Smart IoT Device For Monitoring The Irrigation System

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Abstract- **Asian country well known for agriculture and for its population which increase the demand for water resources. So, smart water irrigation system is playing important role in providing the estimate amount of water to field and prevent the wastage of water. We build IoT devices which would provide live soil moisture, temperature, and rain detection of the field to the farmers**. [1]

INTRODUCTION:

The word agriculture is a late Middle English adaptation of Latin agriculture, from ager 'field' and cultūra 'cultivation' or 'growing'. Agriculture is defined with varying scopes. In its broadest sense, it involves using natural resources to "produce commodities that maintain life, including food, fibre, forest products, horticultural crops, and their related services." Thus, it includes arable farming, animal husbandry, but horticulture and forestry are often excluded in practice. It may also be broadly decomposed into plant agriculture, which concerns the cultivation of useful plants, and animal agriculture, the production of agricultural animals.

In today's era, technological advancements are significant. However, farmers still rely on old traditional methods for monitoring crop health due to cost and reliability issues associated with technology. One of the most significant challenges in agriculture is water scarcity and controlling water content in the area. Soil and environmental parameters affect crop growth, making it essential to monitor these factors to help farmers increase crop yield.

Literature survey.

	DONE	ADVANTAGES	DISADVANTAGES
Researchers: Ram Krishna Jha (2017) [1].	The work involves the implementation of IoT (Internet of Things) devices for field monitoring. The setup includes an Arduino Microcontroller board along with soil, temperature, and humidity sensors.	-Real-time Monitoring -Data-driven decisions. -Crop productivity. -Preventions Measures. -Efficiency.	-Technical Complexity. -Cost - Data Privacy and Security. -Maintenance. -Energy consumption
Researchers: Khin Than Mya (2020) [2].	Design of IoT based Smart Watering System Using Long Range (LoRa) Network is proposed to promote the smart agriculture in the country. The system collects data from paddy field using IoT devices and stored data in cloud server.	It will help to people to prevent the wastage of water, time, cost, and manpower used in farming and increase the efficiency of the irrigation process [2].	Data Security: Ensuring the security of sensitive farming data is essential to prevent unauthorized access or data breaches. Technical Complexity: Farmers may require technical expertise to set up and maintain IoT systems, which could be a barrier for some.

Researchers: S. Solanke (2018) [3].	IoT Based Crop Disease Detection and Pesting for Greenhouse. In this approach, a smart device is placed in between plants lane in a way that it will cover the whole farm in a zigzag manner.[3]	Zigzag Pattern Coverage: The use of a zigzag pattern for device placement can ensure comprehensive coverage of the entire farm, minimizing blind spots where diseases might go unnoticed. Scalability: IoT solutions can be scaled to suit the size of the farm, making them accessible to small-scale as well as large-scale farmers.	High Initial Costs Complexity Connectivity Issues Data Security Data Overload Energy Consumption Compatibility Maintenance Costs
Researchers: C K Gomathy (2021) [4]	To conserve water and enhance efficiency, Smart Irrigation Systems utilize IoT technology with sensors to monitor soil conditions. They automatically activate irrigation when needed and display information on user devices.	Smart irrigation systems provide real-time information on soil conditions and motor status, making it accessible and user-friendly for farmers	

