A Project Report on

Farm Security System

Abstract:

Farm security has become a growing concern in recent years due to increasing incidents of theft and vandalism. Farmers face significant risks, including the loss of valuable equipment, and crops, which can severely impact their livelihood. Traditional security methods like fencing and manual patrolling are both expensive and time-consuming. To address these challenges, a simple and cost-effective farm security system can be designed using Passive Infrared (PIR) sensors.

PIR sensors detect motion by sensing the infrared radiation emitted by living beings, such as humans or animals, making them ideal for farm surveillance. These sensors are easy to install, operate in various weather conditions, and require minimal power, making them highly suitable for outdoor use in agricultural settings. Once motion is detected, the PIR sensor can trigger an alarm or light, alerting farmers immediately to potential intruders or threats.

This project underscores the potential of simple technologies to address significant challenges in agricultural security. By providing timely alerts and enhancing awareness, the motion detection system empowers farmers to safeguard their livelihoods more effectively. Future improvements may focus on integrating advanced features, such as mobile notifications, to further enhance the system's functionality and adaptability in diverse farming environments.

Background:

Farm security has become increasingly vital in recent years due to rising incidents of theft and vandalism affecting agricultural properties. Farmers often face significant losses from stolen equipment, livestock, or crops, which can jeopardize their livelihoods. Traditional security measures, such as fencing and manual patrols, are not only costly but also labor-intensive, often requiring constant vigilance. As a result, there is a pressing need for more effective and automated solutions to enhance security on farms.

A Farm Security System using a PIR Sensor is an affordable and straightforward way to protect farmland from intruders and animals. This system uses a Passive Infrared (PIR) sensor to detect motion by sensing the infrared radiation emitted by humans and animals. When the sensor detects movement, it triggers an alarm to alert the farmer about potential security threats.

Problem Definition & Design:

Nowadays, security is becoming an significant matter for farmers, despite that the threat of a violence on farm is marginal, we must consider our liability to criminal deeds such as robbery of farm equipment or chemicals, criminal disruption involving unsecured equipment and machinery, destruction of bioengineered plants, common vandalism. Acts of terrorism have elevated our consciousness of the requirement for increased personal and farm security. Unauthorized access to farm chemicals and application equipment are greatest security danger to farms, nurseries and greenhouses where plants are developed. And as an adult we know that insecticides should be stored away from children. In addition, insecticides should be protected from trespassers, vandals, intruders, and thieves who may accidentally, or intentionally, use these chemicals to damage other individuals, crop or noncrop lands, the environment or even themselves. Be responsible for the safety of yourself, your family, representatives, and your group. Set up your farm to endure the pressure of unauthorized activity. Thus this study aims for the solution for the problem.

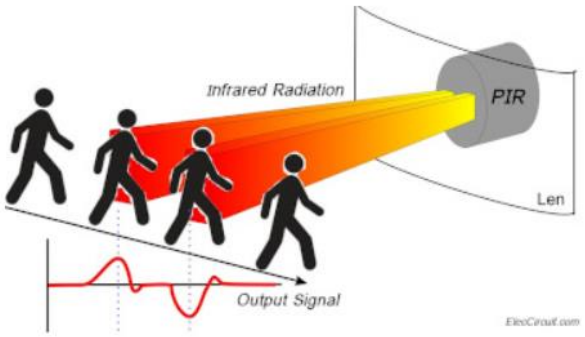
This system uses a Passive Infrared (PIR)* sensor to detect motion by sensing the infrared radiation emitted by humans and animals. When the sensor detects movement, it triggers an alarm to alert the farmer about potential security threats.

The PIR sensor is the heart of this system. It is a small, low-cost device that can detect movement within its range by picking up infrared radiation. Humans and animals naturally emit this radiation as heat, and when the sensor detects a change in the infrared levels in its environment, it recognizes this as motion.

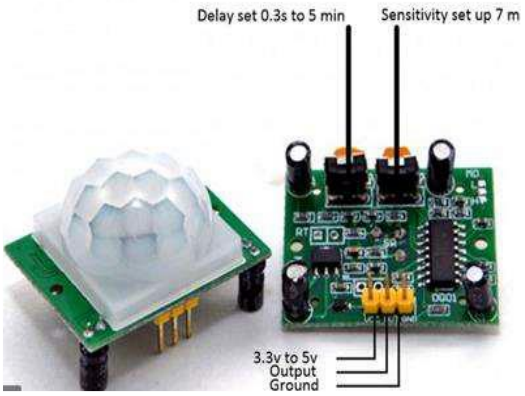
The PIR sensor is connected to a simple relay system that activates the alarm when movement is detected. Farmers can easily install and maintain this setup without technical expertise. Furthermore, the absence of microcontrollers makes the system more affordable, while still providing reliable protection. By installing multiple PIR sensors across the farm, the farmer can monitor larger areas and ensure comprehensive protection, improving overall farm security without needing advanced technical knowledge.

