Smart Agriculture System for Animal Detection and Automated Irrigation Control Using IR Camera, Raspberry PI and Sensor Integration

S. Md. Jakheer[1], G. Ramesh[2], V. Sravan Kumar[3], S. Bhavathi[4], S. Naziya Sultana[5], D. Srinivasulu[6]
Assistant professor[1], UG Students[2,3,4,5,6], Department of Electronics & Communication Engineering,
Sai Rajeswari Institute of Technology, Proddatur[1,2,3,4,5,6]– 516360

mdjakheersyed@gmail.com[1], gandluriramesh20@gmail.com[2], sravankumar4625@gmail.com[3], reddybhavathi0@gmail.com[4] ,syednaziyasultana558@gmail.com[5] ,sreenivastaz147@gmail.com[6]

ABSTRACT:
The primary objectives are to detect animals in the agricultural fields using AI-based image recognition, and to automate irrigation based on soil moisture levels and ambient temperature. this smart agriculture system enhances farm productivity by combining AI-based animal detection with automated irrigation control. The integration of cutting-edge technologies facilitates precision farming, leading to improved crop yields, reduced resource wastage, and increased overall sustainability in agriculture.

Introduction:

The system's core components include an AI camera for animal detection, a Raspberry Pi for data processing and control, and soil moisture and DHT11 sensors for real-time environmental monitoring.

The primary objectives of this system are twofold: to employ AI-based image recognition for detecting animals in agricultural fields and to automate irrigation based on soil moisture levels and ambient temperature.

The Raspberry Pi serves as the central processing unit, orchestrating data collection, analysis, and decision-making processes to optimize resource management. With its user-friendly interface, the system empowers farmers to monitor real-time data, receive alerts, and manually control the irrigation system as needed.

Problem Statement

In traditional agriculture practices, farmers face challenges in effectively managing crop health, optimizing irrigation practices, and mitigating the impact of pests and environmental factors on crop yields. Limited access to real-time data on soil moisture levels, temperature, and pest activity hinders timely decision-making and can result in suboptimal resource allocation and crop management strategies. Additionally, manual monitoring and intervention processes are labor-intensive, time-consuming, and prone to human error, leading to inefficiencies and reduced productivity.

To address these challenges, there is a need for an advanced smart agriculture system that leverages emerging technologies such as artificial intelligence (AI), Internet of Things (IoT), and sensor integration to enable precise monitoring, predictive analysis, and automated control of farm operations. Such a system should be capable of accurately detecting and identifying pests, monitoring environmental conditions, and dynamically adjusting irrigation schedules based on real-time data and predictive analytics. Moreover, the system should be user-friendly, cost-effective, and scalable to accommodate varying farm sizes and agricultural practices.

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METHODOLOGY:

The methodology for developing the IoT-based hydroponic plant monitoring and control system involves several key steps, including system design, sensor integration, control unit development, actuator implementation, and user interface creation. Here's a detailed overview of the methodology:

1. **System Design**:

- Define the requirements and objectives of the hydroponic plant monitoring and control system.
- Identify the essential parameters to be monitored, such as temperature, humidity, pH level, nutrient concentration, and light intensity.
- Determine the communication protocol for wireless data transmission between sensors, control unit, and user interface.
- Design the architecture of the system, including the placement of sensors, actuators, and the central control unit within the hydroponic setup.

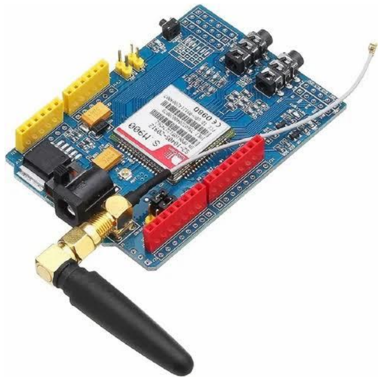
2. **Sensor Integration**:

- Select appropriate sensors capable of accurately measuring the required parameters in a hydroponic environment.
- Integrate sensors into the hydroponic system, ensuring proper placement and calibration for accurate data collection.

Components Used:

GSM/GPRS Module:

The GPRS is a non-voice high-speed packet switching system developed for GSM networks. GPRS is a packet-aligned, wireless communication service that transmits a mobile signal on 3 G and 2 G cellular transmission networks. This module originated in 1970 at the Bell Laboratories. Used predominantly in the world of communication system, an open and digital cellular technology. the GSM module finds its applications in the transmission of mobile voice and data services which operate in the following frequency bands- 1850MHz, 900MHz, 1800MHz and 1900MHz



