Adhiyamaan College of Engineering
(An Autonomous Institution, Affiliated to Anna University, Chennai)
Department of Electronics and Communication Engineering

CDIO Approach (Conceive, Design, Implement, Operate)

PROJECT REPORT

Student Name	: VIDYADHEESHA M PANDURANGI	
Reg. No.	: 6176AC22UEC162	
Semester	: V	
Name of the Program	: B.E. Electronics and Communication Engineering	
Class & Section	: B.E. ECE - C	
Course Code & Course Title	: 522ECH41 / IoT Processors	
Report for the period	From: 15 – 07 - 2024	To: 04 – 11- 2024

Specifics of Pre- and Post-Completed Work

1. General routine activities performed :

Week 1: Project Planning and Objective Setting

- Defined the project objective: creating a basic motion-detection security system using a PIR sensor.
- Identified necessary components: Arduino Uno, PIR sensor, LED, and buzzer.
- Established a timeline and weekly goals for project progress.

Week 2: Component Procurement and Research

- Researched component specifications and compatibility with Arduino.
- Procured components from online sources and local vendors.
- I studied Arduino and PIR sensor documentation to understand functionality.

Week 3: Circuit Design and Initial Setup

- Designed the circuit layout using a breadboard to connect the PIR sensor, LED, and buzzer with Arduino.
- Created a wiring plan to ensure clear and efficient connections.
- Discussed initial power requirements and voltage compatibility for each component.

Week 4: Coding in Arduino IDE

- Wrote the basic Arduino code in C to initialize the PIR sensor, LED, and buzzer.
- Programmed LED and buzzer activation upon motion detection by the sensor.
- Debugged initial coding errors and refined basic program logic.

Week 5: Tinker Cad Simulation

- Set up the circuit and code in Tinker Cad to simulate the design virtually.
- Tested sensor responses to motion and adjusted code based on simulation results.
- Identified and fixed minor code issues related to timing and sensor sensitivity.

Week 6: Component Testing and Calibration

- Physically connected components on a breadboard and tested each individually.
- Calibrated the PIR sensor to ensure optimal range and sensitivity.
- Verified LED and buzzer responses based on different distances and speeds of movement.

Week 7: Integration and Serial Monitoring

- Integrated all components on the breadboard with the Arduino and final code.
- Implemented serial monitoring to display alerts in the Arduino IDE.
- Analyzed sensor performance to confirm consistent alert notifications in the serial monitor.

Week 8: Troubleshooting and Refinement

- Identified issues, such as false triggers from environmental factors like lighting or temperature.
- Adjusted sensor placement and code sensitivity to improve accuracy.
- Updated the code for optimized response timing and to reduce false alerts.

Week 9: Power Supply Optimization

- Explored power-saving options to reduce power consumption when inactive.
- Implemented a low-power mode for the Arduino when no motion is detected.
- Discussed battery vs. USB power options for efficient system operation.

Week 10: System Testing and Validation

- Conducted several tests to ensure consistent and reliable system responses.
- Documented test results, highlighting successful motion detection and alert notifications.
- Analyzed any remaining inaccuracies and prepared final adjustments.

Week 11: Final Adjustments and Documentation

- Made final tweaks to code and hardware based on test feedback.
- Began drafting the project report, covering methodology, testing, and results.
- Discussed the addition of potential improvements, such as multiple sensors for wider coverage.

Week 12: Project Report Completion and Presentation

- Finalized the project report with sections on objectives, methodology, and findings.
- Included diagrams, code snippets, and a detailed summary of system performance.
- Prepared a presentation of the project and reviewed documentation for clarity and completeness.

2. Technology / Skill areas identified:

- Arduino Programming in C:
- Sensor Integration:
- Circuit Design and Breadboard Wiring:
- Tinker Cad Simulation:
- Embedded Systems

3. Project / technical area title: **Security System using PIR Sensor / IoT & Embedded Systems**

4. Details of Discussions held:

August 2, 2024: The project objectives were finalized, including creating a basic motion-detection security system. Components such as the Arduino Uno, PIR sensor, LED, and buzzer were identified as essential elements.

August 9, 2024: Research was conducted on component specifications and their compatibility with Arduino. Discussions included procurement strategies and studying PIR sensor functionality for optimal integration.

August 16, 2024: Circuit layout was designed on a breadboard, and a wiring plan was formulated to ensure efficient connections. Initial power requirements and voltage compatibility for all components were reviewed.

August 23, 2024: The team discussed writing basic Arduino code in C for initializing the PIR sensor and other components. Early debugging steps and refining logic for motion detection were emphasized.

August 30, 2024: A simulation of the circuit was tested using Tinker Cad. Discussions revolved around fixing code issues identified during virtual testing, such as timing and sensor sensitivity adjustments.

September 6, 2024: Physical testing of components on the breadboard was performed. Discussions focused on calibrating the PIR sensor for optimal range and ensuring proper functionality of LED and buzzer responses.

September 13, 2024: The integration of all components was completed, with serial monitoring implemented to display alerts in the Arduino IDE. Sensor performance was analyzed to ensure reliable notifications.

September 20, 2024: Issues such as false triggers caused by environmental factors were identified and discussed. Adjustments to sensor placement and sensitivity settings were made to enhance accuracy.

September 27, 2024: Power optimization techniques were explored, including using low-power modes for the Arduino. Discussions included comparisons of battery and USB power options for efficiency.

October 4, 2024: Extensive system testing was conducted, and results were documented. Discussions centered around addressing any remaining inaccuracies and planning final adjustments.

October 11, 2024: Final tweaks to both hardware and software were discussed based on feedback from testing. Initial sections of the project report were reviewed for clarity and completeness.

October 18, 2024: The addition of potential improvements, such as integrating multiple sensors for wider coverage, was discussed. Progress on the report and documentation was evaluated.

October 25, 2024: The project report was finalized, including detailed sections on objectives, methodology, and results. Presentation materials were prepared, and the system was reviewed for readiness.

November 1, 2024: A final review of the system and report was held, with discussions on its effectiveness and potential future enhancements. Preparation for project submission and presentation was completed.