*PIR Sensor:

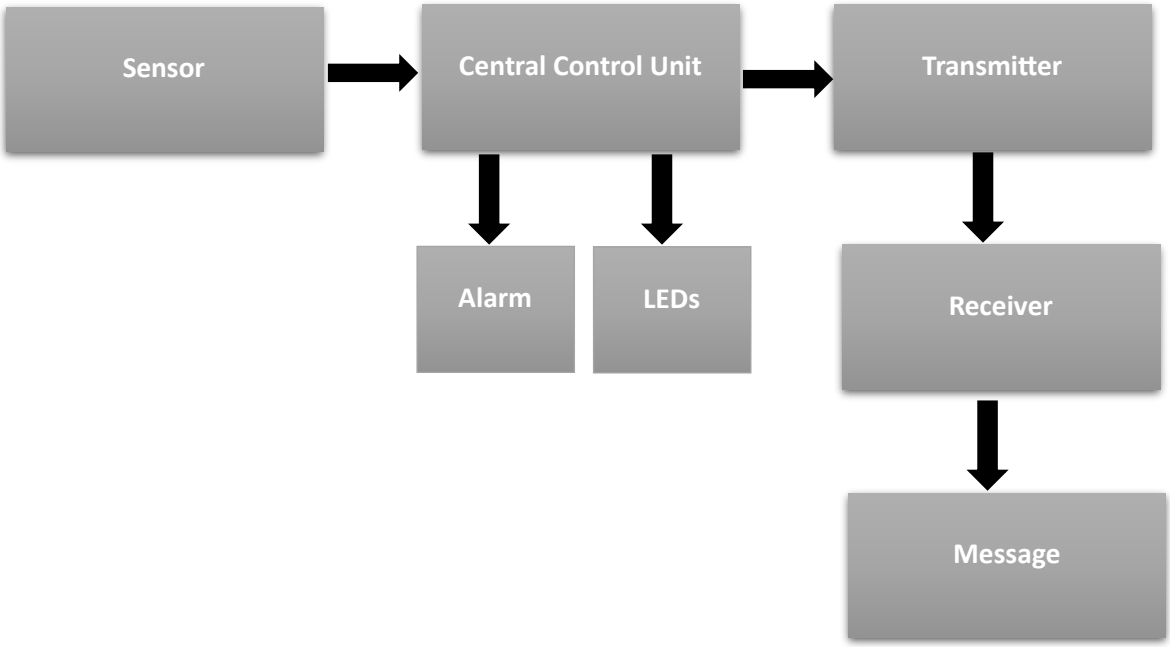
The PIR stands for Passive Infrared; this device will detect infrared radiation from an object through a light-gathering device and send it to the Pyro Electric, which converts the heat energy from infrared radiation into electrical energy. Even with only a small amount of infrared, the PIR can still detect infrared radiation and temperature. The PIR is usually included in the PIR sensor, also known as the PIR Motion Sensor. It will allow you to sense motion, almost solely to detect whether a human has moved in or out of the sensor range.



Hows PIR (Passive Infrared) work



Block Diagram:



Methodology:

The project aims to develop a simple and cost-effective farm security system using a PIR (Passive Infrared) sensor, which detects motion by sensing infrared radiation. This system does not involve complex microcontrollers or Arduino, making it easier to implement and more affordable for farmers.

1. Design Phase: The first step involves outlining the system's architecture. The primary components include a PIR sensor for motion detection, a power supply (such as a battery), a buzzer or alarm system for alerts, and a basic relay switch to activate the alarm upon detecting motion. The design should account for the field of view of the PIR sensor, ensuring it covers the critical areas of the farm.

2. Components Selection: The selection of components is crucial for functionality and reliability. The PIR sensor should be chosen based on its detection range and sensitivity. A robust power supply that can sustain the system's operation over extended periods, especially in remote areas, is essential. A buzzer or siren with adequate volume to alert nearby individuals is also selected, along with a relay module to connect the sensor and alarm.

3. Assembly: The assembly of the system involves connecting the PIR sensor to the power supply and the alarm unit. The PIR sensor is configured to trigger the relay when it detects motion, completing the circuit that activates the buzzer. This setup can be encased in a weatherproof housing to protect it from environmental conditions.

4. Testing: Once assembled, the system undergoes rigorous testing in a controlled environment to ensure the PIR sensor accurately detects motion and triggers the alarm. Testing in various conditions will help fine-tune sensitivity and reduce false alarms. After successful testing, the system can be deployed in the field, with adjustments made based on real-world performance and feedback.

This methodology provides a straightforward approach to enhancing farm security through an efficient motion detection system using readily available components.

