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A Review On Intelligent Irrigation for Millets with GSM Application

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***Abstract*—**Agriculture is called the backbone of the Indian economy because majority of the population is dependent on agriculture. The agriculture sector contributes about 14% of the total GDP in India. Several irrigation techniques are used in agriculture like irrigation sprinklers, surface irrigation, drip irrigation, manual irrigation, etc. Some of these techniques are effective in the management of water resources but still, they do not measure the moisture or the required amount of water. So, to further improve the mode of irrigation, smart irrigation techniques are used to improve the effective usage of water resources. The challenges faced by the existing irrigation system are water wastage, manual labour, and poor performance, so sensors like moisture, temperature, and pH are used in monitoring and irrigating the field. From the sensed value of the temperature and moisture sensor, the field would be irrigated if the sensed value is low. If the moisture and temperature value for the particular crop is reached the irrigation system would turn off automatically. So this technological improvement would be helpful in meeting the demand for irrigation, as there may be a scarcity of water in the future.

Keywords- Agriculture, Sensors, Intelligent irrigation, IoT

I. INTRODUCTION

Smart irrigation would play an important role in the world where the world is moving towards smart technologies. As the needs of people keep on expanding with the increase in population, this smart farming technology would be useful in meeting the demands of people. Some farmers have introduced smart farming to monitor and irrigate their fields.

Water is an important element in the agricultural sector. By using these smart farming technologies, the usage of water can be significantly reduced. The irrigation is done according to the requirement of the plant to grow healthier. The quality of the crop is increased if it is not over or under-watered. Using smart irrigation technology would be beneficial for both the environment and the farmer as the amount of water consumed is reduced and the yield quality is increased.

Smart farming uses sensors like temperature, moisture, and other sensors to monitor and irrigate the field. Factors like climate, soil, temperature, season, crop type, and moisture are important factors in agriculture. These factors can be determined in smart farming. Soil moisture is an important parameter in determining the crop's requirement for irrigation. The smart irrigation system irrigates the land based on soil moisture, temperature, and humidity. The moisture sensor and the temperature sensor monitor the soil moisture and environment temperature respectively and irrigate the crop based on the readings. Water can also be irrigated by calculating the water loss that may happen in the field due to climatic conditions.

II. REVIEW OF LITERATURE

To improve the effectiveness of water usage during irrigation, soil moisture sensors have been used along with temperature sensor LM35 was connected to the relay through Arduino UNO microcontroller board and irrigates the field when the moisture level was below the threshold value. A mobile application has also been provided. Arduino IDE 1.8.9 software has been used for coding and uploading to the Arduino board [1].

Based on the tank monitoring system, the Arduino UNO (ATMEGA328P) is a microcontroller board, which would run at 5 V, 16 MHz clock speed, 14 digital input/out pins, 6 analog input (A0–A5) pins, 6 PWM outputs, 1 universal asynchronous receiver transmitter (UART), and programming interface (USB) via ATMega16U2 [2].

A notification would be sent to the user if the moisture level of the farm was low. A low-cost moisture sensor, temperature sensor and humidity sensor were used. The water level of the water source was also monitored and if there was a fall in the water level it would also be indicated.[3]