November 8, 2024: The completed project and report were submitted. The team reflected on the entire process, discussing key learnings and areas for future exploration

Action Plan for the next period:

January: Integrating additional PIR sensors into the system to expand the detection range, ensuring coverage of larger areas. Conducting initial tests to verify the compatibility and functionality of the sensors with the existing Arduino setup. Optimization the sensor placements for maximum efficiency and minimum blind spots.

February: implementing wireless communication technologies such as GSM or Wi-Fi modules for remote notifications. Developing the system to send real-time alerts via SMS or a mobile app. Test the wireless communication setup for reliability and user-friendliness.

March: Enhancing power efficiency by incorporating low-power modes for the Arduino and associated components. Exploring battery-operated configurations and conduct tests to ensure the system's longevity. Calibrate the PIR sensors further to reduce false triggers, improving detection accuracy.

April: Adding a data logging feature using an SD card module or cloud storage to record motion events. Analyze the collected data to identify patterns and refine the system's responsiveness. Perform comprehensive system testing and finalize adjustments to ensure the system is ready for advanced security applications.

Signature of the student Signature of the Faculty

Date:

SECURITY SYSTEM USING PIR SENSOR

A PROJECT REPORT

SUBMITTED BY

VIDYADHEESHA M PANDURANGI
(6176AC22UEC162)

Under Supervision of

Mrs. B. Uma., M.E.,

of

Bachelor of Engineering

in

Electronics and Communication Engineering

(Duration: 15.07.2024 to 04.11.2024)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ADHIYAMAAN COLLEGE OF ENGINEERING
(An Autonomous Institution)
Approved by AICTE, Affiliated to Anna University, Chennai
Hosur, Tamil Nadu, India

NOVEMBER 2024

BONAFIDE CERTIFICATE

Certified that this project report **"SECURITY SYSTEM USING PIR SENSOR"** is the Bonafide work of "**VIDYADHEESHA M PANDURANGI (6176AC22UEC162)**" who carried out the Term paper writing and Seminar under my supervision**.**

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I wish to express my heartfelt gratitude to the Department of Electronics and Communication Engineering, Adhiyamaan College of Engineering for the continued support, in technical expertise to excel this techno savvy world.

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Finally, I would like to thank my parents, relatives and friends for providing me with emotional and financial help generously but without which I wouldn't have been in this stage of life.

ABSTRACT

PIR sensor-based Arduino home security system is an advanced security system that uses a combination of PIR sensors and Arduino microcontroller to detect any movement in a designated area and trigger a response accordingly. This system is designed to provide a cost-effective and efficient solution to secure homes and protect them from any potential intruders. The PIR sensor, also known as the motion sensor, is a small electronic device that detects changes in infrared radiation patterns caused by moving objects. When an intruder enters the area monitored by the PIR sensor, it detects the change in the infrared radiation and triggers the Arduino microcontroller to activate the security system. The Arduino microcontroller is the brain of this security system. The PIR sensor-based Arduino home security system is highly customizable and can be tailored to meet the specific needs of a homeowner. It can be programmed to activate different responses depending on the time of the day or the type of movement detected. For instance, it can be set to send a notification to the homeowner's phone during the day and activate an alarm at night. One of the main advantages of this security system is its low cost. The components used in the system, such as the PIR sensor and Arduino microcontroller, are affordable and easily available. This makes it an ideal option for those looking for a budget-friendly home security solution. Moreover, the PIR sensor-based Arduino home security system is easy to install and does not require any professional assistance. With some basic knowledge of electronics and programming, homeowners can set up the system themselves. This not only saves the cost of installation but also gives homeowners flexibility to modify the system according to their needs. Apart from its affordability and ease of installation, the PIR sensor-based Arduino home security system is also energy-efficient. The PIR sensor only activates when it detects movement, which helps in conserving energy.

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CHAPTER 1

INTRODUCTION

Security has become a paramount concern in various settings, including residential, commercial, and industrial spaces. Traditional security systems, though effective, often come with high costs and complex installation processes, making them inaccessible for small-scale applications. In response, this project introduces a simple, yet effective security solution based on a Passive Infrared (PIR) sensor, which can detect motion and trigger alerts, providing an affordable and scalable alternative to complex security systems.

The core component of this system, the PIR sensor, can detect infrared radiation emitted by objects within its field of view. When motion is detected, the system immediately activates both visual and auditory indicators—an LED and a buzzer—alerting individuals in the vicinity. Additionally, an alert message is transmitted to a serial monitor, offering real-time status updates and making it suitable for integration with digital monitoring setups.

This project highlights the practical use of basic components in creating responsive and reliable security measures. By focusing on simplicity and effectiveness, this PIR-based security system serves as a feasible option for anyone seeking a quick and affordable security solution, with potential applications in homes, small offices, and other areas requiring accessible monitoring capabilities.

RATIONALE OF THE STUDY

In an increasingly interconnected world, ensuring security in both personal and professional spaces is essential. Traditional security systems often require significant financial investment, complex installations, and regular maintenance, which can be prohibitive for small-scale users. This project aims to address the need for an accessible, affordable, and efficient security system, particularly for individuals and organizations seeking basic intrusion detection without the need for advanced infrastructure. The choice of a PIR sensor-based system stems from its practicality and effectiveness in detecting motion by sensing infrared radiation. Unlike complex systems that rely on high-end cameras or wired networks, a PIR sensor-based approach offers a straightforward solution for real-time security needs. It allows immediate detection of unauthorized movement and instant response through audible, visual, and digital alerts, which can deter intruders and alert users promptly. This study also explores the potential for small, embedded systems to enhance security in a range of settings, from residential spaces to smaller offices and storage facilities. By leveraging commonly available and low-cost components, the project demonstrates how effective security measures can be created without extensive resources. This approach not only broadens the accessibility of security systems but also encourages further innovation in low-cost, high-impact security technology for widespread use.