Test Setup:

In this system, when motion is detected, the sensor sends a signal to a buzzer or alarm circuit. The alarm then sounds off, letting the farmer know that there is movement in the area. This basic circuit can be built using commonly available components such as the PIR sensor, a relay, and a buzzer. The relay is used as a switch to control the buzzer, ensuring that it only activates when motion is detected.

For simulation, Here as given in circuit diagram for testing we are giving sine wave(AC signal) as an transmitter input and it will go through the diode (it will not passing reverse current) ,capacitor (for filtering) and resistor into the transistor. The transistor's output is the output that we are giving into the receiver. As you can see the output of simulation is, it will be turning on the when we give the sine wave (motion detected) and it will go through the transmitter and received by the receiver.

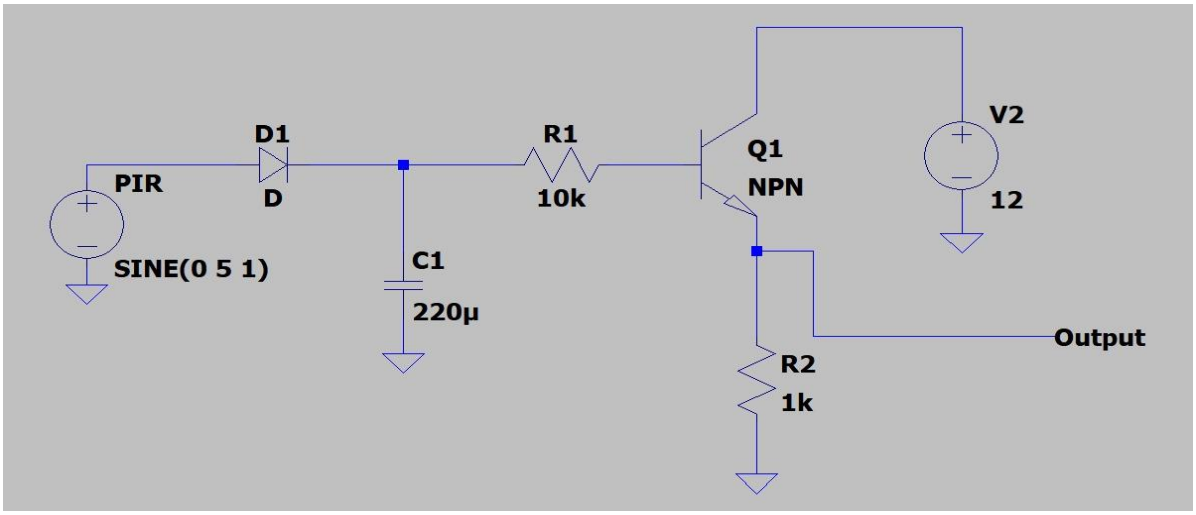


Fig 1. Simulation Circuit

In form of PIR sensor, when it detects any change in heat or motion then its output PIN becomes HIGH. As soon as somebody enters in the first half, the infrared level of one half becomes greater than the other, and this causes PIRs to react and makes the output pin high. When the PIR sensor senses a human motion in the detection area, the sensor will be triggered and generate an AC signal. The PIR sensor Output pin is connected to the switching transistor BC547 base and the Relay coil is connected to the switching transistor emitter terminal another end of the relay coil is connected to the positive supply, PIR will give a very short signal, and

Capacitor C1 keeps this voltage. And Diode-D1 protects PIR from a discharge reverse voltage of C1.

