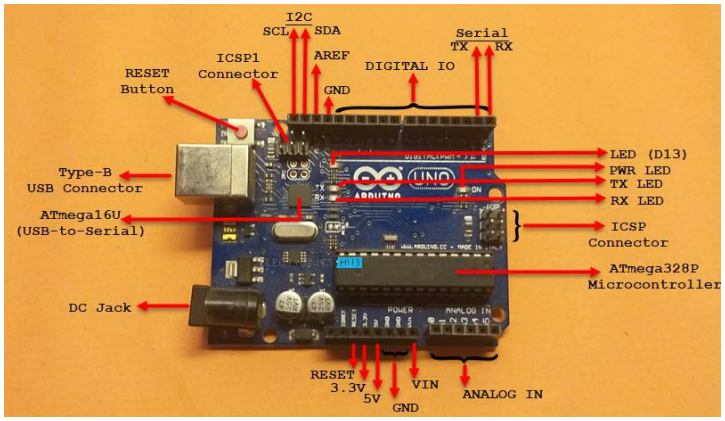


Fig 4.1

The Arduino Uno is a versatile microcontroller board with 14 digital I/O pins, 6 analog input pins, USB connectivity, and a user-friendly programming environment. The Arduino Uno has a total of 14 digital input/output (I/O) pins, of which 6 can be used as pulse-width modulation (PWM) outputs. Additionally, it has 6 analog input pins for reading analog signals from sensors.

4.3.4 PIR SENSOR

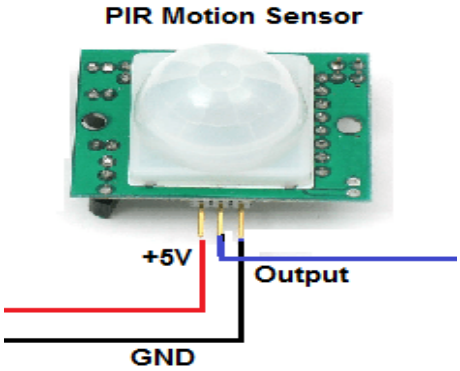


Fig 4.2

A PIR (Passive Infrared) motion sensor is a compact electronic device that detects changes in infrared radiation emitted by objects in its field of view. Commonly used in security systems and lighting control, it triggers an action (such as turning on lights or activating an alarm) when it senses motion, making it a key component in automated and energy-efficient applications.

4.3.5 RELAY MODULE

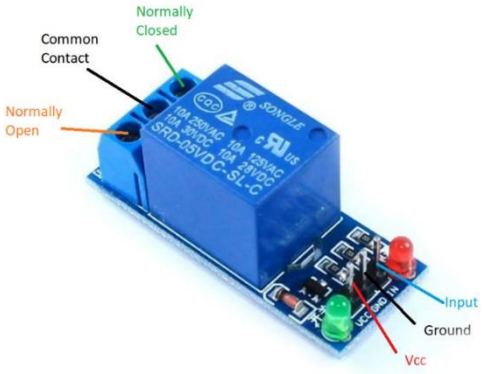


Fig 4.3

A relay module is like a remote-controlled switch. It lets you use a low-power signal from the Arduino to control high-power devices like lights, motors, or appliances. It has input pins to connect to the Arduino, a relay that physically opens or closes the switch, and terminals for high-power devices.

4.3.6 LED (LIGHT EMITTING DIODE)

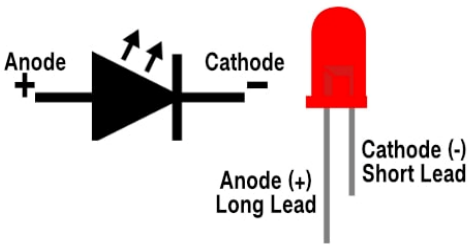


Fig 4.4

LEDs are small, energy-efficient lights used in projects for indicators, lighting, and visual effects. They offer low power consumption, long life, and easy digital control with microcontrollers like Arduino. Ensure correct polarity and use current-limiting resistors for safe operation.

4.3.7 RESISTOR

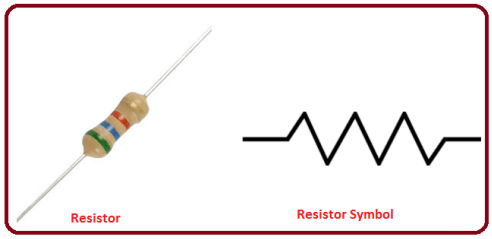


Fig 4.5

It's crucial for controlling current flow, protecting components, and setting bias points. Resistors, with defined values, are key in LED circuits, sensor interfaces, and preventing damage.

