PROJECT REPORT
ON
SECURITY SYSTEM USING PIR SENSOR

Submitted in partial fulfillment for the requirement of the award of

TRAINING

IN

IoT & EMBEDDED SYSTEMS

Submitted By

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INTRODUCTION

In increasing complexity in today's world, the need for a good security system has never been more critical. Security systems provide safeguarding measures for homes, business enterprises, and public places from unauthorized access and other threats. Among various technologies in security surveillance, Passive Infrared sensors have also gained upper hand by reason of reliability and low cost.

IMPORTANCE OF SECURITY ALARM SYSTEMS

Security alarm systems provide an effective deterrent to would-be intruders while giving a good amount of peace of mind to the property owner. They may be developed for basic residential applications or large, complex commercial installations. One of the most integral parts of any good security alarm system would have to be a motion detection device, alerting one to suspected activity and triggering an appropriate response.

OVERVIEW OF PIR SENSOR

The PIR sensor is an electronic sensor that detects infrared radiation emitted by objects in its field of view. This means it is very good at detecting motion based on changes in infrared radiation emitted by warm objects, such as human beings and animals. Their application areas include almost all motion detection applications, due to the ability to provide a great amount of sensitivity and accuracy with little consumption of power.

PROBLEM STATEMENT

In the contemporary landscape of security and surveillance, protecting properties from unauthorized access and potential threats remains a pressing concern. Traditional security systems, while effective, often come with high costs, complex installation processes, and maintenance challenges. This creates a significant need for a more efficient, reliable, and cost-effective solution to enhance security.

Key Problems Identified:

1. **High Cost of Advanced Security Systems:** Many advanced security systems involve substantial financial investment, which may be prohibitive for residential users or small businesses. These systems often include sophisticated technology and services that drive up the overall cost.

2. **Complexity in Installation and Maintenance:** Existing security systems can be complex to install and maintain, requiring specialized knowledge or professional services. This complexity can deter users from implementing effective security measures.
3. **Limited Detection Capabilities:** Traditional systems may lack the capability to detect subtle or small-scale movements, leading to potential security breaches. Ensuring accurate and reliable motion detection is crucial for effective surveillance.
4. **Inadequate Real-Time Alerts:** Many security systems fail to provide timely alerts or notifications, which can delay the response to potential security threats. A system that offers immediate and accurate notifications is essential for timely intervention.

PROPOSED SOLUTION

Concerning these challenges, this project is set to be designed for a security alarm system that will feature Passive Infrared sensors. PIR sensors are well-known for their high effectiveness in detecting motion by changes of infrared radiation against objects, as the human body and animal bodies. In adapting PIR sensor technology, this project aims at:

1. **A low-cost solution:** Design an inexpensive security alarm system to bring effective security closer to more people.
2. **Simplify Installation and Operation:** Provide a user-friendly system that is very easy to install and use, hence eliminating special knowledge and reducing the involvement of professional services.
3. **Improve Detection Accuracy:** Offer a system with PIR sensors, which will provide stable and accurate detection of motion, hence reducing the possibility of undetected intrusion.
4. **Provide Timely Alerts:** Design real-time alert mechanisms so that the user is informed in time upon the detection of motion to allow for quick responses in case of threats.

By solving these problems, the resulting project will be a pragmatic and efficient security alarm system that ensures safety and security with simplicity and affordability.

SOFTWARE USED

TINKER CAD:

Tinker cad is an intuitive, web-based Autodesk application for 3D design, electronics simulation, and coding. It is vastly applied in education, by hobbyists, and students due to ease and accessibility. Tinker cad is an environment that easily allows one to create, test, and repeat different projects; hence, it is very useful for both learners and experts in design and electronics.

PROGRAMMING LANGUAGE USED

C PROGRAMMING:

C is a general-purpose programming language. It was developed in the 1970s by Dennis Ritchie and is still very commonly used and influential. By design, C's features should map cleanly to typical machine instructions. It has found lasting use in operating systems code, especially in kernels, device drivers, and protocol stacks, but its use in application software has been slowly decreasing. C is widely used in computer architectures, which range from the very largest systems.