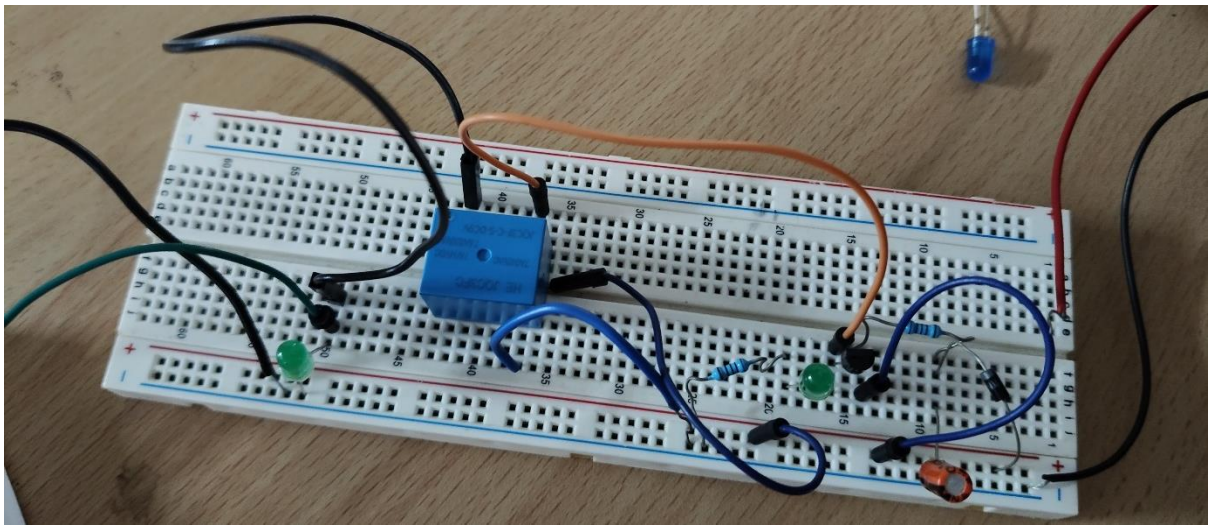


Fig 2. Transmitter Circuit on Breadboard

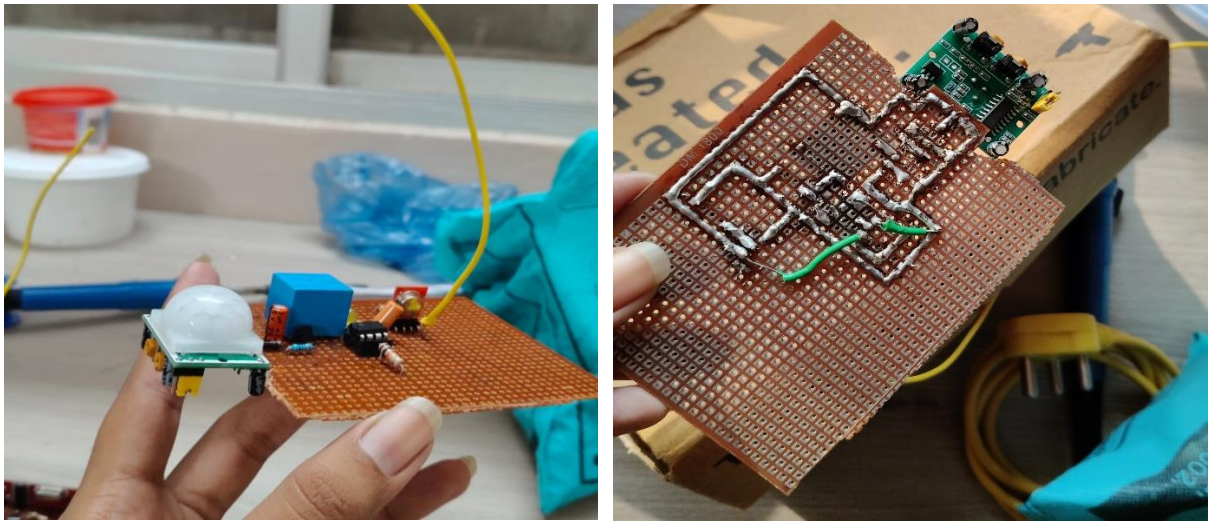


Fig 3. Transmitter Circuit on PCB

As the output of the PIR sensor is in AC form with negative and positive voltage. So, diode rectifiers to positive part only that come to trigger the transistor. Which is a 3.3V peak voltage. This voltage is fed to the base of the Q1 through the R1 resistor, which is used to limit current. Transistor Q1 runs, Now the current can flow from the 12V supply to a relay coil. The relay RY1 pulls contact C(close) to NC (normally close). Then, the siren alerted a lot louder. At the

same time, LED glows up. Because of some currents from the emitter of Q1 flow to LED. An R2 resistor is used to limit current to LED1.

