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Integrated Agriculture System

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Abstract: Automatic irrigation systems leverage advanced technologies, including the Internet of Things (IoT), soil moisture sensors, weather forecasting, and automation, to optimize irrigation processes. It continuously monitors soil moisture levels, weather conditions, and plant water requirements in real-time. The system aims to optimize water usage and enhance crop health by automating the irrigation process based on predefined schedules or manual user input. The NodeMCU, equipped with soil moisture sensors and a water pump, continuously monitors the soil moisture levels in the agricultural field. When the moisture level drops below a specified threshold, the NodeMCU triggers the water pump to initiate irrigation.
The Animal Health Monitoring System was created as a comprehensive and integrated method of managing and monitoring the health and general welfare of animals. This system makes use of advanced technologies, including Sensor devices, sophisticated data analysis algorithms, and effective communication systems, to enable real-time monitoring and analysis of crucial animal health parameters. Its main goals are to advance animal welfare, make health issues easier to spot early, and enable quick action by veterinarian or other cares when required.

***Index Terms* - Health Care, Node MCU, Irrigation, Sensors, Soil moisture, Water Resources, Agriculture, Animals.**

I. Introduction-

In both developing and developed countries, agriculture contributes significantly to GDP. With the projected global population of approximately 10 billion by 2050, it is essential to increase food production by at least 70% to ensure continuous nourishment for the growing population. Achieving food security requires the adoption of sustainable agricultural practices across all farming activities. Sustainable agriculture aims to enhance overall agricultural output while minimizing the environmental impact caused by inefficient farming techniques. However, smart agriculture, which incorporates advanced technologies and automation, often lags in research and necessitates extensive research and development (R&D) efforts. Effective irrigation management is a critical aspect of agriculture that requires particular attention. Currently, 70% of the world's freshwater resources are used for irrigation, highlighting 2 the importance of effective and efficient water use in the agricultural sector. The primary source of social and economic growth is groundwater; only a substantial amount of the earth is utilized by agriculture. Some of the most commonly observed agricultural characteristics for irrigation planning include soil moisture, humidity, and temperature. This smart agriculture system operated by Node MCU includes a soil moisture sensor, a water pump with calling, and an alert SMS system. When the system is activated, it monitors the soil moisture percentage. This data is subsequently sent to the IoT cloud (ThingSpeak) for real-time monitoring. If the ground's levels of moisture fall below a particular point, the water pump is activated automatically, and a call alert will be sent to the farmer.
The Animal Health Monitoring System is an innovative system for managing and monitoring the health and welfare of animals. This system aims to offer immediate insights into animal behavior and physiological parameters, enabling early detection of health problems, prompt intervention, and enhanced overall care. Animal health has traditionally been monitored through manual inspections and routine visits from

veterinarians. These techniques, however, frequently lack continuous monitoring capabilities and might miss minute alterations in animal health. The Animal Health Monitoring System uses innovative sensor technology, data analysis algorithms, and communication systems to overcome these limitations. Various animal populations, such as livestock, pets, and wildlife, can use the Animal Health Monitoring System. It aids in the detection and management of health issues in livestock farming, enhancing productivity and lowering the need for antibiotics. It enables pet owners to monitor their companion animals' health remotely and give preventive care. The system helps with wildlife conservation by monitoring endangered species and spotting potential hazards to their survival.

II. OBJECTIVES-

The primary objective of our system is to use a soil moisture sensor to accurately and consistently monitor soil moisture levels. This allows users to assess moisture levels in real time. The system is designed to collect soil moisture data from the sensor and send it to a handheld ThingSpeak server for data analysis and storage. The objective is to provide real-time access to the data for analysis, visualization, and decision making and to develop a comprehensive soil moisture monitoring and motor control system that accurately measures soil moisture levels, provides real-time access to data for analysis and decision-making, and enables remote control and automation. And the objective of the Animal Health Monitoring system is to promote animal welfare, facilitate early detection of health issues, and enable timely intervention by veterinarians or caretakers when required.

III. LITERATURE REVIEW-

In 2016, Archana and Priya proposed a study in which humidity and soil moisture sensors are installed in the root zone of plants. Based on the measured values, the microprocessor controls the water supply to the surrounding area. This farming method fails to provide the farmer with data regarding the condition of the field **[1].**

Sonali D. Gainwar and Dinesh V. Rojatkar proposed a paper in 2015 in which the soil properties like pH level, relative humidity, the moisture, and temperature can be measured so as to increase the soil yield. The motor pump is fully automated and is switched ON/OFF according to the soil moisture content. The system does not inform farmers about the current status of their fields **[2]**.