COMPONENTS USED

Arduino UNO R3:

The Arduino UNO R3 is the microcontroller board for projects of the series that are based on the Atmega328P microcontroller. It belongs to the Arduino platform, which is a highly available and user-friendly way for users to create active electronic projects. In this board, ease of use, flexibility, and strong community support are the major peculiarities.

PIR SENSOR:

A PIR sensor detects motion through changes in infrared radiation from objects, typically warm objects like humans or animals, within its field of vision. In this case, "passive" means not that the sensor does not radiate itself, but rather it detects infrared radiation emitted or reflected by other objects.

BREAD BOARD:

A breadboard is a reusable, non-permanent platform for construction and testing of electronic circuits. It has a grid of interconnected holes into which electronic components and wires can be inserted and connected without soldering, making it easier to experiment and change.

RESISTOR:

An electrical resistor is a component of an electronic circuit which resists the flow of electrical current. It is used in circuits to regulate current flow, to divide voltages, and as a safety device to protect other components of excessive current. Resistors are characterized by their resistance value, measured in ohms. They come in several forms: fixed resistors have a constant resistance value;

variable resistors are potentiometers that are adjusted. Basically, a resistor is used in almost every electronic device or circuit.

LIGHT EMITTING DIODE (LED):

A semiconductor device, which, when there is an electrical current passing through it, gives off visible light. An LED is energy-efficient and highly long-lasting, hence finding wide applications in fields such as lighting, displays, and indicators.

PIEZO:

It is essentially a piezoelectric component, which can be used as both a sensor and a buzzer. In its function as a sensor, the idea is to translate any pressure, or vibrations applied to into an electric signal. Whereas, during its function as a buzzer, a sound is created after an electric signal has been applied. In Tinkercad, quite often, this component is shown as a basic module usable while creating many different simulations and projects.

SCHEMATIC CONNECTION DIAGRAM

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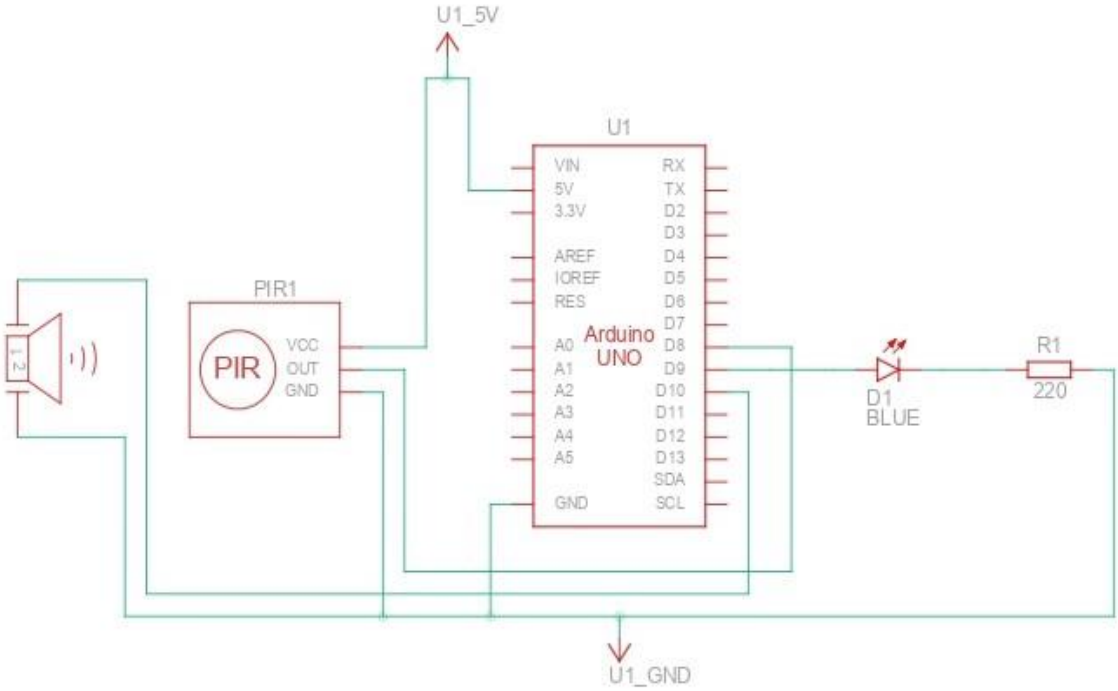