OBJECTIVE(S) OF THE STUDY

1. To design and implement a motion-detection security system using a Passive Infrared (PIR) sensor that can identify the presence of unauthorized movement within a designated area.
2. To develop an alert mechanism that activates an LED and buzzer immediately upon detecting motion, providing real-time visual and auditory alerts to nearby individuals.
3. To integrate a serial monitor for digital notifications, enabling the system to send an alert message to the monitor upon motion detection for real-time monitoring and logging purposes.
4. To create a cost-effective and scalable security solution that can be easily deployed in small-scale settings such as homes, offices, and other areas that require basic intrusion detection.
5. To demonstrate the feasibility of using embedded systems for security purposes, showcasing how simple components like PIR sensors, LEDs, and buzzers can enhance safety in an efficient and affordable manner.
6. To explore the potential for further enhancements in low-cost security systems by assessing system performance and identifying areas for future integration, such as connecting with wireless alerts or cloud-based monitoring.

CHAPTER 2

LITERATURE REVIEW

The rising need for cost-effective and efficient security systems has driven extensive research in motion-detection technologies, particularly in settings where traditional surveillance systems may be impractical or prohibitively expensive. Passive Infrared (PIR) sensors have emerged as a popular choice for intrusion detection systems due to their simplicity, low power consumption, and reliability in detecting infrared radiation from moving objects.

Book / Journal Name	Author(s)	Year of Publishing	Summary
Application of PIR Sensors for Home Security	P. V. Manohar and M. B. V. Srinivas	2019	This paper discusses the use of PIR sensors in home security applications, covering the basic setup and real-time motion detection capabilities.

Design of an Automated Security System with Motion Detection and Alarm Trigger	V. P. Rao and K. and S. R. Anjaneyulu	2019	The authors outline an automated system that triggers an alarm on detecting motion. Focus is on low-cost, accessible technology for home security.
PIR Motion Sensing in Security Systems: A Review	M. S. Nagarajan et al.	2020	Provides an in-depth review of PIR sensors in security systems, highlighting various motion detection methodologies and applications in IoT-based setups.
18 + Arduino Projects	Rui Santos	2018	Offers a practical guide to Arduino projects, including a variety of sensor-based applications, which are relevant to DIY security system setups using PIR sensors.
Designing Embedded Systems with Arduino: A Fundamental Technology for Makers	Tianhong Pan and Yi Z.	2017	Discusses the fundamental concepts of embedded systems using Arduino, including interfacing with sensors, which supports basic security system designs.

"Application of PIR Sensors for Home Security" by P. V. Manohar and M. B. V. Srinivas (2019) explores the advantages of using PIR sensors in home security, emphasizing their simplicity and affordability. However, it points out that the detection range is limited, and environmental disturbances can impact the system's accuracy. This paper suggests that PIR sensors alone may not provide enough coverage for larger areas or could trigger false alarms in specific environmental conditions, requiring additional components or modifications to enhance.[1]

"Design of an Automated Security System with Motion Detection and Alarm Trigger" by V. P. Rao and K. S. R. Anjaneyulu (2019) reviews motion detection systems that trigger alarms upon detecting motion. The system in this study faces issues in differentiating between benign and malicious movements, which could lead to unnecessary alarms. The paper does not focus on refining the sensor's sensitivity to differentiate various types of motion, which may limit its applicability in real-world scenarios where environmental or non-dangerous movements are frequent.[2]

"PIR Motion Sensing in Security Systems: A Review" by M. S. Nagarajan et al. (2020) provides an in-depth review of PIR sensors' application in security systems. The paper identifies false positives and environmental interference as key challenges. PIR sensors, while cost-effective, can be sensitive to temperature changes, pets, or other minor movements, leading to false alerts. The paper does not suggest a solution to minimize these environmental impacts, which is a significant limitation in PIR sensor-based systems for home security.[3]

Limitations and Future Research: While PIR sensor-based systems provide an economical and straightforward security solution, they do face limitations, such as sensitivity to environmental factors (e.g., temperature and humidity) and a limited detection range. Research by Tanaka et al. (2022) suggests that integrating PIR sensors with additional sensors (such as ultrasonic or microwave sensors) could further enhance reliability and reduce false positives. Additionally, advancements in wireless communication and cloud storage offer potential pathways for enhancing such systems with remote monitoring capabilities, opening opportunities for more robust, yet still cost-effective, security solutions.

CHAPTER 3

EXISTING METHODOLOGY

Early security systems were primarily developed as deterrents and alarms, with designs focusing on basic, reliable technologies for detecting unauthorized entry. Many of these systems were limited in functionality but laid the foundation for more sophisticated security setups. The methodologies reviewed below reflect the progression from basic mechanical and electrical security systems to simple sensor-based approaches, setting the context for your optimized PIR-based design.

IR sensors are integrated to detect movement by sensing variations in infrared radiation emitted by moving objects, as demonstrated by Manohar and Srinivas (2019) in their work on PIR sensor applications for home security. Their system relies on immediate signal transmission upon motion detection, though it does not provide remote alerts, limiting its application scope. [1]

Automated security setups often employ microcontrollers, such as Arduino, to process sensor signals and trigger alarms, a technique outlined by Rao and Anjaneyulu (2019), where they used motion detection to activate both a visual and auditory alert, ensuring a rapid response to intrusions.

However, such systems tend to lack real-time communication features like mobile notifications, thus confining the security response to local areas only. [2]

Further, embedded Arduino-based systems, as described by Singh et al. (2018), support efficient integration with motion sensors, allowing for customized responses upon detecting motion. Although flexible and adaptable, these setups primarily provide local alerts without extensive connectivity or scalability for larger security frameworks. [5]

Collectively, these existing approaches illustrate fundamental principles of PIR sensor-based motion detection and Arduino integration in security systems but reveal gaps in remote monitoring, scalability, and advanced alert mechanisms, which can be addressed in more optimized security designs.