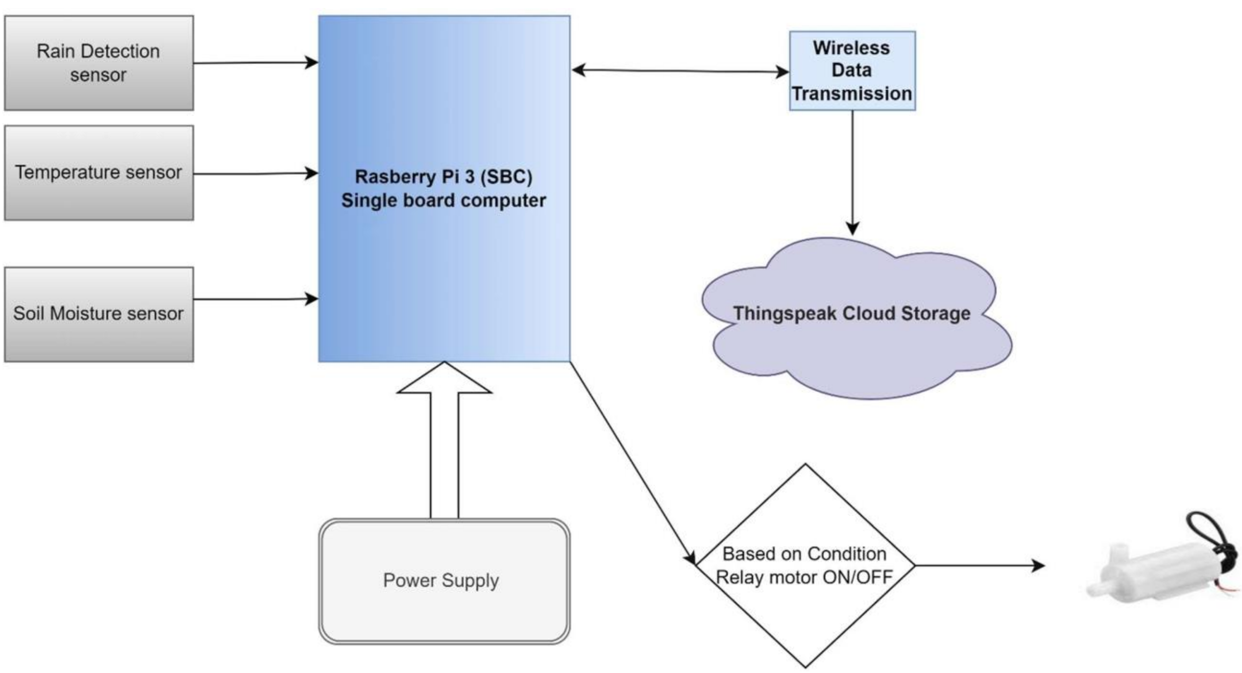


Fig 1. Block Diagram of Proposed system.

The block diagram above illustrates the condition of the soil. It encompasses various components, including a wireless sensor, data transmission, a temperature sensor, a Raspberry Pi 3 single-board computer, a soil moisture sensor, ThingSpeak cloud storage, a power supply, and a relay for motor control. The diagram likely portrays the flow of data and processes within the rain detection system.