4.3.8 BREADBOARD

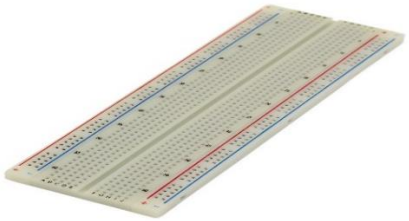


Fig 4.6

A reusable, solderless prototyping board with a grid of holes. It enables easy and temporary connections for experimenting with electronic circuits, making it a fundamental tool for Arduino projects.

4.3.9 JUMPER WIRES

Fig 4.7

Short, flexible connectors for easy circuit connections. Essential for quick prototyping without soldering. Jumper wires are an essential tool for prototyping and experimenting with electronics, allowing for easy and flexible connections between components.

4.3.10 ARDUINO IDE

Fig 4.8

The Arduino Integrated Development Environment (IDE) is a software platform designed for programming and developing applications for Arduino microcontroller boards. It provides a user-friendly interface that simplifies coding for both beginners and experienced developers. The IDE is based on the C and C++ programming languages and offers a vast library

4.3.11 TINKERCAD

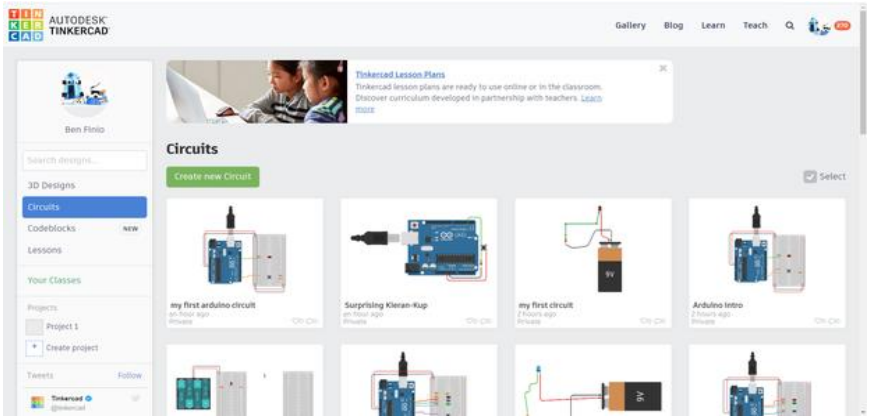


Fig 4.9

Tinkercad is an online platform for 3D design, electronics, and coding, primarily used for educational purposes and prototyping. It offers an intuitive, user-friendly interface that allows users to create 3D models, its circuit simulation capabilities allow for the creation and testing of electronic circuits without physical components.

4.4 METHOD DESCRIPTION

- Motion Sensor (PIR): The system starts with a Passive Infrared (PIR) motion sensor that detects changes in infrared radiation caused by the movement of objects or people in a particular range.
- Signal Processing Unit (Microcontroller): The sensor's output is sent to an Arduino which processes the sensor data. It can also control the sensor's settings and interface with other components.
- Decision Logic: Arduino contains decision logic that interprets the sensor data to determine whether motion is detected. It may involve algorithms and threshold values to distinguish between motion and background noise.
- Output: If motion is detected, the led is turned ON and it is delayed with the help of time relay module for a specific time until there is no object detected by the sensor. In that case the led is turned OFF when there is no object detected and hence electricity consumption is saved.

