M.KUMARASAMY
COLLEGE OF ENGINEERING
NAAC Accredited Autonomous Institution
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ISO 9001:2015 Certified Institution
Thalavapalayam, Karur – 639 113.

A Minor Project Report on

AUTOMATIC CONTROL OF ELECTRICAL APPLIANCE USING PIR SENSOR

Submitted by

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M.KUMARASAMY COLLEGE OF ENGINEERING

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THALAVAPALAYAM, KARUR-639113.

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M.KUMARASAMY COLLEGE Of ENGINEERING

(Autonomous Institution, Affiliated to Anna University, Chennai)

BONAFIDE CERTIFICATE

Certified that this Report titled **"AUTOMATIC CONTROL OF ELECTRICAL APPLIANCES USING PIR SENSOR"** is the bonafide work of **PRATHEEPA R (927622BEE082), SANTHOSH S(927622BEE098), SREE RAKSHA K A (927622BEE0113)** who carried out the work during the academic year (2023-2024) under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other project report.

SIGNATURE OF THE SUPERVISOR

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Assistant Professor
Department of Electrical and Electronics Engineering
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SIGNATURE OF THE HEAD OF THE DEPARTMENT

Dr.J.Uma M.E., Ph.D.,
Professor & Head
Department of Electrical and Electronics Engineering
M.Kumarasamy College of Engineering, Karur.

Submitted for Minor Project II (18EEP202L) viva-voce Examination held at M. Kumarasamy College of Engineering, Karur-639113 on ……...

DECLARATION

We affirm that the Minor Project report titled "**AUTOMATIC CONTROL OF ELECTRICAL APPLIANCES USING PIR SENSOR"** being submitted in partial fulfillment for the award of **Bachelor of Engineering in Electrical and Electronics Engineering** is the original work carried out by us.

REG.NO	STUDENT NAME	SIGNATURE
927622BEE082	**PRATHEEPA R**	**----------**
927622BEE098	**SANTHOSH S**	**----------**
927622BEE113	**SREE RAKSHA K A**	**----------**

VISION AND MISSION OF THE INSTITUTION

VISION

- ✓ To emerge as a leader among the top institutions in the field of technical education

MISSION

- ✓ Produce smart technocrats with empirical knowledge who can surmount the global Challenges.
- ✓ Create a diverse, fully-engaged, learner - centric campus environment toprovide Quality education to the students.
- ✓ Maintain mutually beneficial partnerships with our alumni, industry and Professional associations.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To produce smart and dynamic professionals with profound theoretical and practical knowledge comparable with the best in the field.

MISSION

- ✓ Produce hi-tech professionals in the field of Electrical and Electronics Engineering by inculcating core knowledge.
- ✓ Produce highly competent professionals with thrust on research.
- ✓ Provide personalized training to the students for enriching their skills.

PROGRAMME EDUCATIONAL OBJECTIVES(PEOs)

- ✓ **PEO1:** Graduates will have flourishing career in the core areas of Electrical Engineering and also allied disciplines.
- ✓ **PEO2:** Graduates will pursue higher studies and succeed in academic/research careers
- ✓ **PEO3:** Graduates will be a successful entrepreneur in creating jobs related to Electrical and Electronics Engineering /allied disciplines.
- ✓ **PEO4:** Graduates will practice ethics and have habit of continuous learning for their success in the chosen career.

PROGRAMME OUTCOMES(POs)

After the successful completion of the B.E. Electrical and Electronics Engineering degree program, the students will be able to:

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/Development of solutions:

Design solutions for Complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety,and the cultural, societal and environmental considerations.

PO4: Conduct Investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply reasoning in formed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

`

PO9: Individual and Team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES(PSOs)

The following are the Program Specific Outcomes of Engineering Students:

- **PSO1:** Apply the basic concepts of mathematics and science to analyse and design circuits, controls, Electrical machines and drives to solve complex problems.
- **PSO2:** Apply relevant models, resources and emerging tools and techniques to provide solutions to power and energy related issues & challenges.
- **PSO3:** Design, Develop and implement methods and concepts to facilitate solutions for electrical and electronics engineering related real world problems.