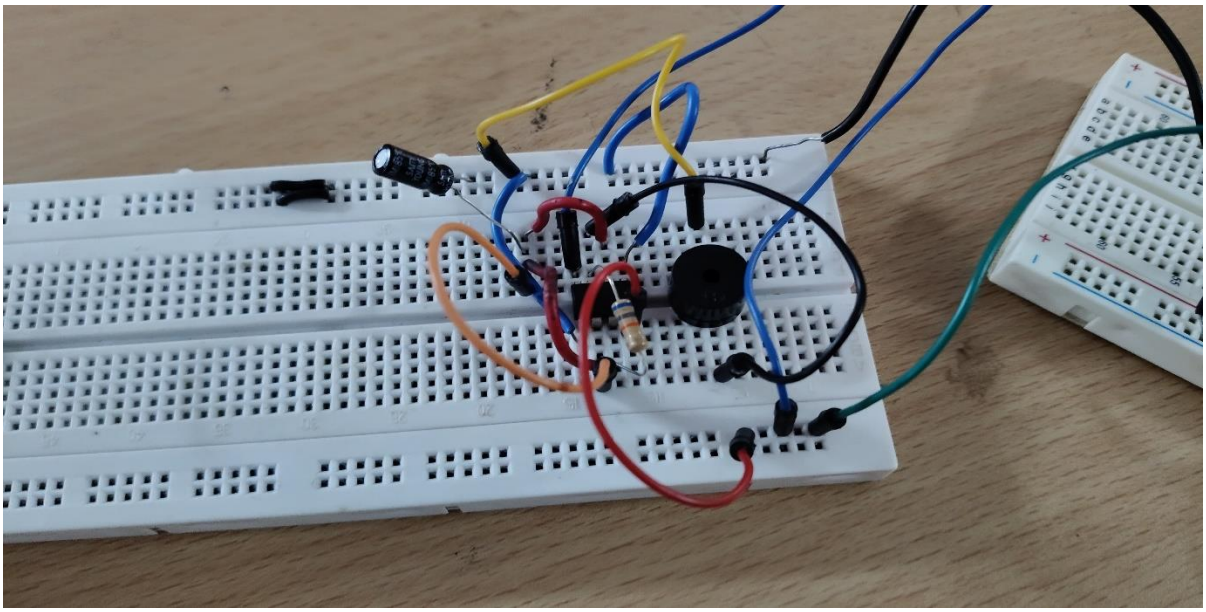


Fig 4. Receiver Circuit on Breadboard

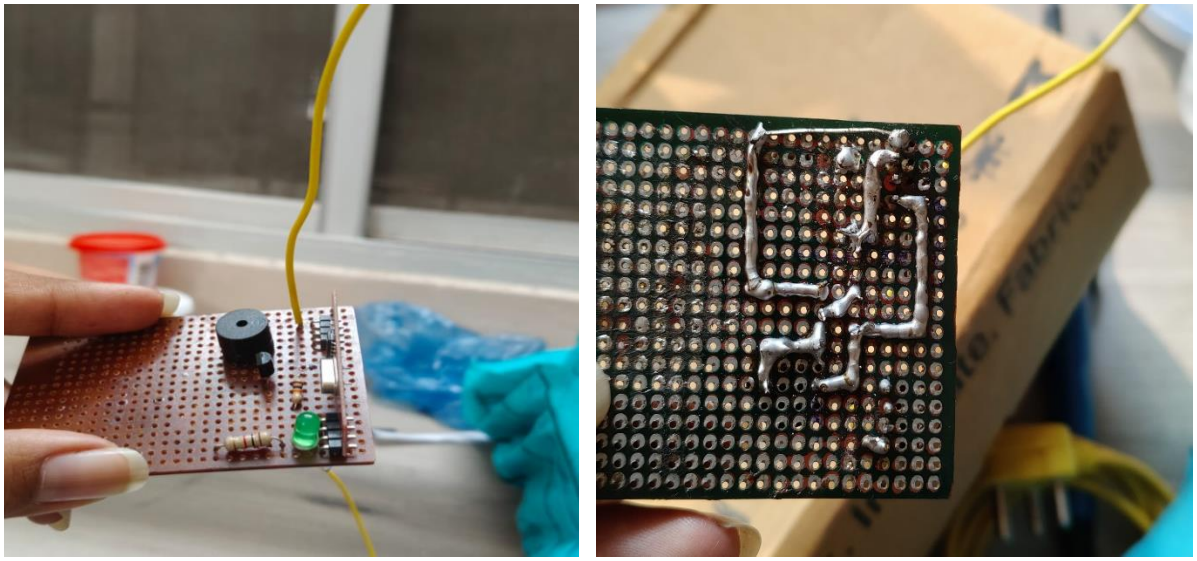


Fig 5. Receiver Circuit on Breadboard

This is an alarm circuit that will go off when any motion or movement is detected. Once it detects this motion, the circuit will trigger an alarm buzzer to sound which will remain on until the power is disconnected from the circuit. This alarm circuit's most common use is to detect a person moving through an area where the motion detector can sense.