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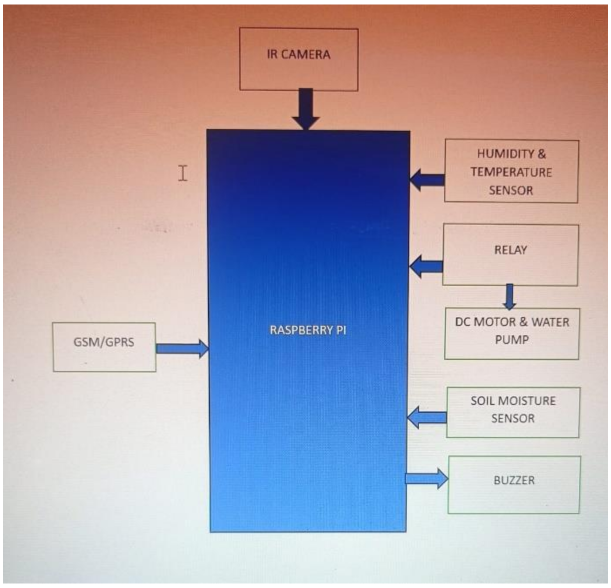
Block Diagram:



Raspberry pi

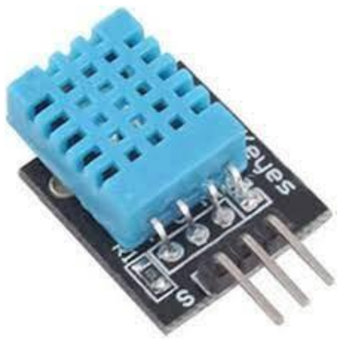
In IoT-based Smart Agriculture projects, Raspberry Pi is most widely used as the main controlling unit that can manage the operation of the various sensors and devices.

Using Raspberry Pi, it is easy to control soil moisture, humidity, PH level, bug detection, and more.

The DHT11:

The DHT11 is a basic, low-cost digital temperature and humidity sensor.

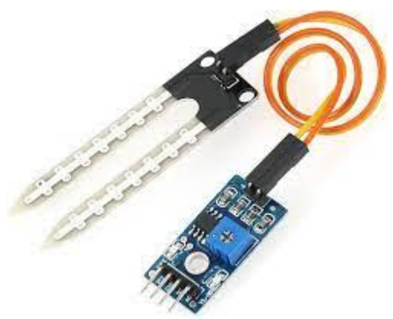
It consists of a capacitive humidity sensor and a thermistor for temperature measurement, integrated with a small microcontroller for data processing.



Soil moisture:

Soil moisture refers to the amount of water present in the soil, typically measured as a percentage of the soil's total weight.

It plays a crucial role in plant growth and agriculture. Monitoring soil moisture levels helps farmers optimize irrigation schedules, prevent overwatering or underwatering, and conserve water resources..



Motor:

A water motor is a device that pumps water from a water source, such as a well or a reservoir, to a desired location, such as a storage tank or irrigation system.

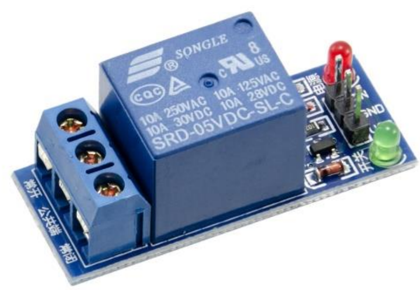
Water motors are commonly used in agricultural, industrial, and residential settings for tasks such as irrigation, water supply, and wastewater management.

Buzzer:

A passive buzzer is an electronic component that produces sound when an alternating current is applied.

Passive buzzers are commonly used in various electronic devices, such as alarms, timers, and notification systems

Relay:



A Relay is an electromechanical device that can be used to make or break an electrical connection. It consists of a flexible moving mechanical part which can be controlled electronically through an electromagnet, basically, a relay is just like a mechanical switch but you can control it with an electronic signal instead of manually turning it on or off. Again this **working principle of relay** fits only for the electromechanical relay.:

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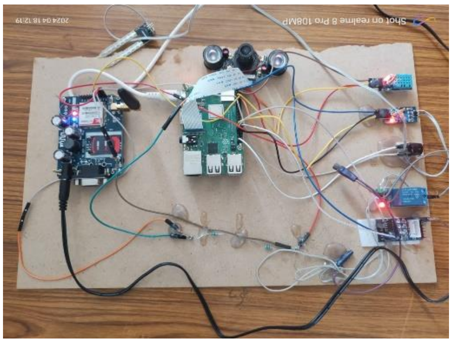
Result:



Conclusion:

Management, offering automated solutions for crop monitoring and irrigation control. By integrating cutting-edge technologies such as AI-based animal detection and real-time environmental sensing, the system enhances productivity, reduces resource wastage, and promotes sustainable agricultural practices. Its user-friendly interface and scalable design make it a valuable asset for farmers seeking to optimize their operations and achieve better yields.

Finally we conclude that by adding the additional components like Solar Panel, GSM, AI camera for both day time and night time viewing and ,Raspberry pi. we can protect our crops and and in crop yielding

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