CHAPTER 4

PROBLEM IDENTIFICATION

One of the significant challenges in PIR sensor-based security systems is the issue of false triggers, which are often caused by environmental factors. These factors include wind, fluctuating temperatures, the movement of pets, or even leaves swaying in the wind, all of which can be misinterpreted by the sensor as motion. These unintended detections can lead to unnecessary false alarms, which negatively impact the reliability and efficiency of security systems. Users may become desensitized to frequent, irrelevant alerts, which reduces the overall effectiveness of the system. Furthermore, persistent false alarms can lead to unnecessary operational costs, as systems may require maintenance or recalibration more frequently to maintain their accuracy. This issue underscores the importance of refining sensor technologies and algorithms to minimize the occurrence of false positives, thereby enhancing the overall user experience and system reliability.[1]

Another critical limitation identified by V. P. Rao and K. S. R. Anjaneyulu in their study (2019) is the insufficient alert mechanisms provided by traditional automated security systems. In many existing systems, the alert mechanism is often limited to either visual or auditory notifications, and in some cases, these systems fail to deliver digital alerts, such as messages or emails. The lack of a multi-modal alert system makes it difficult for users to respond to security threats promptly, as the warning signal may not be sufficient in certain environments. For instance, an auditory alarm may not be heard in noisy surroundings, and a visual indicator may be missed if the user is not in the immediate vicinity of the system *[2]*

Many Arduino-based security projects suffer from a lack of customization options, particularly when it comes to adjusting sensor sensitivity and modifying trigger actions. In traditional Arduino-based security systems, users typically cannot modify the sensitivity of the motion sensors or control
how the system responds to detected motion. As a result, these systems may not be adaptable to specific environments, such as homes with pets, areas with fluctuating temperatures, or places that require a different response to motion detection. These limitations can hinder the effectiveness of the security system, as users may need a system that can be tailored to their unique needs.

The proposed methodology addresses the key problems identified in previous systems, such as false alarms, inadequate alert mechanisms, energy inefficiency, lack of customization, scalability, and real-time processing limitations. By optimizing the sensor configuration, alert responses, energy usage, and system modularity, the proposed system provides a more reliable, flexible, and efficient security solution.

CHAPTER 5
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PROPOSED METHODOLOGY

The proposed methodology for this project aims to develop a simple, efficient, and reliable security system using a Passive Infrared (PIR) sensor. The system will detect motion and respond by activating an LED and buzzer while simultaneously sending an alert message to the serial monitor. This multi-faceted response provides immediate awareness of potential intrusion and enables real-time monitoring through the serial interface.

5.1 SPECIFICATIONS AND COMPONENTS:

PIR Sensor:

Figure 1 – PIR Sensor

A Passive Infrared (PIR) sensor is a crucial component in the proposed security system, as it detects motion by sensing infrared radiation emitted by objects in its vicinity. When the PIR sensor identifies movement, it sends a signal to the Arduino, which then activates both the LED and the buzzer to provide immediate visual and auditory alerts. This sensor operates within a typical range of 5 to 12 meters and is compatible with the Arduino's 3.3V to 5V operating voltage, making it ideal for small-scale, low-power applications. The PIR sensor's rapid response time and wide field of view ensure effective real-time detection, making it well-suited for basic security setups.

Arduino UNO:

Figure 2 – Arduino UNO

The Arduino Uno is a widely used microcontroller board based on the ATmega328P, popular for its ease of use in electronics and embedded systems projects. It operates at 5V with a clock speed of 16 MHz and includes 14 digital I/O pins, 6 of which support PWM output, as well as 6 analog input pins, which allow it to interact with a variety of sensors and actuators. The board is programmable via the Arduino IDE and communicates over USB, making it accessible for both beginners and experienced developers. Its versatility, affordability, and robust community support make it an ideal choice for projects like home automation, sensor networks, and security systems.

Bread Board:

Figure 3 – Bread Board

A breadboard is an essential tool for prototyping electronic circuits without the need for soldering. It features a grid of interconnected sockets where components like resistors, LEDs, and microcontrollers can be inserted and easily rearranged. The breadboard's layout typically includes horizontal and vertical rows of sockets connected internally, with power rails running along the sides for easy power distribution. This design allows for quick, flexible testing and modification of circuits, making breadboards ideal for experimenting with and refining circuit designs, particularly in educational settings or in initial project stages where frequent changes are expected.

LED:

Figure 4 - LED

An LED, or Light Emitting Diode, is a semiconductor device that emits light when an electric current flows through it. LEDs are highly energy-efficient, converting most of the electricity into light rather than heat, unlike traditional incandescent bulbs. They come in a variety of colors, typically determined by the materials used in the semiconductor, and are available in different sizes and shapes. Due to their long lifespan, low energy consumption, and small size, LEDs are commonly used in a wide range of applications, including indicator lights, digital displays, and lighting systems. In electronics projects, LEDs are valuable for providing visual feedback, such as signaling power status or circuit activity.

Piezo:

Figure 5 – Piez

A piezo, or piezoelectric buzzer, is a device that produces sound through the piezoelectric effect, where certain materials generate an electric charge when mechanically stressed. In a piezo buzzer, a small ceramic disc made of piezoelectric material is attached to a metal plate. When an electric current is applied, the disc vibrates rapidly, causing the metal plate to produce sound. Piezo buzzers are compact, energy-efficient, and capable of generating various tones by adjusting the input frequency, making them popular in applications such as alarms, timers, and electronic indicators. They are easy to integrate into circuits and commonly used for providing auditory feedback in electronics projects, including security and alert systems.

Resistor:

Figure 6 – Resistor

A 220-ohm resistor is a passive electronic component commonly used to limit current in a circuit, ensuring components operate safely within their specified current range. It is particularly useful in applications like protecting LEDs, where excessive current can damage the diode. The resistor's value, 220 ohms, determines the level of resistance it offers according to Ohm's law: V=IR V = IRV=IR, where III is the current and RRR is the resistance. Its compact size and availability in different tolerances make it a versatile component for various electronic projects, including prototyping and educational purposes. Resistors are typically identified by color bands on their body, with the 220-ohm resistor having a color code of red, red, brown, and a tolerance band like gold or silver.