System Design and Implementation Detail

Block Diagram/System Architecture

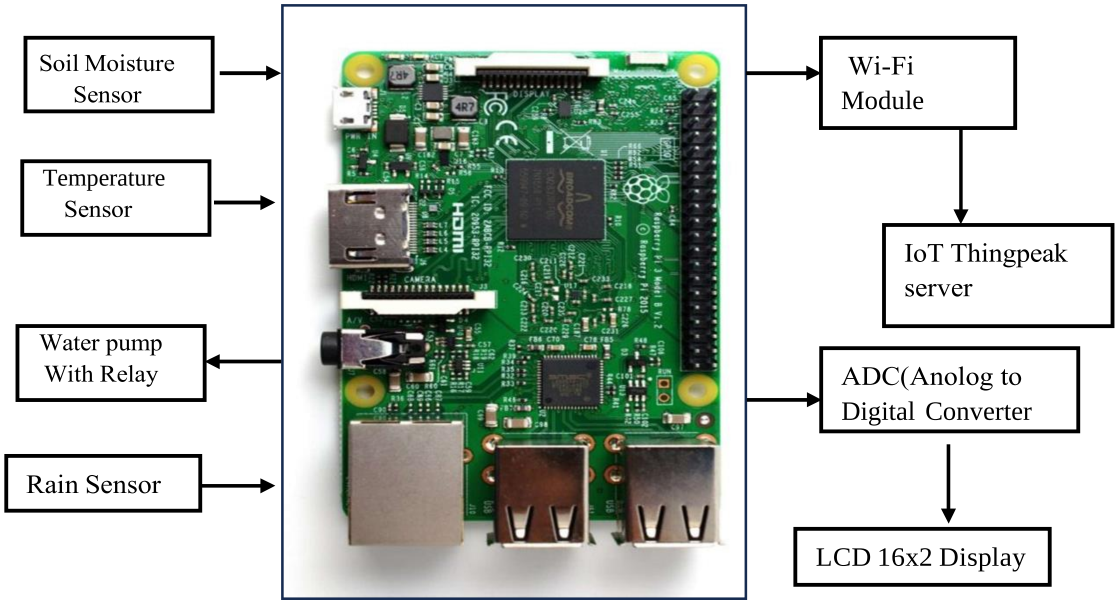


Fig 2. System Block Diagram

The above system block diagram represents the main structure of the project, illustrating how the Raspberry Pi is connected to various input and output devices. The primary inputs include soil sensors, temperature sensors, and a rain sensor. The main outputs from the Raspberry Pi are the water pump controlled by a relay, a Wi-Fi module connecting to the ThingSpeak server, and an LCD 16x2 display for visualizing the sensor data.

Hardware used:

a) Raspberry Pi: The Raspberry Pi is a compact, pocket-sized computer designed for performing lightweight computing and networking tasks. It plays a crucial role in the realm of the Internet of Things (IoT), facilitatinginternet access and enabling the connection of automation systems to remote control devices.

The Raspberry Pi 3 is a versatile and affordable computing platform that packs significant processing power into acompact form factor. It features a 1.2 GHz quad-core ARM Cortex-A53 CPU, making it capable of handling a wide range of computing tasks. It also includes 1GB of RAM, providing ample memory for various applications.

One of the notable features of the Raspberry Pi 3 is its built-in wireless connectivity. It comes with both Wi-Fi (802.11n) and Bluetooth 4.1, eliminating the need for external adapters and enhancing its suitability for IoT (Internetof Things).

Fig 4. Raspberry Pie

b). Soil Moisture sensor: A soil moisture sensor is a device designed to gauge the water content present in the soil by leveraging the soil's electrical resistance characteristics. The correlation between the measured property and soil moisture levels is calibrated and can be influenced by environmental factors like temperature, soil composition, and electrical conductivity. In this context, the sensor is employed for detecting soil moisture in a field and transmitting this data to a Raspberry Pi, enabling the automation of water pump control based on moisture levels.

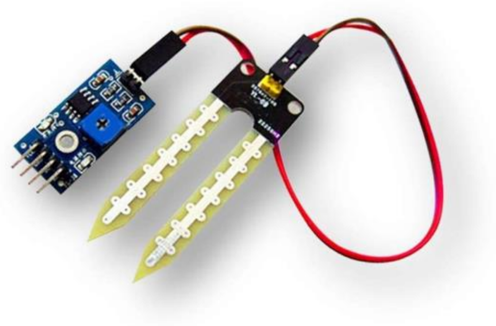


Fig.4 Soil Moisture Sensor

c) Rain sensor detection:

A rain sensor or *rain switch* is a switching device activated by rainfall. The rain sensor works on the principle of total internal reflection. An infrared light beam at a 45-degree angle on a clear area of the windshield is reflected and it is sensed by the sensor-inside the car. When it rains, the wet glass causes the light to scatter and lesser amount of light gets reflected to the sensor.

Fig.5 Rain sensor detection

d) Temperature sensors: LM35 is a temperature measuring device having an analogy output voltage proportional to the temperature. It provides output voltage in Centigrade (Celsius). It does not require any external calibration circuitry. The sensitivity of LM35 is 10 mV/degree Celsius. As temperature increases, output voltage also increases. E.g., 250 mV means 25°C.It is a 3-terminal sensor used to measure surrounding temperature ranging from -55 °C to 150 °C. LM35 gives temperature output whichis more precise than thermistor output.

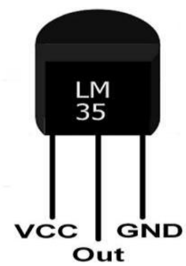
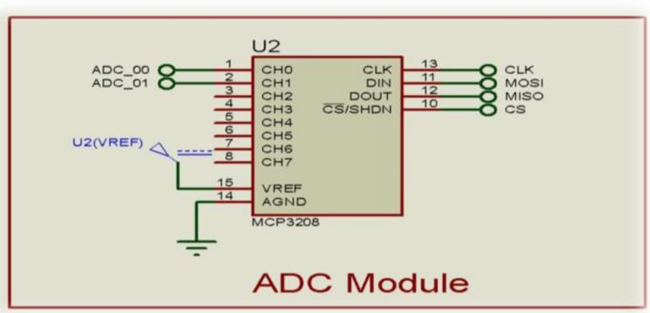


Fig.6 LM35 Temperature Sensor

e) Relay: A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must becontrolled by one signal.