In their paper presented in 2016, V. R. Balaji and M. Sudha proposed that the system obtains power from sunlight using photovoltaic cells. This system doesn't require electricity. With the help of the PIC microcontroller and soil moisture sensor, the motor pump was turned on and off depending on the sensed values. This system does not involve weather forecasting **[3]**.

R.Subalakshmi proposed a paper in 2016 that would simplify the irrigation process by automating the complex processes of irrigation. A microcontroller and GSM are used in the system. When the sensed values from the soil moisture, temperature, and humidity sensors exceed the system's acceptable range, the GSM informs the farmer. This system fails to estimate the soil's nutrient content. **[4]**.

Karan Kansara put forth an automated irrigation system in 2015, in which soil conditions are detected by means of humidity and temperature sensors and the flow of water is managed by a microcontroller based on that data. GSM will be used to inform the farmer. This kind of system fails to monitor the nutrient content of the soil. **[5]**.

In 2016, G.Parameswaran and K.Sivaprasath proposed an Internet of Things-based smart drip irrigation system with temperature, humidity, and pH sensors. The irrigation status is sent to the server or local host through personal computer. The farmer cannot learn about the condition of his field unless he has access to the internet **[6]**.

When pet owners are busy or away from their pets, they should be most concerned about the installation of an internet of things-based Pet Care System, which includes a pet food dispenser, water dispenser, and trash box. They utilise IoT technology in the project in order to create a single system that includes these three components. With the help of Wi-Fi modules and Arduino Uno boards, the three components are connected to the local network **[7]**.

IoTAH (Internet of Things in Animal Healthcare): A Review of Recent Advances in Architecture, Sensing Technologies, and Real-Time Monitoring. The article covers a wide range of animal-friendly biosensors, computers, communication, and wearable technology. The primary goal of this article is to look at the latest advances in the field of animal healthcare, involving domestic, farm, and wild animals. The article examines the currently available smart technologies for various animal species. The findings of this study are expected to improve current and future research and development on animal welfare systems. Water consumption can be monitored using the water dispenser. The litter box records how frequently and when the pet makes use of the bathroom. A smartphone interface is used to link the three subsystems, allowing the user to track, regulate, and display data from the devices. **[8]**.

Yu-Huei Cheng's growing architecture for an online animal control system makes use of the Internet of Things and artificial intelligence. This paper unveils a development architecture for an Internet of Things and AI-based smart animal management system. Its main goal is to use IoT and AI to perform various time-consuming animal care tasks, allowing administrators to more systematically care for and manage animals. **[9]**.

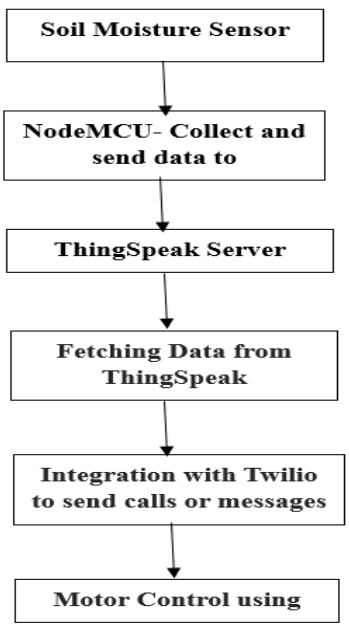
IV. METHODOLOGY-

4.1 Automatic Irrigation System –

An Automatic irrigation system is designed to efficiently water plants based on real-time environmental conditions, reducing water wastage and improving crop yield. The system in this project utilises soil moisture detection to decide when and how much to water the plants. The methodology involves several components working together to create an automated irrigation system:-

The system initializes by collecting the initial soil moisture data using the soil moisture sensor connected to the NodeMCU board. the NodeMCU board periodically sends the collected soil moisture data to the ThingSpeak server using appropriate communication protocols like HTTP or MQTT. This ensures that the data is continuously updated on the server and accessible from anywhere with internet connectivity. The Python code running on a separate device fetches the data from the ThingSpeak server using HTTP requests to the ThingSpeak API. The data is extracted and analyzed to determine the moisture level trends over time. Based on the analyzed data, the system can make intelligent decisions about whether the plants need watering or not. For example, If the level of soil moisture falls below an established threshold, the system activates the irrigation motor. Further, the Python code integrates with the Twilio API to send calls and messages. Alerts can be set up to notify the user of critical events, such as low moisture levels or system malfunctions.