5.2 SOFTWARE USED:

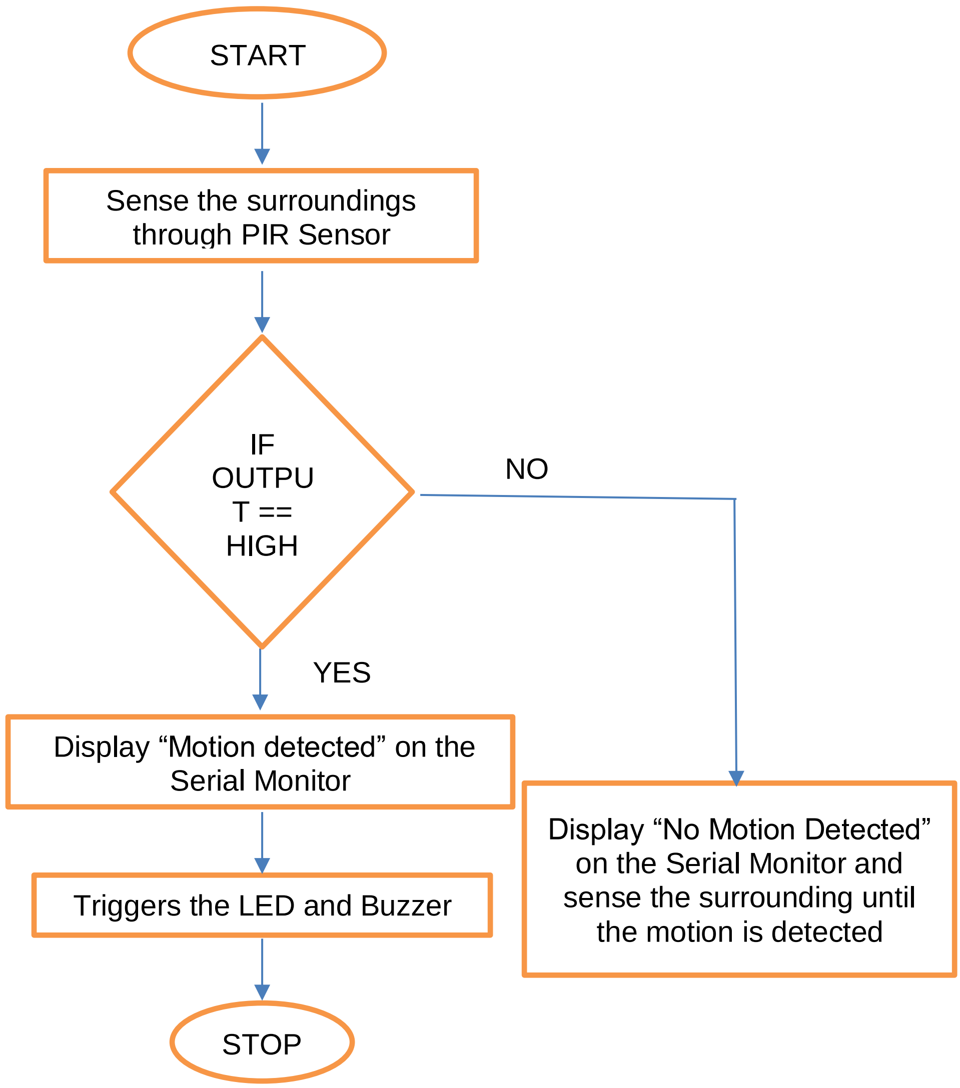
ARDUINO IDE:

The Arduino IDE (Integrated Development Environment) is a software platform used to write, compile, and upload code to Arduino microcontrollers. It provides an easy-to-use environment, making it accessible for beginners and professionals alike. The primary language used in the IDE is C/C++, but the environment simplifies the code structure with pre-built libraries, making it less complex for users to interact with hardware components. The platform is cross-platform, and also supports a wide range of boards beyond the traditional Arduino Uno, allowing users to explore various microcontroller options.

Key features of the Arduino IDE include:

- **Code Editing**: It provides an editor where users can write and modify their Arduino sketches (programs).
- **Compiler:** Once the code is written, the IDE compiles it to machine code that the Arduino board can execute.
- **Uploader:** The IDE connects directly to Arduino hardware to upload compiled code through the serial port.
- **Library Support:** The IDE offers access to numerous libraries for various sensors and modules, simplifying the integration of external hardware.