Fig.7 Relay Device



f) ADC module: An analog-to-digital converter (ADC) is used to convert an analog signal such as voltage to a digital form so that it can be read and processed by a microcontroller. Most microcontrollers nowadays have built-in ADC converters.

Fig. 8 ADC Module

SOFTWARE USED:

a) Simulation Details:

Simulation of Physical Data: Proteus software is a popular simulation software that can be used to simulate and test the IoT based smart agriculture monitoring system before deploying it in the field. This software allows you to simulate the behavior of the system, test the code, and verify the overall functionality of the system. It can simulate the behavior of the Arduino board, sensors, and actuators, and test the code that controls the actuators. Proteus software can also verify the accuracy of the data obtained from the sensors and ensure that the actuators are being controlled as intended based on the sensor data. It can also be used to test the system under different environmental conditions, such as varying light intensity and soil moisture levels, to save time and resources.

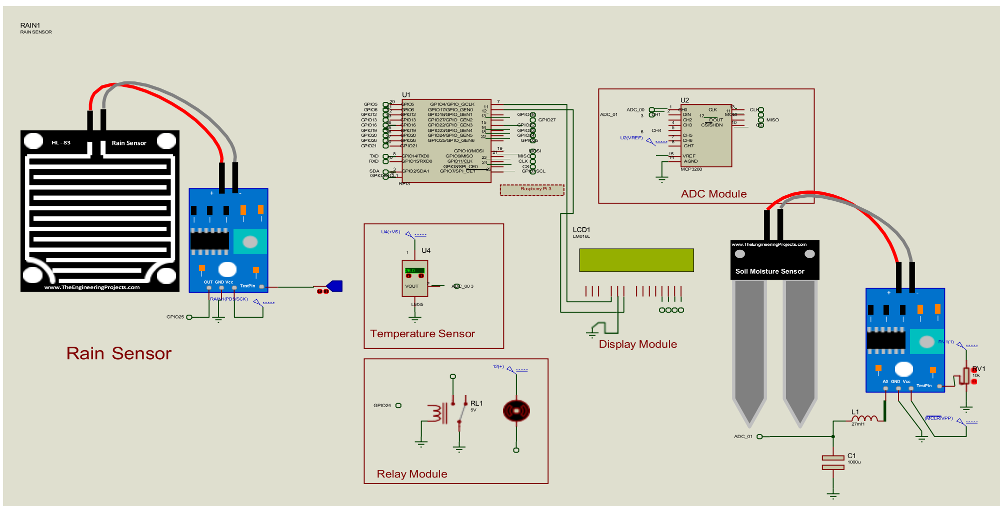
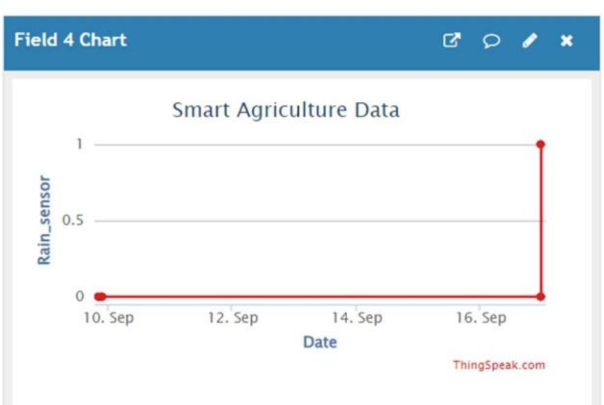
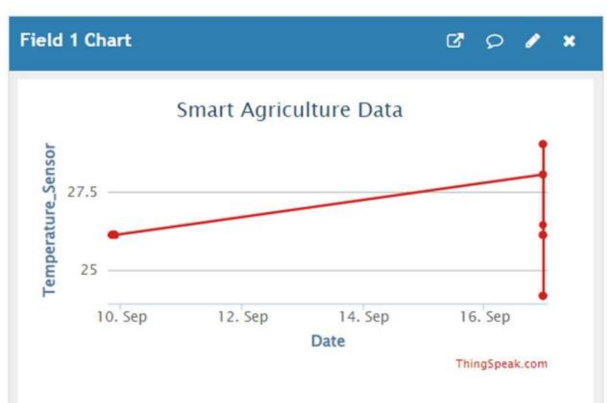