Fig: 9 - *Schematic Connection Diagram for Security System using PIR Sensor*

CODE FOR THE PROJECT

 # C PROGRAM #

```
int led = 9;
int sensor = 8;
int buzzer = 10;
int state = LOW;
int val = 0;

void setup()
{
  pinMode(led,OUTPUT);
  pinMode(sensor, INPUT);
  pinMode(buzzer,OUTPUT);
  Serial.begin(9600);
}

void loop()
{
  val = digitalRead(sensor);
  if (val == HIGH)
  {
    // check if the sensor is HIGH
    digitalWrite(led,HIGH);
    delay(100);
    if (state == LOW)
    {
      Serial.println("Motion Detected!");
      tone(buzzer,1000);
      state = HIGH;
    }
  }
  else
  {
    digitalWrite(led,LOW);
    delay(200);
    if (state == HIGH)
    {
      Serial.println("No Motion Detected");
      noTone(buzzer);
      state = LOW;}}}
```

EXPIREMENTAL RESULTS

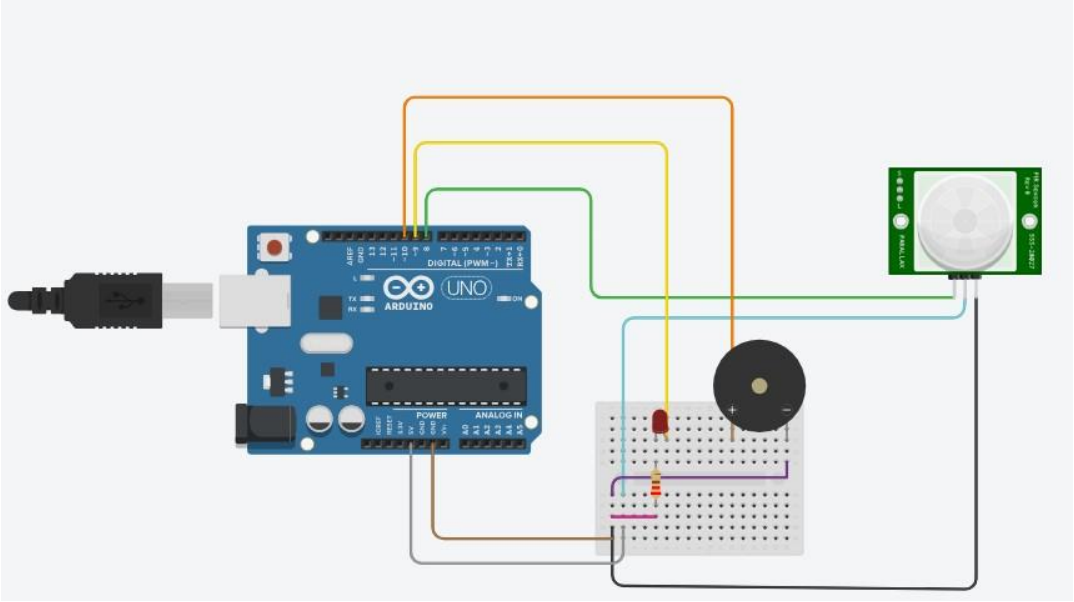

Fig: 11.1 – *Circuit constructed using Tinker CAD*

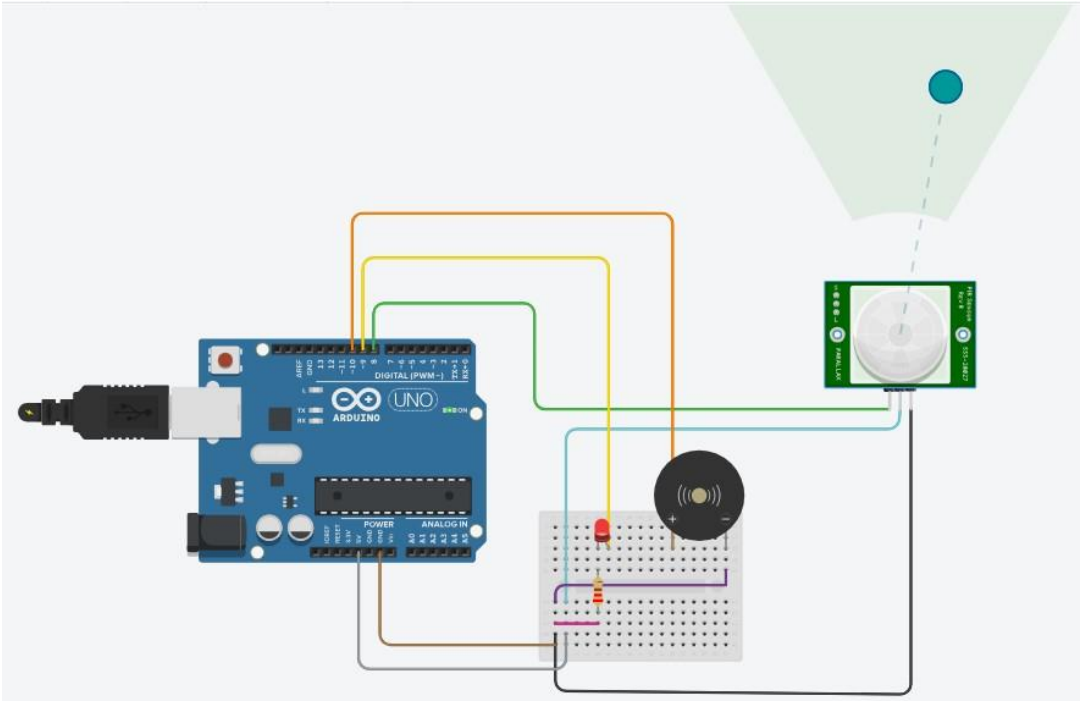

Fig: 11.2 – *PIR Sensor activates when the motion is detected and triggers the alarm and LED*