5.3 FLOWCHART:



5.4 WORKING PRINCIPLE:

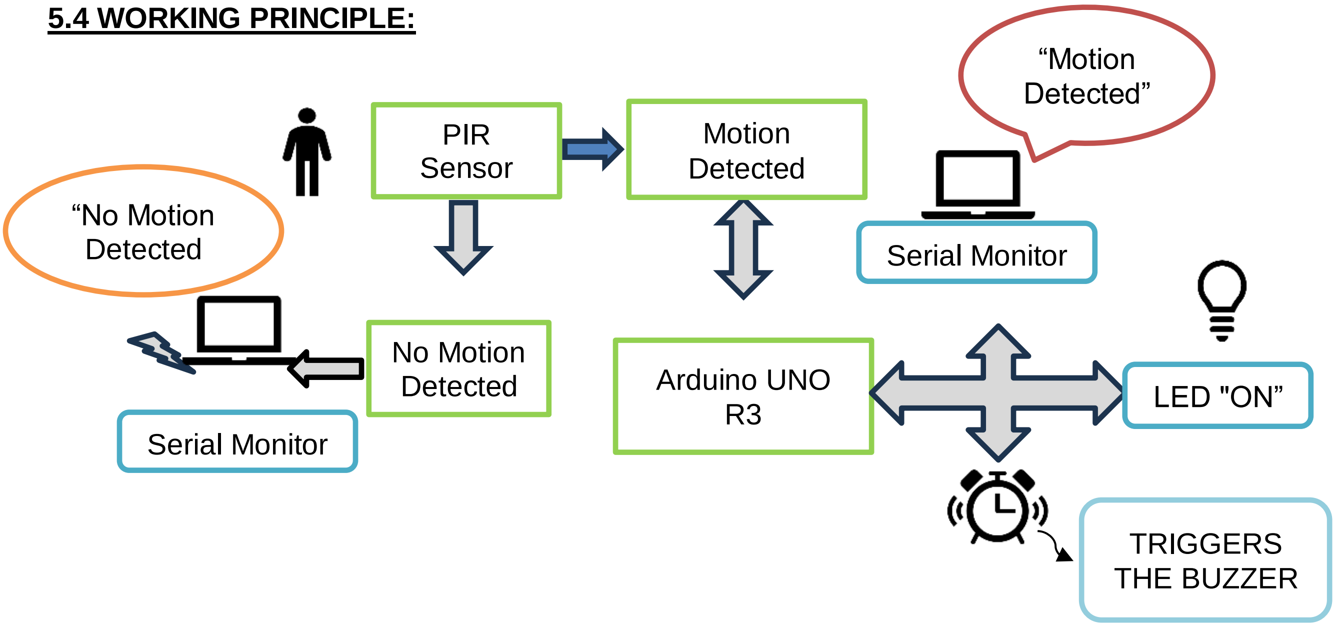


Figure 6 – Block Diagram

The connections must be made in accordance with the circuit diagram above. Connect the PIR motion sensor's VCC to the Arduino's 5-volt pin. Link the Arduino's GND pin to the PIR sensors. Connect the PIR sensor's OUT pin to Arduino's digital-8 pin. Connect the LED's positive leg to the Arduino's digital-9 pin and its negative leg to the Arduino's ground via a 220-ohm resistor. Connect Piezo's positive leg to the Arduino's digital-10 pin and its negative leg to the Arduino's ground A breadboard can be used to create the common connections. After uploading the code, your security system is now operational.

The PIR sensor-based security system operates by detecting infrared (IR) radiation emitted by objects within its field of view, specifically designed to sense motion. When the PIR (Passive Infrared) sensor detects a change in IR radiation, which occurs when a warm object like a human or animal enters its detection range, it generates a signal. This signal is transmitted to the Arduino, which processes the input and initiates a series of actions: activating an LED as a visual alert, sounding a piezo buzzer for an audible warning, and sending an alert message to the serial monitor for immediate notification.

This setup leverages the Arduino's processing capabilities to ensure rapid response times, providing real-time alerts when motion is detected. By combining visual, audible, and digital notifications, the system effectively signals unauthorized movement, making it ideal for basic security applications. Furthermore, the simplicity of this approach ensures reliable operation with low power consumption and minimal components, allowing for an efficient, cost-effective security solution.

5.5 Code for the Study:

```
const int PIR_SENSOR_PIN = 8;
const int LED_PIN = 9;
const int BUZZER_PIN = 10;
void setup() {
  Serial.begin(9600);
  pinMode(PIR_SENSOR_PIN, INPUT);
  pinMode(LED_PIN, OUTPUT);
  pinMode(BUZZER_PIN, OUTPUT);
  Serial.println("Motion Detection System Initialized");
}
void loop() {
  int sensorValue = digitalRead(PIR_SENSOR_PIN);
  if (sensorValue == HIGH) {
    digitalWrite(LED_PIN, HIGH);

digitalWrite(BUZZER_PIN, HIGH);
    Serial.println("Motion Detected");
  }
  else {
    digitalWrite(LED_PIN, LOW);
    digitalWrite(BUZZER_PIN, LOW);
    Serial.println("No Motion Detected");
  }
  delay(200);
}
```

Advantages of the Proposed System

- **Cost-effective**: The use of basic components like Arduino, PIR sensor, LED, and buzzer makes the system inexpensive and accessible.
- **Real-time Alerts**: The system provides immediate feedback in real time, making it suitable for use in home or small-scale security setups.
- **Simple Design**: The design focuses on simplicity and efficiency, making it easy to build and deploy for beginners in electronics and embedded systems.

Limitations of the Proposed System

- **Limited Detection Range**: The PIR sensor may have a restricted detection range, which can limit its effectiveness in larger spaces or areas with obstructions.
- **False Positives/Negatives**: Sensitivity adjustments might be needed to reduce the chances of false positives or missed detections.
- **Lack of Remote Monitoring**: The system only provides local alerts via LED, buzzer, and serial monitor, lacking remote access or real-time notifications through mobile or internet-connected devices.