Fig.9 Simulation image from proteus software

a) Thingspeak: Thingspeak is an open-source Internet of Things application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. Thingspeak enables the creation of sensor logging applications, location tracking applications, and a social network ofthings with status updates. Thingspeak was launched as a service in support of IoT applications.





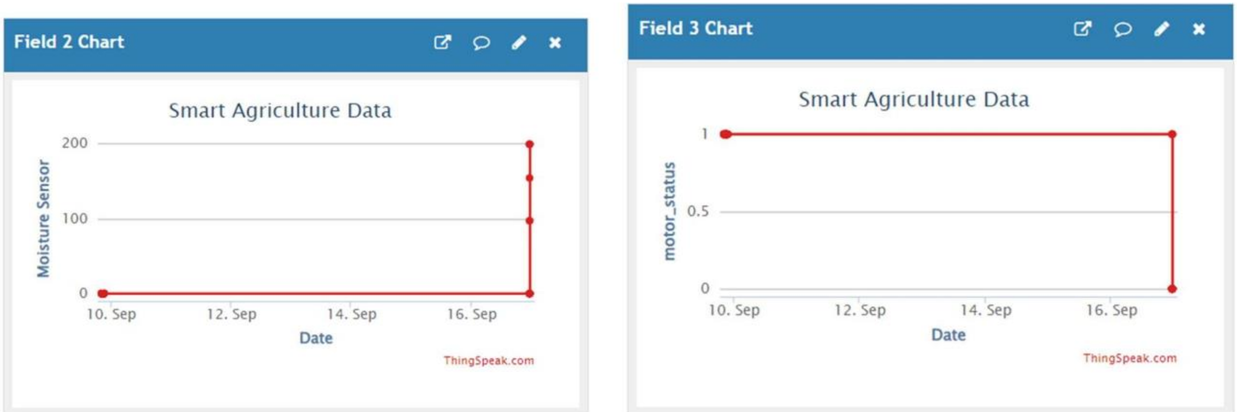


Fig 10. Live data of sensors shown on graph using ThingSpeak

The above graph shown the live data of sensors working on the raspberry pi:

Field 1:
Field 1 displays real-time temperature sensor data. The x-axis represents time, and the y-axis represents temperature in degrees Celsius.

Field 2:
Field 2 presents real-time soil moisture data. The x-axis denotes time, while the y-axis represents the moisture level.

Field 3:
Field 3 illustrates the on/off status of the motor in a graph. On the y-axis, a value of 1 indicates that the motor is on, while a value of 0 indicates that the motor is off. The x-axis represents time.

Field 4:
Field 4 depicts data from the rain sensor. A value of 1 on the y-axis indicates the detection of rain, while a value of 0 signifies no rain detection

CONCLUSION:
The sensors are successfully interfaced with raspberry pi and wireless communication is achieved.
After the successful integration and monitoring the Implementation of such a system in the field can help to improve the yield of the crops and to manage the water resources effectively reducing the wastage.

References

[1] R. K. Jha, "Field Monitoring Using IoT in Agriculture," in *International Conference on Intelligent Computing,Instrumentation and Control Technologies*, 2017.

[2] K. T. Mya, "A Design for IoT Based Smart Watering System," in *IEEE 9th Global Conference on Consumer Electronics (GCCE*, 2020.

[3] S. Solanke, "IoT Based Crop Disease Detection and Pesting for," in *3rd International Conference for Convergence in Technology (I2CT)* , 2018.

[4] D. C. K. Gomathy, "THE SMART IRRIGATION SYSTEM USING IOT," in *International Research Journal of Engineering and Technology (IRJET)*, 2021.