Abstract (Key Words)	Mapping of POs and PSOs
PIR (Passive InfraRed) sensor, microcontroller unit (MCU), automated control system for electrical appliances, energy efficiency and user convenience	P01, PO2, PO3, PO4, POS, PO6, PO7, PO8, PO9, PO10, PO11, PO12, PSO1, PSO2, PSO3.

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We would like to express my deep gratitude to our Minor Project Guide **Mr.V.Jaya Kumar M.E., Assistant Professor, Department of Electrical and Electronics Engineering,** for his constant encouragement, kind co-operation, valuable suggestions and support rendered in making our project a success.

We offer our wholehearted thanks to our Minor project coordinator **Dr.B.Rajesh Kumar M.E., Ph.D., Assistant Professor, Department of Electrical and Electronics Engineering,** for his constant encouragement, kind co-operation and valuable suggestions for making our project a success.

We are glad to thank all the **Faculty Members** of **Department of Electrical and Electronics Engineering** for extending a warm helping hand and valuable suggestions throughout the project.

Words are boundless to thank **Our Parents and Friends** for their constant encouragement to complete this Minor project successful.

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ABSTRACT

The project focuses on implementing an automated control system for electrical appliances through the integration of Passive Infrared (PIR) sensors. The primary objective is to enhance energy efficiency and user convenience by employing motion detection technology. The PIR sensors detect human presence and trigger the corresponding control of connected electrical appliances. The system is designed to interface with various household devices such as lights, fans, and other electronic equipment. This dynamic functionality not only curtails unnecessary energy usage but also simplifies daily tasks for users. The project incorporates microcontroller technology to process sensor input and execute control commands. Additionally, a user-friendly interface allows for customization of settings, ensuring adaptability to different environments and user preferences. The integration of PIR sensors in this automatic control system represents a significant step towards creating smart and energy-efficient homes, contributing to sustainability efforts. The primary goal is to enhance energy efficiency and user convenience by detecting human presence through PIR sensors and subsequently activating or deactivating electrical appliances accordingly. The system comprises PIR sensors strategically placed in key locations, a microcontroller unit to process sensor data, and relay modules for controlling electrical devices. An Arduino-based MCU is utilized to interface with PIR sensors, process data, and control the appliances. The MCU acts as the brain of the system, executing predefined logic. the project aims to demonstrate the feasibility and practicality of employing PIR sensors in creating smart and energy-efficient environments for various applications. The project aims to demonstrate the feasibility of employing PIR sensors in creating smart and energy-efficient environments for various applications. This abstract provides a glimpse into the project's objectives, methodologies, and expected outcomes within the specified scope.

LIST OF FIGURES

LIST OF TABLES

Department of Electrical and Electronics Engineering
18EEP202L – Minor Project II
Problem Identification – Survey Form

1. **Name and Address of the community:**

   Mrs.Thunga

   Periya Andankoil,

   Karur- 639008.

2. **Age Group:**

   More than 50 Years

3. **Discussion:**

   a) **What?** *(Define the Problem)*
   Difficulty and inconvenience in operating the electrical appliances.

   b) **Why?** *(Reason for the Problem occurrence)*
   Unable to operate due to visual impairment and memory loss because of ageing in elderly peoples and physically challenged people.

   c) **When?** *(When the problem began or first noticed)*
   For elderly people the problem was first noticed during the phase of their ageing**.**

   d) **Where?** *(Place of the problem's first occurrence or sighting)*
   The problem was first noticed in the place where a person needs to operate an electrical appliance despite of their inability to do it.

   e) **Who?** *(The person or thing that the problem affects)*
   The problem affects physically challenged and elderly people.

   f) **How?** *(The sequence of events that resulted in the problem)*
   The need of manual interaction to operate an appliance resulted in this problem.