CHAPTER 6

EXPERMENTAL RESULTS

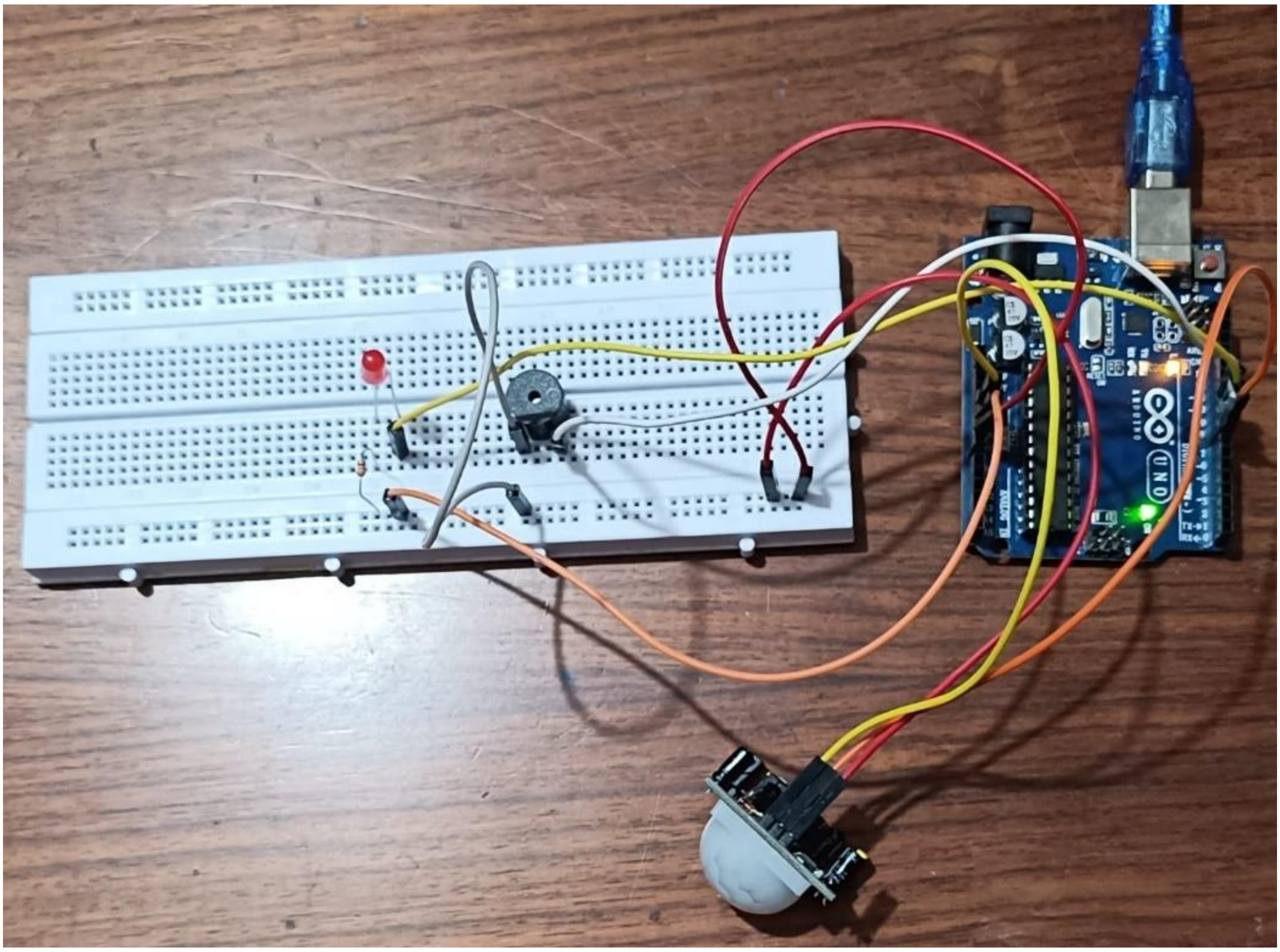


Figure 8: Security System using PIR Sensor

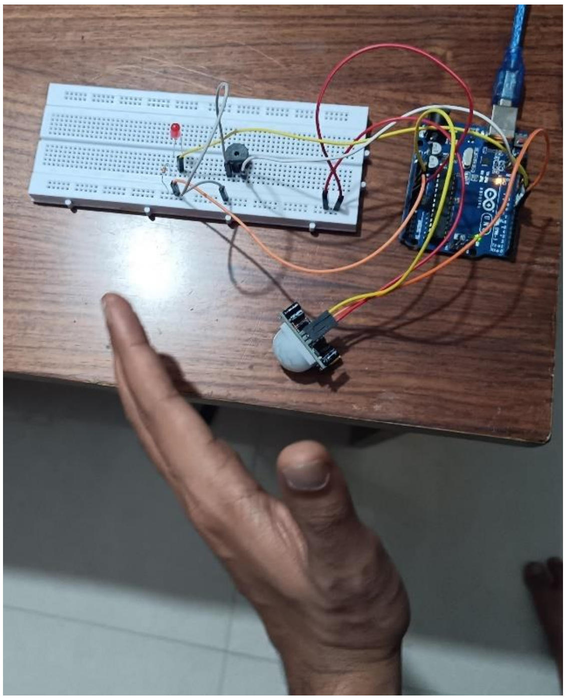


Figure 9: LED and Buzzer turn off when When Motion is Detected

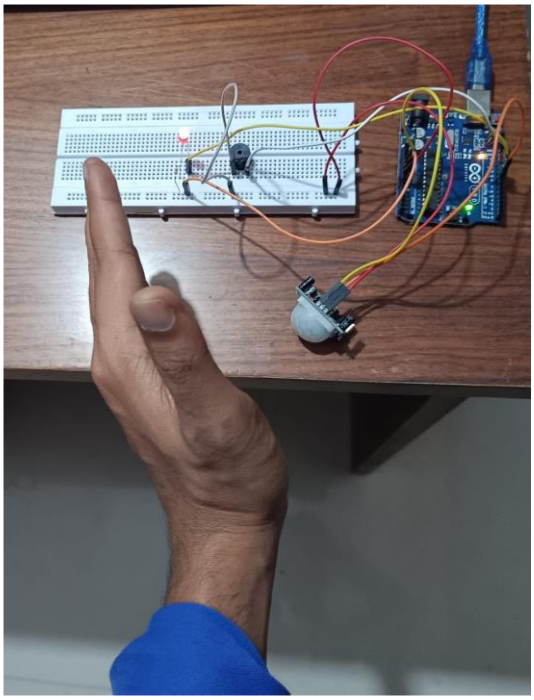


Figure 10: Triggers LED and Buzzer when No Motion is Detected

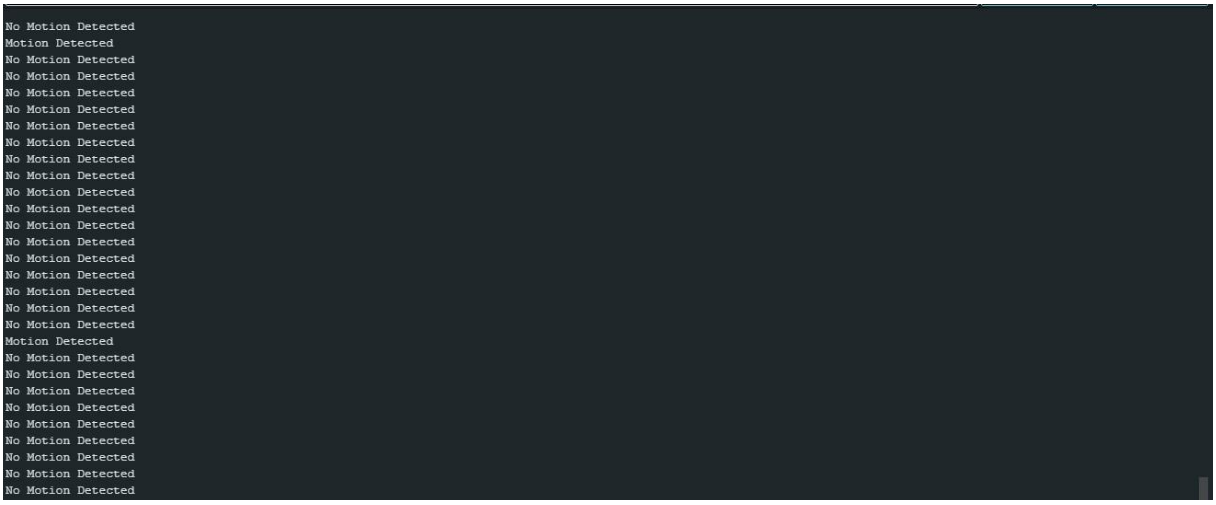


Figure 11: Output at the Serial Monitor

CHAPTER 7

FUTURE SCOPE

The proposed security system, which uses a PIR sensor to trigger an LED, buzzer, and send alerts to a serial monitor, provides a foundational framework for small-scale motion detection. Building on this methodology, there are multiple avenues for future improvements and expanded applications, particularly as technology in security and IoT advances. Potential future enhancements are as follows:

1. Integration with IoT for Remote Monitoring

- Expanding the system to connect with IoT platforms can enable remote monitoring and control. For instance, integrating Wi-Fi or GSM modules would allow the system to send alerts to mobile devices or web applications, making it accessible from anywhere.
- This enhancement would provide real-time notifications via SMS or app alerts, making it ideal for home security applications.