Flowchart for automatic irrigation system-



Steps Followed-

Soil Moisture Sensing: The system begins by gathering data collected by the soil moisture sensor. To determine the moisture level, the NodeMCU board examines the soil moisture sensor. The moisture-related data is temporarily saved.

Sending Data to ThingSpeak: The NodeMCU board sends the collected data to the Thing Speak server. The data is transmitted using an appropriate communication protocol (e.g., HTTP, MQTT). The NodeMCU establishes a connection with the ThingSpeak server and sends the moisture data.

Fetching Data from ThingSpeak: A Python code running on a separate device fetches data from the Thing Speak server. The Python code sends an HTTP request to the Thingspeak API. The data received from the server is extracted and processed as required.

Integration with Twilio: The Python code integrates with the Twilio API to send calls and messages. Relevant information, such as moisture data or alerts, can be used to trigger the Twilio functionality. The Twilio API is accessed using appropriate credentials and API requests to send calls or messages.

Motor Control using NodeMCU: Another NodeMCU board is utilized to control a motor. A Python code with a Tkinter-based GUI is developed to create an interface for motor control. The GUI includes an on/off button to control the engine. The Python code establishes communication with the NodeMCU board to send commands for motor control.

Motor Control Execution: The Python code waits for a button press event from the GUI. If the button is pressed, the Python code sends a command to the NodeMCU board to turn on the motor. If the button is pressed again, the Python code sends a command to the NodeMCU board to turn off the motor. By following this methodology, the system collects data from the soil moisture sensor, sends it to the ThingSpeak server, fetches data using Python code, integrates with Twilio for call and message functionality, and controls a motor using another nodeMCU board and a Python code with a Tkinter-based GUI.

4.2 Animal Monitoring System-

This methodology in figure.07 involves designing and implementing a system that effectively collects, analyses and presents animal health data in a meaningful way. It aims to provide timely insights and alerts to animal owners, caretakers, and veterinarians, facilitating proactive health monitoring and decision-making. System Design and Sensor Selection: The objectives and requirements of the Animal Health Monitoring System, including the types of animals to be monitored and the parameters to be measured. sensors selection is done which includes sensors such as MAX30100 SPO2 AND bpm sensor DHT11.

Sensor Installation: Determining the optimal locations for sensor placement on the animal bodies, ensuring comfort and minimal interference with their natural behaviour. Safely attaching or implanting sensors on the animals, following appropriate procedures, and considering the species-specific requirements.

Health Monitoring Dashboard: Creating a user-friendly interface or dashboard that displays real-time health information of the monitored animals. Present the data in a clear and understandable manner, using visualizations, charts, and alerts to highlight important health indicators.

V. Results And Discussion-

5.1 Automatic Irrigation System-

When the soil moisture level lowers, there is a call alert send to the user with message as shown in the image, the pump automatically turns on and distributes water. Similarly, when the soil moisture becomes wet, the pump shuts down and no water is sent to the crop. This not only saves water that would otherwise be squandered, but it also promotes greater crop growth because only the necessary amount of water is applied to the crop.