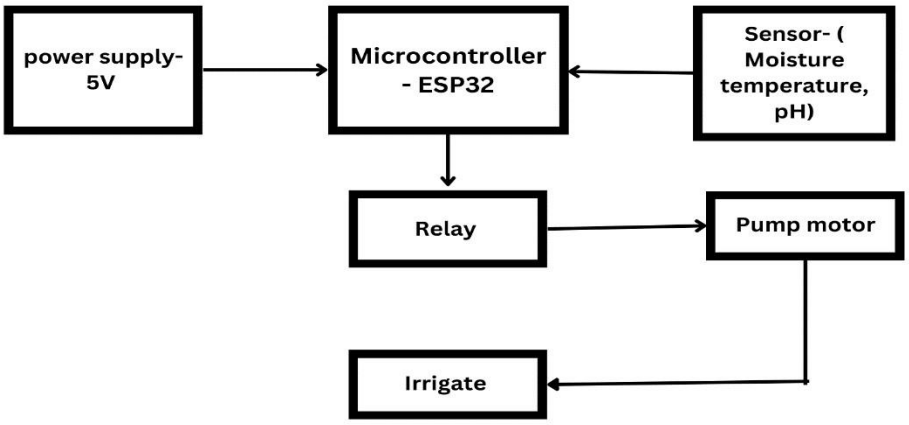

Fig.1: System architecture diagram

ESP 8266 Wi-Fi module, YL-38 soil moisture sensor have been used. This IoT device used architecture based on three-level architecture. Based on the surrounding temperature and the moisture content of the soil threshold value was given. Data were collected and analysed based on the threshold value, the threshold value was analysed and if the value was low the pump would be on automatically. The sensor data were represented with a graphical representation in the application.[4]

An IoT-based smart farming system was used to increase the quality and quantity of the yield using IoT-based technology to monitor the temperature and soil moisture with the help of Arduino UNO. Cloud computing was used to access the current data of the farm through mobile and website for current data access, the results produced were 98% accurate. The system was operated by both battery and a power supply.[5]

Automated and manual irrigation was provided with NODE MCU programmed with Arduino IDE built with DHTTL. The soil moisture and temperature sensor contributed data to the microcontroller to irrigate the field when needed. The farmer can also ON/OFF the motor by the switch provided. The major drawback was that NODE MCU have to be kept within the range of Wi-Fi to rescue the signal.[6]

By monitoring the weather conditions and soil moisture level proper irrigation could be provided by the IoTbased smart irrigation system. The soil moisture sensor detects the moisture and a mobile application was designed to analyze the data and monitor the moisture, humidity, and temperature of the soil.[7]

Modern agricultural methods were used to provide the farmer about the field's current status through the mobile application. The data like moisture, and temperature of the crops and field was displayed on the mobile screen. The pH of the soil was also identified by the pH sensor to notify about the crops which are best suited for the soil. The manual operations of irrigation of the field could be done through the application provided.[8]

The smart irrigation system used drip irrigation and indoor precision agriculture. The system used only soil moisture sensors to irrigate. The soil moisture level was checked and according to the threshold value, the field was irrigated. A drawback of the system was that it does not comprise of a temperature sensor to monitor the climatic condition.[9]

The smart irrigation system with Bluetooth and Arduino was automatic and regulates the usage of water in the field. The system used only soil moisture sensors to monitor and irrigate the field. If the moisture level was below the required moisture, then the system would be on automatically until the desired level of moisture was reached. The addition of a temperature sensor would make the system more efficient as the climatic temperature could also be monitored.[10]

The rate of evaporation was calculated based on feed forward NN (FFNN), a machine-learning technique. The research was conducted for nearly 4 years every hour to evaluate the evaporation rate. Each record consists of six different fields, relative humidity of the air, air temperature, wind direction, Net radiation, wind speed, and evaporation field. In addition, a soil moisture sensor was used to calculate the moisture present in the soil for every 30 minutes. Multi-crop data with the information on irrigation of those crops were saved and used for further irrigation. As the rate of evaporation was calculated, this IoT-based multi-cropping irrigation technique would be more effective in the conservation of water.[11]

The system used soil moisture sensor, temperature sensor, and electrical conductivity. The value of the moisture threshold was set to 800 units and the threshold temperature value was 24 degrees Celsius for the crop. The electrical conductivity value ranged from 5.5 to 6.5 units. The electrical conductivity was used to detect the pH of the soil, further based on the pH value the nutrient level of the soil could be determined. The moisture value was checked by the controller first. If the moisture went above 800, then the temperature was checked. The plant could sustain for one or two days without water in case the threshold temperature value was low. But if the threshold value went above the plant was irrigated.[12]

An IoT-based drip irrigation system used a moisture sensor to determine the moisture level of the soil and to monitor the water level in the tank ultrasonic sensor was used. ATMEGA 382 microcontroller was used to control the smart irrigation systems activities. The feedback pump recycles excess water from the farm back to the reservoir. Temperature sensors could be added to this system to make it more effective.[13]