OUTPUT AT THE SERIAL MONITOR

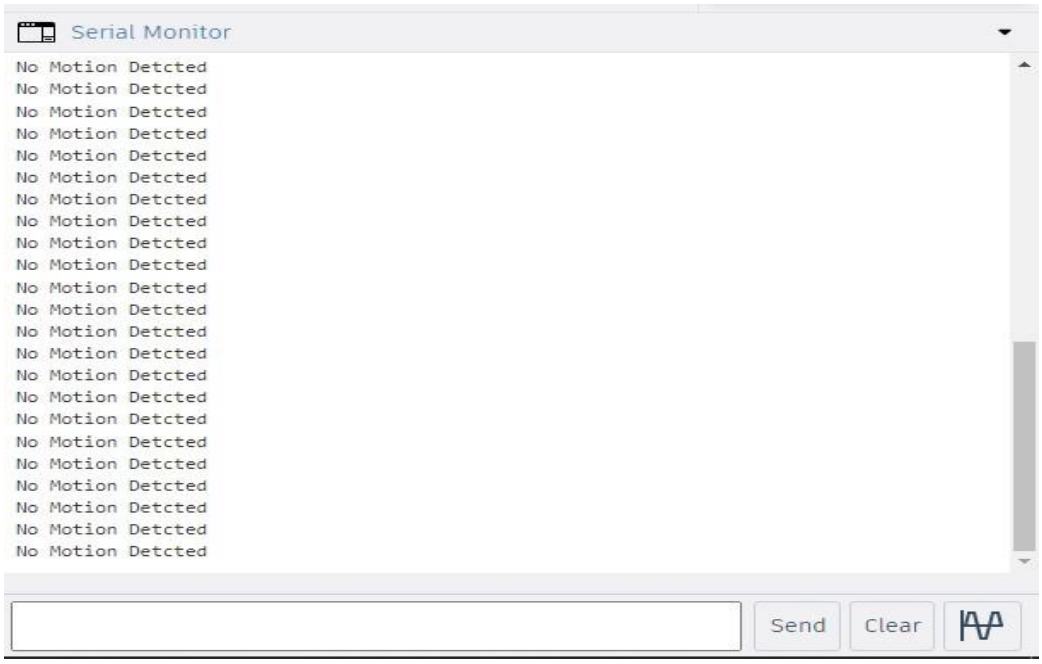

Fig: 12.1 – *Output at the serial Monitor when "No Motion" is detected by the PIR Sensor*

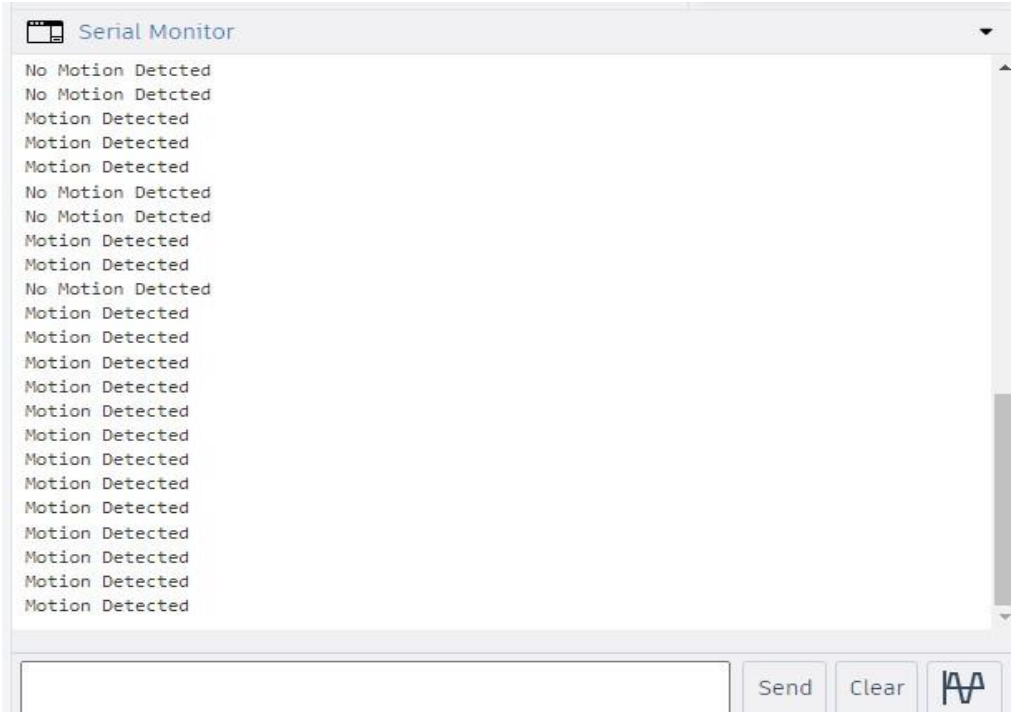

Fig: 12.2– *Output at the serial Monitor when "Motion" is detected by the PIR Sensor.*