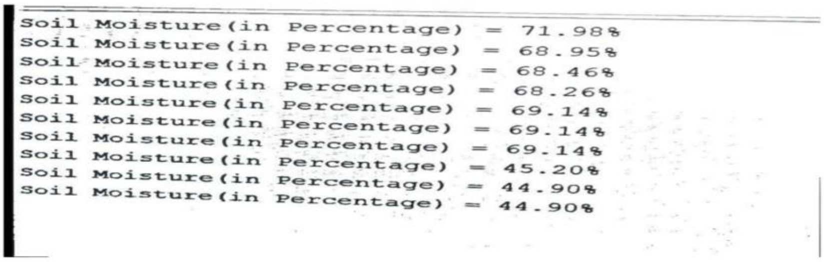


Figure.01 *Soil moisture percentage level*

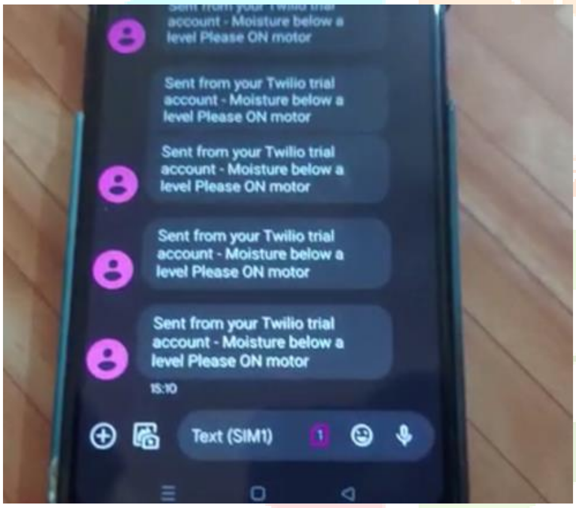


Figure.02 *Alert massage through TWILIO app*

Figure.03 *GUI for motor control*

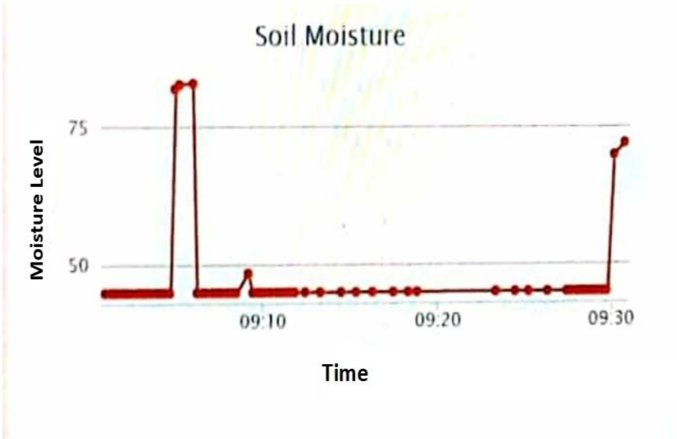


Figure.04 *Time v/s Moisture level graph*

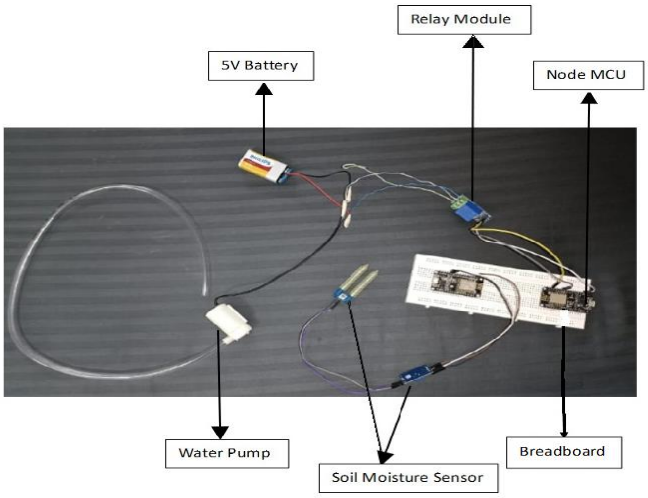


Figure.05 *Experimental set up for automated water irrigation*

5.2 Animal Monitoring System-

The system offers continuous tracking of important data, including temperature, heart rate, and other vital indicators. This makes it possible to identify health problems or abnormalities early on. Early disease or condition symptoms that might go unnoticed during routine observation can be found using the system. The system aids in early intervention and treatment by spotting subtle changes in health parameters, potentially improving prognosis and lowering treatment costs.