2. Enhanced Data Logging and Analytics

- Future versions of this system could store motion detection logs in a database or cloud storage, allowing users to access historical data.
- Integrating analytics to analyze patterns in motion events could provide insights into peak times of activity, which would be useful for businesses and homes to improve security measures based on observed trends.

3. Integration with Camera Systems for Visual Verification

- A camera module could be added to capture images or video when motion is detected, allowing for visual verification of potential intruders. This would be particularly valuable in reducing false alarms and providing evidence in case of security breaches.
- The captured images or videos could be stored locally on an SD card or sent to a remote server for review.

4. Multi-Sensor Integration for Enhanced Accuracy

- To improve detection accuracy, additional sensors such as ultrasonic or microwave sensors could be integrated. These sensors, working together with the PIR sensor, could reduce false alarms and increase detection reliability in various environmental conditions.
- The system could be configured to trigger alerts only if multiple sensors detect motion, enhancing the accuracy of intrusion detection.

5. Integration with Smart Home Systems

- As smart home technology becomes more widespread, this security system could be integrated with existing smart home ecosystems (e.g., Google Home, Amazon Alexa).
- Users could enable or disable the security system through voice commands or mobile apps, making it a more user-friendly option for home security.

6. Customization of Alerts Based on Time and Location

- The system could be programmed to adjust its sensitivity or change its response based on the time of day. For example, alerts could be more sensitive and include phone notifications during night hours while remaining in a lower-alert state during the day.
- Location-based settings could be implemented if the system were used in multiple areas within a facility, adjusting for different levels of sensitivity or alert response in different zones.

7. Battery Backup for Power Resilience

- Future iterations could incorporate a battery backup to ensure the system remains operational during power outages. This would increase reliability and make it a more robust option for continuous security monitoring.

8. Machine Learning for Intrusion Prediction and False Alarm Reduction

- Machine learning algorithms could be employed to analyze motion patterns and differentiate between human activity and non-human motion (e.g., pets or moving branches), reducing false alarms.
- Predictive analytics could identify unusual patterns in detected motion, potentially alerting users to suspicious activity before an actual security breach occurs.

CHAPTR 8

CONCLUSION

This project successfully demonstrates the design and implementation of a basic, yet effective, security system using a Passive Infrared (PIR) sensor. By detecting motion and triggering both visual and auditory alerts, along with sending a real-time message to the serial monitor, the system provides a straightforward and reliable approach to monitoring and securing a designated area. The integration of LED, buzzer, and serial communication offers multiple levels of feedback, enhancing user awareness and allowing for real-time monitoring.

Through this project, we achieved a cost-effective and easily deployable solution that addresses the limitations of more complex and expensive systems. The PIR sensor's sensitivity to infrared changes enables accurate motion detection, making it a suitable choice for small-scale applications, such as home or office security. The system's design ensures continuous operation with minimal power requirements, providing an efficient alternative for basic security needs.

In summary, this project serves as a foundational platform that can be enhanced with additional features such as IoT connectivity, camera integration, and data logging for a more comprehensive security solution. This initial implementation demonstrates the potential of using simple electronic components to create functional security systems and highlight opportunities for further development to meet evolving security demands.

CHAPTER 9

BIOGRAPHY

Vidyadheesha M. Pandurangi is a 3rd-year Electronics and Communication Engineering student with a strong passion for AI, data science, automation systems, VLSI, embedded systems, and IoT. He aspires to integrate these cutting-edge fields to drive innovation and deliver impactful solutions. His academic journey is complemented by hands-on experiences through workshops, internships, and project-based learning. He has actively participated in initiatives like the 'AI for All' program by the Government of India and Intel, a VLSI beginner’s course by NIELIT, and workshops on embedded systems, Python, and IoT. Vidyadheesha has also undertaken projects such as motion detection security solutions, showcasing his ability to apply theoretical knowledge to real-world challenges. Vidyadheesha’ s achievements include securing top rankings in competitions like Flipkart GRiD 6.0 – Round 1 at college level and excelling in technical events and hackathons.

Mrs. B. Uma has excelled in academic and professional development, demonstrating a strong commitment to enhancing her technical expertise. She completed her B.E. in Electronics and Communication Engineering (ECE) with distinction, receiving the Academic Excellence Award for the academic year 2015-2016. She achieved 38th rank among 26,367 candidates in the university's B.E. ECE program and secured the 1st in her department at her college. She has completed her M.E in Communication systems and currently pursuing her PhD in the field of Ad HOC networks. Her consistent academic performance earned her certificates of proficiency for securing top marks during three consecutive years, from 2012 to 2015. 3 patents were published and 1 Australian patent got granted. She has published 10 journal papers in UGC referred journals and 5 papers were presented in National conferences. In her professional journey, Mrs. Uma has completed several certifications. She successfully finished the Mendeley Training Course and the Introduction to Cyber Security course by Cisco Networking Academy. She also completed an Artificial Intelligence and Machine Learning masterclass and a One-Year Intensive Industry Program in Big Data Engineering. Additionally, she holds certifications in CCNA – Network Fundamentals and the Business English Certification (BEC) by the University of Cambridge. Furthermore, she underwent advanced training at BSNL, RGMTTC, Meenambakkam, where she earned Silver, Gold, and Platinum certifications in areas such as Digital Switching, Optical Fiber Technology, IP Networking, and Cybersecurity.

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