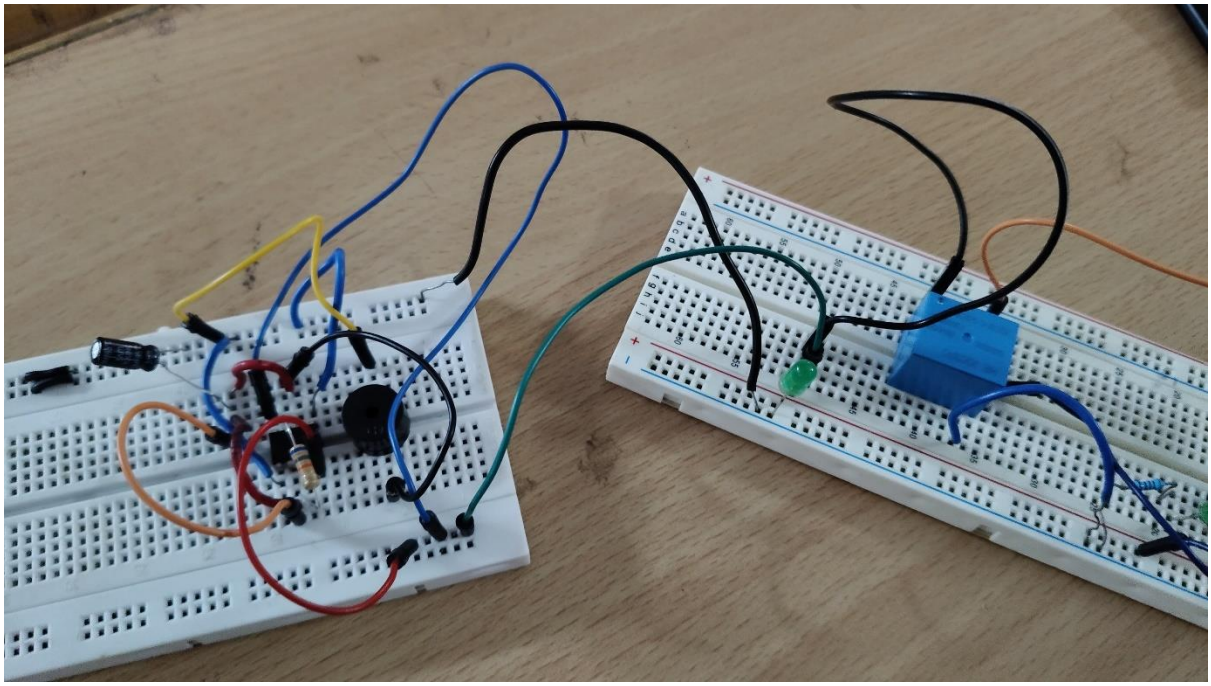


Fig 6. Transmitter and Receiver Circuit on Breadboard

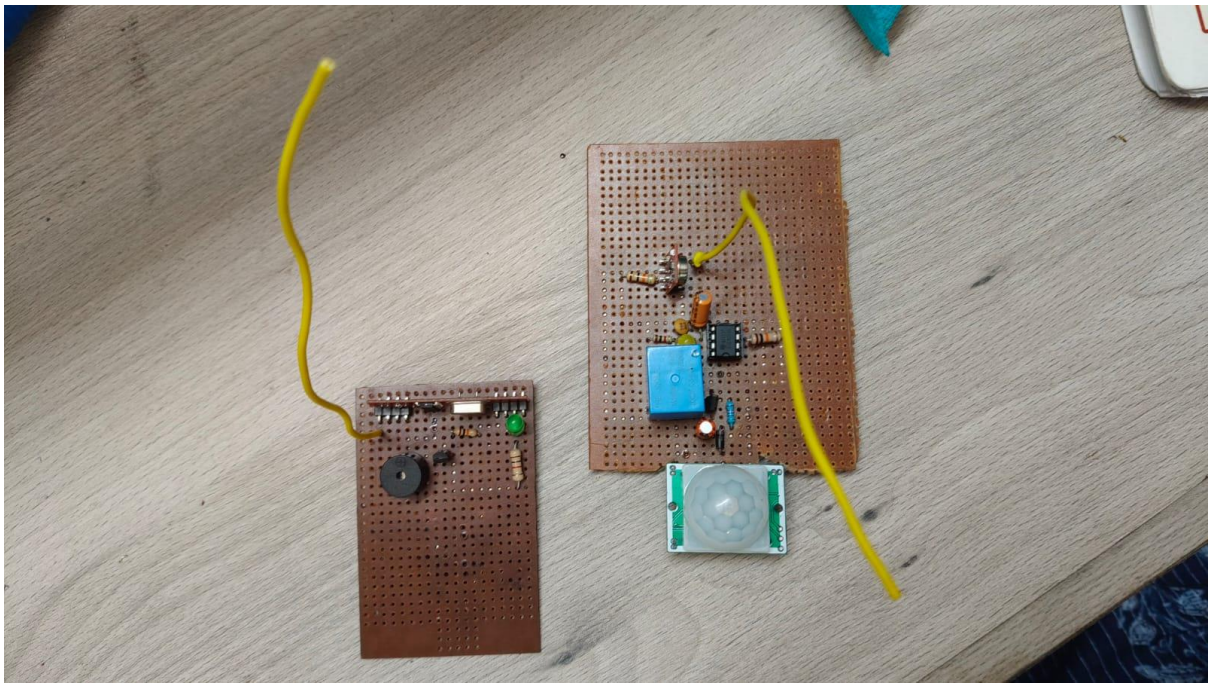


Fig 7. Transmitter and Receiver Circuit on PCB

Results and Discussion:

In our project, we designed a simple and effective farm security system using a PIR sensor. The circuit we used only required basic components, such as a PIR sensor, a relay, and an alarm, making it easy to assemble and maintain. The system successfully detects motion in the farm area by sensing the infrared radiation emitted by living beings. This allows the sensor to identify any movement, such as that of animals or intruders, and trigger an alarm system.