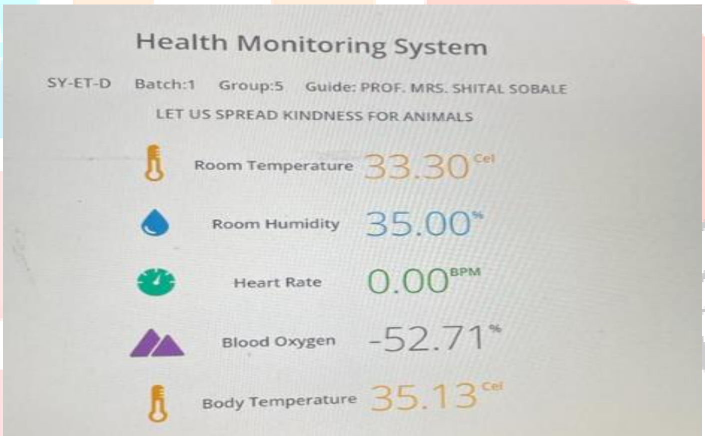


Figure.06 *Animal health monitoring data*

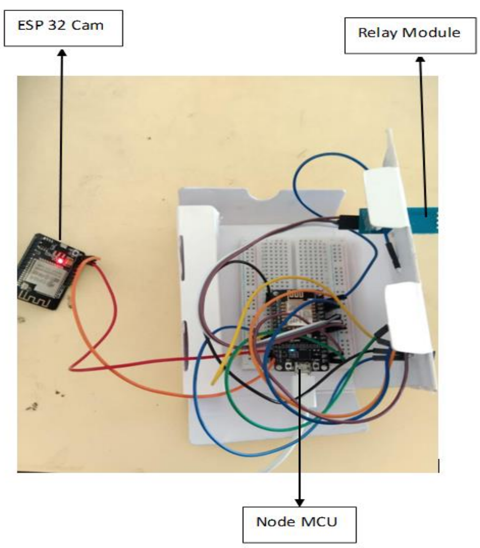


Figure.07 *Experimental Set up for animal health monitoring*

VI. CONCLUSION-

1.1 Automatic Irrigation System-

In conclusion, the developed system offers an efficient and flexible solution for soil moisture monitoring, data management, motor control, and communication. It empowers users with real-time information, alerts, and control capabilities, enhancing productivity and efficiency in various applications such as agriculture, gardening, and automated irrigation systems. With its user-friendly interface and seamless integration of technologies, the system provides a reliable and practical tool for optimizing soil moisture levels and ensuring optimal plant health. We can clearly see that this automated irrigation system, which not only allows water supply based on soil moisture but also takes weather conditions into account, has made water usage more efficient. More research is needed to conduct these types of studies in order to make water usage more efficient by using automatic irrigation systems. This automated irrigation system's main goal is to improve the present setup by making it more creative, simple to use, quick and easy, and efficient. Farmers can access information about crop field nature at any time and from any location because of server updates. As water scarcity becomes an increasingly pressing global issue, automatic irrigation systems will play a crucial role in ensuring responsible and sustainable water management. By conserving water resources, minimizing waste, and optimizing irrigation practices, these systems contribute to the preservation of our environment and the long-term viability of agricultural and landscaping endeavors. The ongoing advancements in technology and the increasing demand for efficient water management indicate a bright future for automatic irrigation systems, paving the way for enhanced productivity, reduced environmental impact, and improved resource utilization in the agricultural and landscaping sectors.

6.2 Animal Monitoring System-

In conclusion, the Animal Health Monitoring System revolutionizes the way animal health is monitored and managed. By harnessing technology and data analysis, it enhances the ability to detect and address health issues promptly, leading to improved animal welfare, reduced healthcare costs, and more sustainable and responsible animal care practices.

VII. FUTURE SCOPE-

5.1 Automatic Irrigation System-

Using sophisticated methods for data analysis like data mining and machine learning, or predictive modeling, the system can provide more insightful information about soil moisture patterns and trends. This can enable users to make more informed decisions regarding irrigation schedules, water conservation, or plant health optimization. The system can be expanded to include additional sensors for collecting more environmental data. Also, by integrating sensors for temperature, humidity, light intensity, or nutrient levels can provide a more comprehensive understanding of the plant's growing conditions. This expanded sensor network can enable better control and management of the overall plant environment.

Integrating weather forecast data into the system can enhance its functionality by considering weather conditions when making decisions about motor control and irrigation. By utilizing weather APIs or services, the system can adjust irrigation schedules based on predicted rainfall, temperature, or other relevant weather parameters. This can further optimize water usage and improve plant health management. These future scopes can extend the functionality, usability, and intelligence of the system, making it more robust, adaptable, and efficient in meeting the evolving needs of users in the field of agriculture, horticulture, and plant care.

5.2 Animal Monitoring System-

Integrating artificial intelligence (AI) and machine learning (ML) algorithms into the Animal Health Monitoring System can enhance data analysis capabilities. AI and ML can help detect complex patterns, predict health issues based on historical data, and provide personalized recommendations for animal care and treatment.

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