Signature of the Respondent

g) **Which?** *(People have attempted to solve the issue)*
The problem is well known but doesn't have any proper solution, hence many people had attempted to solve it.

h) Does the problem appear to have only one possible solution?
Yes, the problem appears to have a good solution.

4) Work Plan of the project

To analyze the problem properly
Identification various methods to solve the problem.
Evaluate the possible method to solve.
To design a prototype/system.
To estimate the budget.

5) Final Solution

The problem can be solved using a sensing operation of the human (PIR sensor) and operating the electrical appliance based on the presence of the human by building a system with the operation of the electrical appliances.

Signature of the Surveyor

CHAPTER 1
SURVEY FORM ANALYSIS

1.1 NAME AND ADDRESS OF THE COMMUNITY:

Mrs.Thunga

Periya Andankoil,

Karur- 639007.

1.2 PROBLEM IDENTIFICATION:

The inability to operate electrical appliances is a multifaceted problem rooted in design, accessibility, inconvenience, inability and technological disparities. Addressing these challenges requires a holistic approach that considers user experience, standardization, accessibility features, and comprehensive user education to ensure safe and efficient operation of electrical appliances for individuals of diverse backgrounds and abilities. In modern society, there is poor energy optimization and the difficulty in operating electrical appliances by the physically challenged and the senior citizens. The problem has been examined and it has determined that a system that operates electrical equipment without human interaction is necessary in residential and business places. Traditional methods of controlling electrical appliances lack the adaptability and responsiveness needed for modern energy-efficient living. Often, users forget to turn off lights or appliances, leading to unnecessary energy consumption. This project addresses the challenge of energy wastage and inconvenience by leveraging the capabilities of PIR sensors. The identified problem revolves around the need for an intelligent system that can automatically control electrical appliances based on human presence. The absence of such a system result in inefficient energy usage and compromises user comfort. By integrating PIR sensors into the control mechanism, this project seeks to mitigate these issues.

CHAPTER 2

LITERATURE REVIEW

Paper 1: Smart Home Automation Systems

Inference: This review article provides a thorough examination of smart home automation technologies. It covers the evolution of home automation, communication protocols, and integration of sensors and actuators.

Paper 2: IoT-Based Energy Management Systems for Residential Applications

Inference: Focusing on the Internet of Things (IoT), this study explores energy-efficient solutions for residential spaces. It discusses the integration of sensors and advanced algorithms to automate and optimize the usage of electrical appliances in homes.

Paper 3: Machine Learning Approaches for Predictive Appliance Control

Inference: This research delves into the application of machine learning for predictive appliance control. By analyzing historical usage patterns to develop models that anticipate user behavior and automate the of electrical appliances.

Paper 4: Wireless Sensor Networks in Home Automation

Inference: Examining the role of wireless sensor networks (WSNs) in home automation, this review highlights the importance of communication infrastructure. It discusses how WSNs enable real-time data exchange, facilitating automatic control.

Paper 5: Security and Privacy Challenges in Smart Homes: An Overview

Inference: As smart homes become more prevalent, this study reviews the potential security and privacy challenges associated with automatic control systems. Understanding these concerns is crucial for the development of robust protocols to protect user data and maintain the integrity of appliance control system.