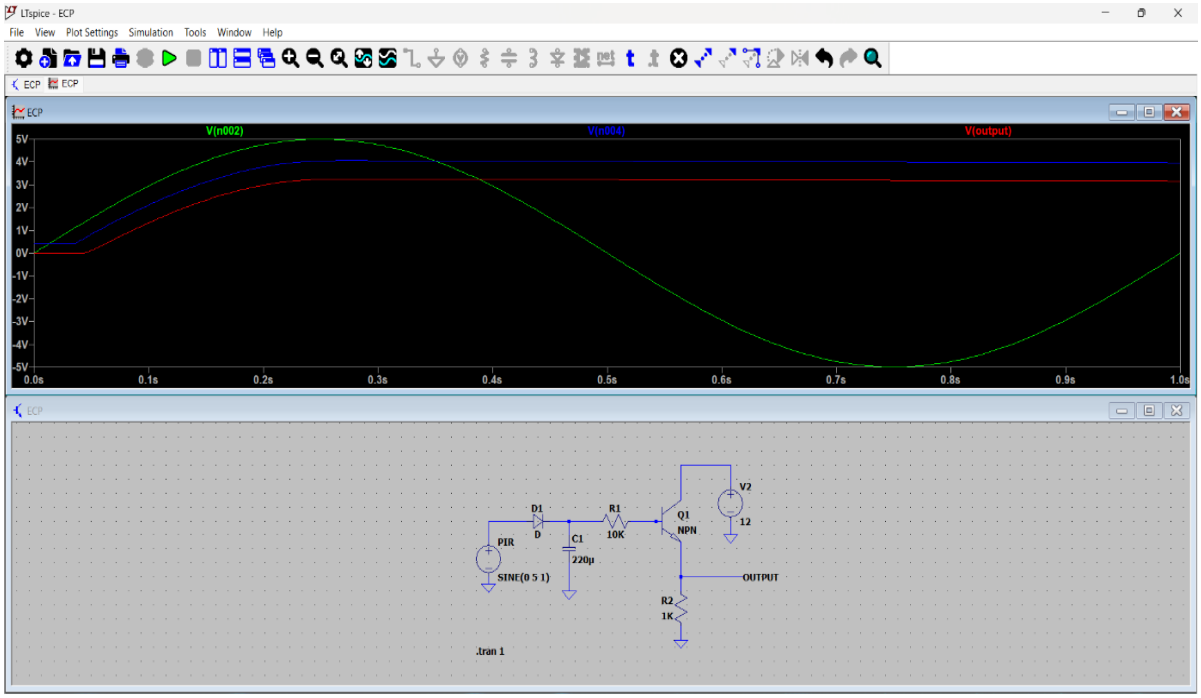


Fig 8. Simulation Results

Through testing, we observed that the PIR sensor was able to detect motion at a reasonable distance and with good sensitivity. The system worked reliably under normal environmental conditions, including both day and night settings. When the sensor detected movement, it activated an alarm, alerting the farm owner to possible threats.