Multi-farming techniques have been introduced so that each part of the land could be cultivated without waste of any land resources. By smart farming, other resources like water and energy could also be conserved. To monitor the field temperature and humidity sensor was used. An advantage of this system was the age of the crop could also be viewed.[14]

The crops were monitored with the help of a wireless sensor network. A basic level temperature and humidity sensor called DHT 11 sensor have been used due to its low cost. Based on the resistance of the soil, the moisture level was determined by a soil moisture sensor. The decision to irrigate the field was done with or without user interference. The Bluetooth technology could be replaced with a Wi-Fi module if required.[15]

The system used a soil moisture and humidity sensors to irrigate the field. The moisture level of the soil was sensed by the sensor and the value was stored and sent to the android phone through the GSM port and irrigated based on the value sent. The temperature sensor could have been added to this system to be more effective.[16]

III. MATERIALS AND METHODOLOGY

Materials:

- Micro Controller
- Relay
- Temperature Sensor
- Moisture Sensor
- Soil pH Sensor

Microcontroller:
Microcontroller is one of the essential components as they provide necessary processing power and control to automate the irrigation process. It gathers information from the moisture, temperature and pH and use the information to make decision on irrigating the field. It also helps to connect the irrigation process to the mobile phone **Relay:**
Relay plays an important role in the flow of water. Relay is connected to the water pump, it turns on/off based on the signals received from the microcontroller. Microcontroller sends signal to the relay to turn on the flow of water if the soil moisture is low and then when the soil moisture is high it turn off the water flow.
Temperature sensor:
By using temperature sensor, the irrigation system can be set up to water more frequently if the temperature is above 30º C and to avoid over irrigation during the cold weather where the soil is moist. **Moisture sensor:** Moisture sensor is used to monitor the soil moisture to irrigate when the moisture level is below 60% and when above 60% there is no need of irrigation. It helps to optimize the irrigation according to the plants needs preventing over or under irrigation. **pH sensor:**
pH sensor helps to monitor the acidity level of the soil, different plants have different pH requirements by monitoring the soil's pH we can adjust the pH of the soil for it to remain healthy by adding manures and fertilizers.

Methodology:
The microcontroller acts as the brain of the system. Every sensor, relay, and pump motor were connected to the microcontroller. If the moisture level is low the field was irrigated and if the desired moisture level was reached the pump motor was switched off. The temperature sensor checks the surrounding temperature and, if the temperature was high the irrigation was carried out. The pH of the soil was checked manually. The mobile application was designed to display the values of the moisture and temperature of the fields. The manual switching on/off of the pump motor was also enabled in the application.

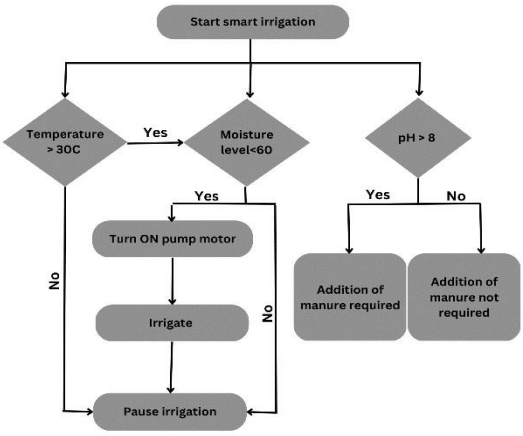

Fig.2: Working of smart irrigation

IV. CONCLUSION

Traditional agriculture practices can be improved by intelligent irrigation system incorporated with moisture sensor to monitor the water content of the soil, temperature sensor to monitor the surrounding temperature of the field and pH sensor to monitor the acidity level of the soil. The intelligent irrigation system can adjust the watering schedule according to the plants requirement of water preventing over or under irrigation which leads to the spoilage of crops. The pH sensor incorporated in the intelligent smart irrigation system alert the farmer to maintain the optimum pH of the soil. Mobile or GSM application provides remote access and complete database of the soil based on the entire agriculture fields data on surrounding temperature, moisture of the soil and pH of the soil

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