ADVANTAGES OF USING PIR SENSOR IN SECURITY SYSTEMS

1. **Motion Detection:** PIR sensors efficiently detect motion in the change of infrared radiation. They emit infrared radiation from warm bodies, like humans and animals, and thus find applications in triggering alarms or other kinds of notifications by detecting movements.
2. **Energy Efficiency:** A PIR sensor consumes very less power compared to other types of sensors, including cameras. More often than not, they find application in battery-driven devices because of their meager power consumption.
3. **Cost-Effective:** PIR sensors are relatively inexpensive and widely available, hence a cost-effective solution to many security applications.
4. **Low False Alarm:** Based on the changes in the levels of infrared radiation covering a certain area, PIR sensors are designed to minimize false alarms due to environmental changes that do not involve actual movement, such as shadows and light variations.
5. **Easy Integration:** PIR sensors can be easily integrated with other components of security systems, including alarm systems, cameras, and smart home systems. They have the ability to trigger several responses upon detecting movement.
6. **Maintenance:** Once fitted, PIR sensors generally require very little maintenance. They are sturdy and have a long life while in operation, which minimizes the need for frequent replacements.
7. **Privacy:** Because PIR sensors detect motion based on heat signatures and not through capturing an image, like in video surveillance systems, it can be an added advantage from a privacy perspective.

LIMITATIONS OF USING PIR SENSOR IN SECURITY SYSTEMS

1. **Low Detection Range:** PIR sensors have a scope within which they can detect motion. If an intruder strays out of this range or is too close to it, the PIR may fail to detect him.
2. **Sensitive to Changes in the Environment:** PIR sensors may be interfered with by temperature changes or environmental factors. Rapid fluctuations in temperature or strong wind may trigger some false alarms.
3. **Detection Blind Spots:** PIR sensors have a specific field of view, and they are subject to a few blind spots where motion might not be detected. Proper placement and positioning are very important to properly cover the intended area.
4. **Limited Detection of Non-Living Objects:** These sensors are able to pick up infrared radiation from warm objects; any other kind of object is not likely to be detected since these usually do not emit heat.

5. Blockage Susceptibility: Anything that obstructs the sensor's view of the area to be watched can interfere with the sensor's operation in sensing the motion.
6. False Alarms from Animals: PIR sensors sense the heat from animals and cause false alarms around pets or wildlife.
7. No Identification Capability: The PIR sensors detect only the motion; they are not capable of identifying the person or type of motion, which is different from the other. They cannot do visual verification or provide more information related to the activity.
8. Limited Effectiveness in Low-Light Conditions: Although not relying on visible light, PIR sensors may be less effective in low-light conditions, where the temperature contrast between the intruder and background is decreased.
9. Possible Interference from Other Heat Sources: Heat-generating devices like heating vents or lamps can cause possible interference in the detection sensor of the PIR. Installation Sensitivity: The requirements for proper installation and calibration are high. Wrong installation can give poor performance and increased false alarm rates.

FUTURE SCOPE OF STUDY

Several areas for further improvement were identified:

1. **Advanced Processing:** Integrating machine learning algorithms to analyze motion patterns and reduce false alarms would improve accuracy.
2. It can be extended to provide more functionalities by integrating other components, such as cameras and alarms.
3. **User Customization:** Developing a friendlier interface to system control and alert configuration would further increase the practicality and usability of the system.

CONCLUSION

In this project, I implemented a security system that uses PIR sensors. We also stated the status of our system on a serial monitor using Tinker cad. It integrates the PIR sensors for motion detection; they work by change in infrared radiation and form one of the integral parts of security systems in today's world. This project clearly depicted the application of the PIR sensor in a security system and showed, with success, all the benefits associated with Tinker cad in simulation and monitoring. The knowledge obtained acts as the strong base for further developing and enhancing security systems working on PIR.

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SIMULATE AND VERIFY

To simulate and verify the experiment

CLICK HERE

OR

LINK:

https://www.tinkercad.com/things/dU0nrXKiVqm-security-system-using-pir-sensor-send-alert-on-serial-monitor