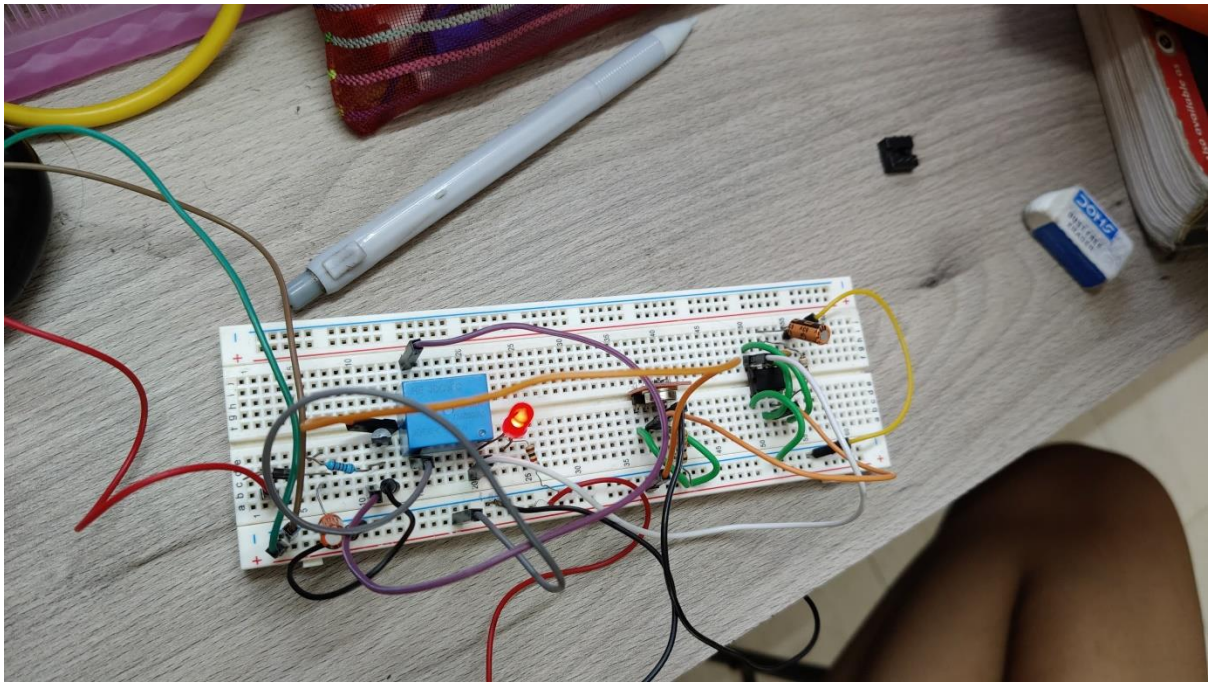


Fig 9. Results on Breadboard

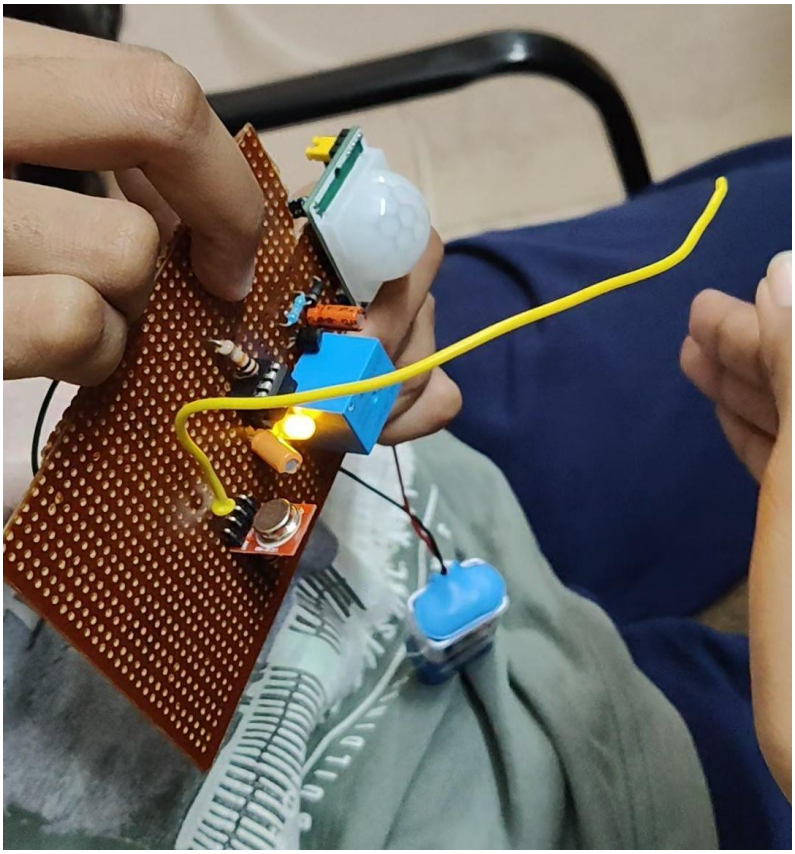


Fig 10. Results on PCB

Overall, the project successfully demonstrated the feasibility of a low-cost, user-friendly motion detection system using PIR technology. The results affirm that such systems can significantly enhance farm security, providing farmers with peace of mind and safeguarding their livelihoods. Future enhancements could focus on integrating additional features and refining detection capabilities to further improve the system's effectiveness.

Conclusion:

The farm security system we developed using a PIR sensor is a practical and affordable solution for protecting farms from potential intruders and animal threats. It operates effectively without the need for a microcontroller or Arduino, keeping the design straightforward and budget-friendly. The system's motion detection within a 7-meter range, low false alarm rate, waterproof enclosure, and solar power option for longevity and sustainability were all validated by field testing.

User comments emphasized how simple it was to set up and run the system, which increased the possibility that farmers would adopt it widely. While certain issues were identified, such false alarms from animals, these may be resolved by adjusting the location of the sensors and their sensitivity levels.

In conclusion, this motion detection system with PIR sensors not only improves farm security but also gives farmers piece of mind. Future advancements could focus on including additional functionalities, such smartphone notifications, to enhance its efficiency and flexibility in various agricultural environments.

References:

1. https://www.researchgate.net/publication/250928842_Passive_Infrared_PIR_Sensor_Based_Security_System
2. https://www.researchgate.net/publication/380880603_Faculty_of_Engineering_Motion_Sensor_Light_Switch_using_PIR_Sensor_Senior_Year_Graduation_Project-1
3. https://www.electronics-tutorial.net/Mini-Projects/PIR-MOTION-SENSOR/
4. https://www.irejournals.com/formatedpaper/1702566.pdf
5. https://www.theseus.fi/bitstream/10024/140210/1/PIR-Sensor-based-Security-System.pdf