CHAPTER 3
PROPOSED METHODOLOGY

3.1 BLOCK DIAGRAM

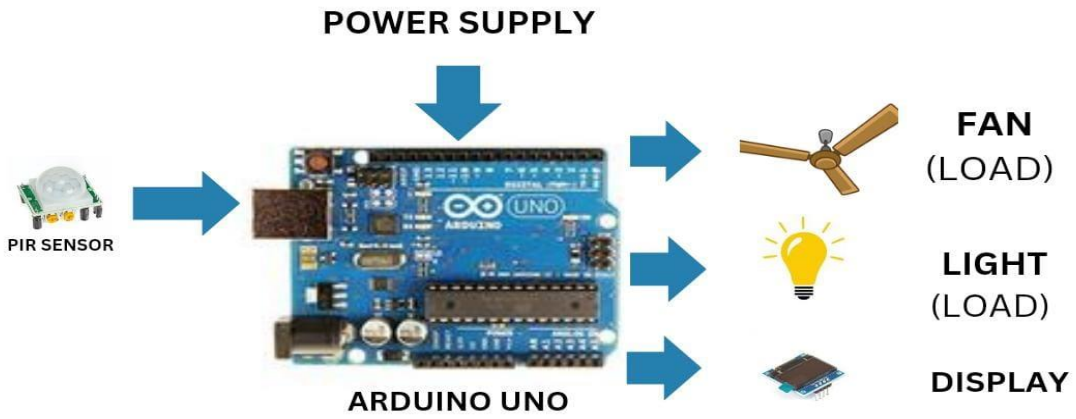

Figure.No.3.1.1 Block diagram of automatic control of electrical appliances using PIR sensor

3.2 BLOCK DIAGRAM DESCRIPTION

The project is designed to enhance convenience, energy efficiency, and user experience by creating a system that automates the control of various electrical appliances within household or commercial setting. The project uses PIR (Passive InfraRed) sensor as sensing element to detect the movement of the human and based on that the electrical appliances operated (ON/OFF).

3.3 COST ESTIMATION

Table No.3.3.1 Cost of estimation

S.NO	NAME OF THE COMPONENT	SPECIFICATION	QUANTITY	RATE/EACH	APPROXIMATE COST
1	PIR Sensor	HC-SR501	2	Rs.400	Rs.800
2	Arduino UNO	R3 ATmega328p	1	Rs.500	Rs.500
3	Display	1.3 Inch OLED	1	Rs.400	Rs.400
4	Miscellaneous				Rs.600
				TOTAL	Rs.2300

3.4 PIR SENSOR

The passive infrared (PIR) sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can see out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected.

Figure.No.3.4.1 PIR Sensor

3.4.1 PIR SENSITIVE CRYSTAL:

The dark portion of the metal where the IR sensitive crystal is housed, the sensitive crystal can detect the level of infrared in the surroundings. It actually houses two pyroelectric sensors for detecting moving objects. If one of the sensitive crystals detects change in infrared (increment or decrement) than the other sensitive crystal, the output gets triggered. A dome shaped plastic structure is normally placed over this sensitive crystal which acts as lens to focus the infrared light on the sensors.

3.4.2 PIR SENSOR FEATURES:

PIR sensors have Wide range on input voltage varying from 4V to 12Vand output voltage is High/Low (3.3V TTL). It can distinguish between object movement and human movement with two operating modes - Repeatable(H) and Non-Repeatable(L). It Covers distance of about 120° and 7 meters. Low power consumption of 65mA. Operating temperature from -20° to +80° Celsius.

3.4.3 TRIGGER MODES:

The PIR module has two trigger modes: Single trigger / non-repeat mode and repeat trigger. These two modes can be access by changing the jumper position given in the module.

Single Trigger Mode / Non-repeat Mode: When the PIR sensor is set in single trigger mode (and the timer knob / delay time is set for 5 seconds (say)), when a human is detected, the output turns HIGH for 5 seconds and turns LOW.

Repeat Trigger Mode: When the PIR sensor is set in repeat trigger mode, when a human is detected, the output turns HIGH the timer counts for 5 seconds, but when another human is detected with in those 5 seconds the timer reset to zero and counts another 5 seconds after 2nd human is detected.

BLOCK TIME: The block time is the time interval where the sensor is disabled or will not detect motion. The block time for HC-SR501 is 3 seconds by default. This occurs after the delay time (which was set by timer knob) the output goes LOW for 3 seconds; during this interval no motion will be detected. After the 3 seconds (LOW) the sensor will be ready to detect motion again.