BLOCK DIAGRAM

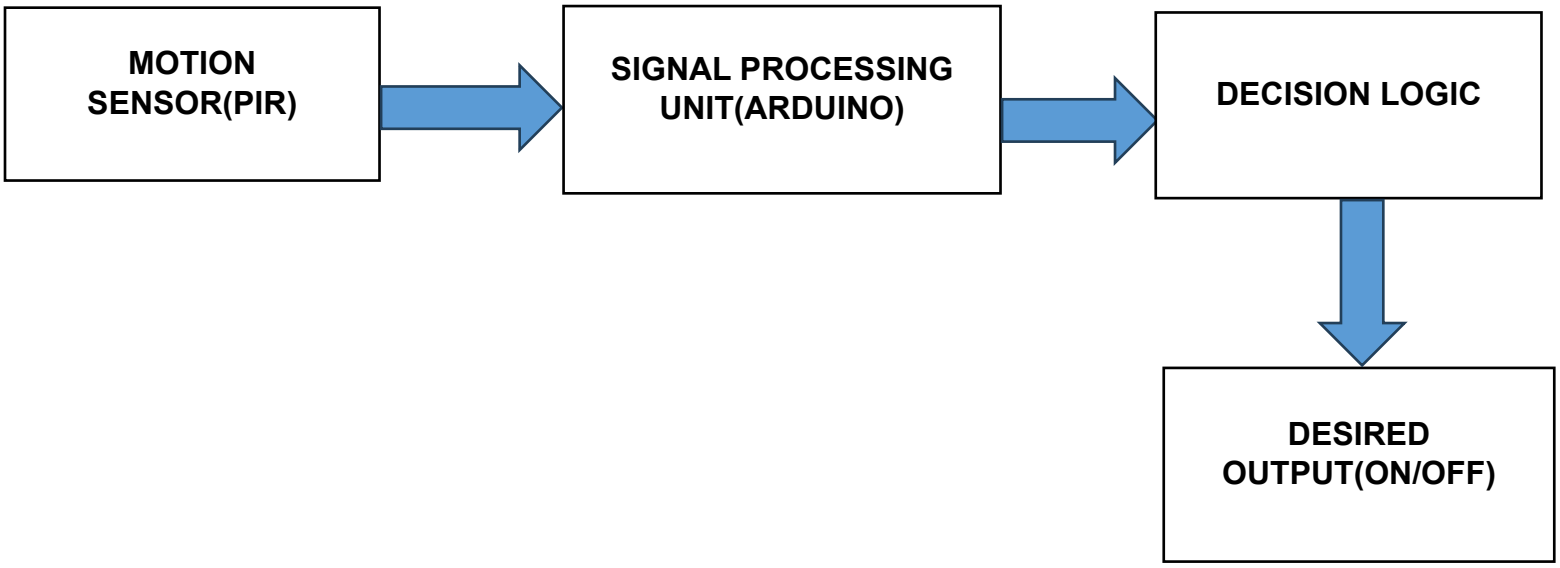
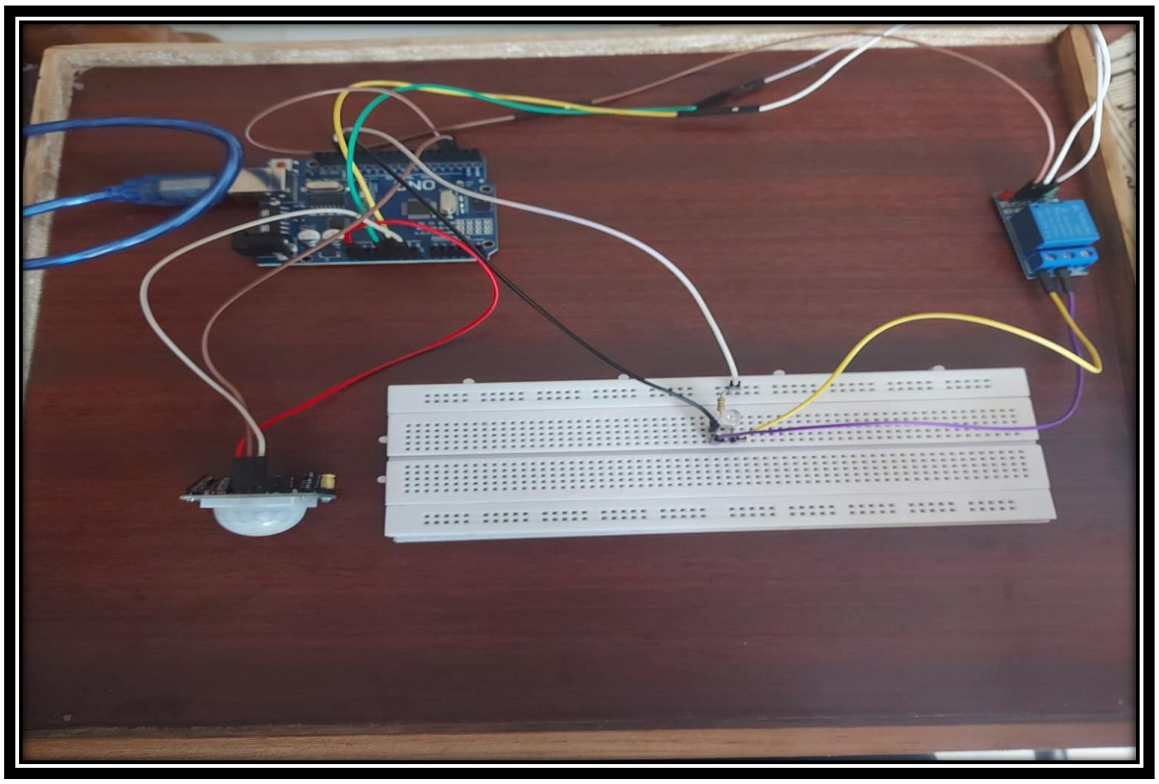
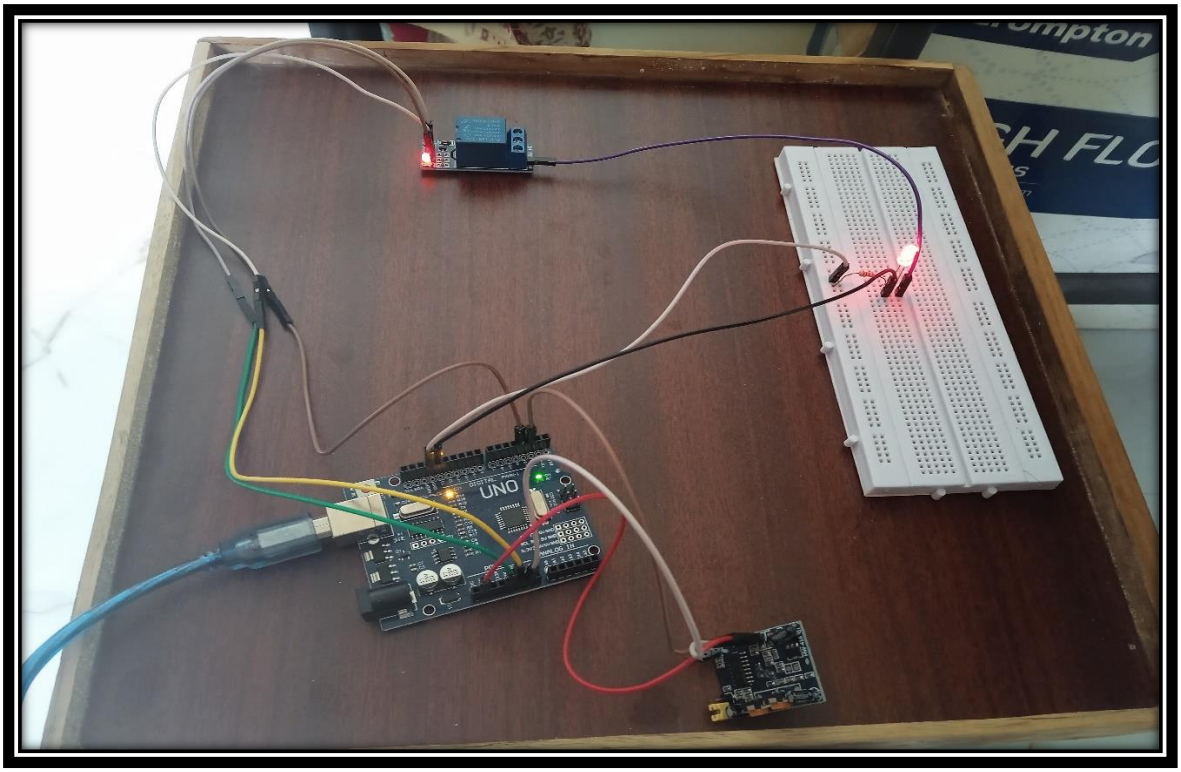


Fig 4.10

4.5 HARDWARE DEMONSTRATION





CHAPTER 5
RESULTS

Many appliances, such as lights, fans, and heaters, are often left on when not in use, resulting in unnecessary energy consumption. It can detect when a room is occupied and activate these appliances, but they can also turn them off when no motion is detected for a specified period. This reduces energy wastage and lowers utility bills. Motion-activated systems enhance convenience by automating everyday tasks. You don't have to manually turn on or off lights, fans, or other appliances when entering or leaving a room.

CHAPTER 6
CONCLUSIONS

The Smart Motion-Activated Appliance Control System project has demonstrated significant success in improving energy efficiency, enhancing user convenience, and promoting cost savings. Its customization, security features, and sustainability impact contribute to a more seamless and sustainable way of living. The project's future readiness and compliance ensure its continued relevance and adherence to evolving standards and user needs.

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