3.5 ARDUINO UNO:

The microcontroller used here is Arduino UNO R3. The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller (MCU). The microcontroller board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment).

In Arduino UNO R3 the Operating voltage of 5V DC Input voltage of 7-12V (recommended). Maximum current per pin of 40 mA. Low power consumption of 20 mA. Quartz crystal oscillator with a clock speed of 16 MHz It has In-circuit serial programming (ICSP) header for debugging and programming and Wide operating temperature range of -40 to 85 °C. On-board LED to indicate power and data transfer activity. It has Reset button to reset the microcontroller. The Arduino UNO has Power jack for accepting a barrel-type power plug.

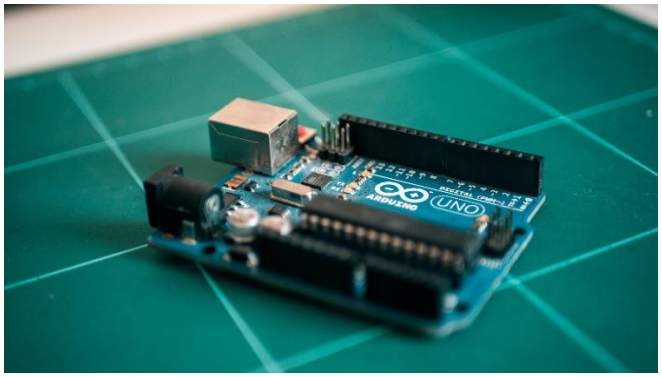

Figure.No.3.5.1 Arduino UNO R3

CHAPTER 4

HARDWARE IMPLEMENTATION

4.1 IMPLEMENTATION PICTURES:

Figure.no.4.1.1 Implementation picture1

Figure.no.4.1.2 Implementation picture 2

4.2 IMPLEMENTATION VIDEO LINK:

https://drive.google.com/file/d/1ZD34TJAxN41QZdcyX8D4l2Qr4Br5p7vy/view?usp=drivesdk

4.3 POST IMPLEMENTATION OBSERVATIONS:

4.3.1 IMPACT ASSESMENT:

- **Energy Efficiency**: Measured the reduction in energy consumption achieved by automatically controlling appliances based on occupancy detected by PIR sensors.

- **User Convenience**: Assessed the convenience and user satisfaction with the automated control system compared to manual operation.

4.3.2 CHALLENGES AND SOLUTIONS:

- **Sensor Placement**: Addressed challenges related to optimal placement of PIR sensors to ensure accurate detection without false positives or negatives.
- **Integration Issues**: Discussed any difficulties encountered in integrating the sensor-based control system with existing appliances or home automation systems and the solutions implemented.
- **Technical Limitations**: Addressed the technical limitations of PIR sensors, such as limited detection range or sensitivity to environmental factors like temperature changes, and propose mitigation strategies.

4.3.3 RESULTINGS AND FINDINGS:

- **Energy Savings**: Present data on energy savings achieved through automated control of appliances using PIR sensors, including percentage reductions in energy consumption.
- **User Satisfaction**: Summarized the feedback from users regarding the convenience, reliability, and effectiveness of the automated control system.

4.3.4 POST IMPLEMENTATION SURVEY FORM:

1. **Name and Address of the community:**

   Mr. Sanjai

   Velusamypuram

   Karur- 639008.

2. **Age Group:**

   More than 18 Years

3. **Discussion:**

   a. **What?** *(Define the Problem)*
   The inconvenience and difficulty in operating the electrical appliances to turn off after every use result in high rise electricity tariff.

   b. **Why?** *(Reason for the Problem occurrence)*
   Unable to have an energy optimization in usage of appliances due to memory loss of peoples to turn off the appliances after it's use.

   c. **When?** *(When the problem began or first noticed)*
   The problem was first noticed after the appliances kept ON without actively utilizing the energy.

   d. **Where?** *(Place of the problem's first occurrence or sighting)*
   The problem was first noticed in the place where a person needs to operate an electrical appliance in an efficient way.

   e. **Who?** *(The person or thing that the problem affects)*
   The problem affects physically challenged, elderly people and every electricity consumer

   f. **How?** *(The sequence of events that resulted in the problem)*
   The need of manual interaction to operate an appliance resulted in this problem.

Signature of the Respondent

g. **Which?** *(People have attempted to solve the issue)*

The problem is well known but doesn't have any proper solution, hence many people had attempted to solve it.

h. **Does the problem appear to have only one possible solution?**

Yes, the problem appears to have a good solution.

6) Work Plan of the project

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Signature of the Surveyor

CHAPTER 5

FUTURE SCOPE & ITS IMPLEMENTATION PLAN

5.1. IMPLEMENTATION PLAN:

5.1.1. PROJECT OVERVIEW:

- Define project goals, objectives, and scope.
- Identify target electrical appliances for automatic control.

5.1.2. REQUIREMENT ANALYSIS:

- Conduct a detailed analysis of user requirements and expectations.
- Identify the specific types of electrical appliances to be controlled.
- Define the acceptable range of detection for the PIR sensors.

5.1.3. SYSTEM ARCHITECTURE DESIGN:

- Develop a system architecture that includes PIR sensors, microcontrollers, and communication modules.
- Design a user interface for manual control and configuration if needed.
- Establish protocols for communication between sensors, the control unit, and the appliances.

5.1.4. PROTOTYPE DEVELOPMENT:

- Develop a prototype system with a minimal set of appliances for testing.
- Integrate PIR sensors with the chosen microcontroller and communication modules.
- Implement basic control functions to test the accuracy and responsiveness of the system.

5.1.5. USER INTERFACE DEVELOPMENT:

- Design and implement a user-friendly interface for manual control and configuration.
- Ensure compatibility with mobile devices, if applicable.
- Implement user recognition and personalization features.

5.1.6. TESTING AND OPTIMIZATION:

- Conduct comprehensive testing to identify and address false triggers and response time issues.
- Optimize PIR sensor configurations and system algorithms.
- Evaluate the system's performance in different environmental conditions.

5.2. FUTURE SCOPE:

The future scope of the project is in exploring the integration of additional sensors, such as temperature or light sensors, could enable a more comprehensive and context-aware automation system. Research into energy-efficient communication protocols and edge computing solutions may contribute to reducing latency and enhancing the overall responsiveness of the system. Additionally, expanding the project's scope to include a centralized control platform accessible through mobile applications or web interfaces would offer users greater flexibility and control over their connected appliances remotely.

REFERENCES:

BOOKS:

1. Arduino Project Handbook: 25 Practical Projects to Get You Started" by Mark Geddes.

2."Practical Electronics for Inventors" by Paul Scherz and Simon Monk.

3."Home Automation for Dummies" by Dwight Spivey.

4. "Internet of Things: Principles and Paradigms" by Rajkumar Buyan, Amir Vahid

WEBPAGES:

- Arduino PIR Sensor Tutorial" by Adafruit: https://learn.adafruit.com/pir-passive-infrared-proximity-motion-sensor/overview
- "Motion Detection using PIR Sensor and Arduino" by Electronics Hub: https://www.electronicshub.org/motion-detection-using-pir-sensor-arduino/"
- "Motion Detection using PIR Sensor and Arduino" by Electronics Hub: https://www.electronicshub.org/motion-detection-using-pir-sensor-arduino/
- "PIR Motion Sensor with Arduino Tutorial" by How to Mechatronics: https://www.youtube.com/watch?v=6e3fP_5LtYI

RESEARCH PAPERS:

Title**:** “Energy saving system using a PIR sensor for classroom monitoring”

LINK:https://www.researchgate.net/publication/318737592_Energy_saving_system_using_a_PIR_sensor_for_classroom_monitoring\