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Research Article

IoT-Based Precision Irrigation for Agriculture

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AGRI-AUTOMATA stresses efficiency by boosting the yield by primarily focusing on soil temperature and humidity while also keeping track of soil moisture content and sunlight in order to monitor and control the essential elements of agricultural farming utilizing modernized IOT Technology. By improving the automated maintenance system, productivity is raised through this method. The sensors are strategically positioned across the farm in order to collect data and provide the farmer with relevant information using IoT technology and the necessary user-friendly software. The automated system in this proposed system can even be utilized to change the temperature, which will improve agricultural productivity, water availability, and brightness intensity. The Node MCU microcontroller serves as the overall automated system's decision-making and controlling mechanism in conjunction with the incorporation of numerous sensors.

Keywords: IoT Technology, Node MCU Microcontroller, Cloud Computing.

1. Introduction

In our country, most of the advanced developing industrial sectors depend solely upon Agriculture, which is the basic foundation of survival. There is a rise of additional needs in traditional agricultural practices. By implementing automated and productive technologies we can produce in massive quantities to cope with adequate needs. As there is an increase of sudden and catastrophic usage of water, the level of groundwater reduces day by day, due to which there arises the lack of appropriate natural calamities and environmental support produced by nature in the modern era. This leads to the drastic drop in water levels on earth.

According to a survey conducted by an NGO, the scarcity of water is one of the major problems in the rural areas because of which there is not a satisfactory amount of water supplied to the fields of farmers. Water is the most needed essential element throughout the globe. Agricultural sectors top the need of water in every country as a consequence of which the production of agriculture is directly proportional to the supply of water and correct usage of human resources available in each country.

Significant loss of water is the paramount problem of the field of agriculture. Even the floods cause severe damage to the crop fields resulting in massive losses. The main aim of the modern tech system is to save energy and monitor the water level and humidity by controlling the system manually. The level of water in the soil is automatically detected and according to the need, it is also supplied to the fields. As the population is exponentially growing and to meet the needs in terms of food and consumption, the implementation of the

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modernized tech system is much needed. Traditional irrigation processes are carried out through canal systems and the required water is supplied to the crop fields based upon the availability of water regularly. As there is no feedback system in the fields, the supply of water is produced in excessive quantities in some areas. For efficient and productive use of water, irrigation systems should be able to supply water to the crop fields as per the climatic changes and the patterns based upon the dynamic predictions of the fields for the next few days.

This paper is organized as follows. In Section 2 presents the background on existing ontology mapping algorithms. Section 3 presents the background work carried out in the proposed area of research. Section 4 discusses proposed method for addressing semantic heterogeneity and the results of the proposed method. Section 5 concludes our work on ontology mapping and suggests directions for further work.

2. Related Work

The system here is implemented by incorporating the technology of Arduino boards to control the supply of water and the roofing up of greenhouses of the production fields [1]. It is being trained to monitor with the provided statistical data obtained from the fixed sensors which take the available data of temperature of crop fields, humidity and light intensity in the field [2]. There is an assimilation of a specified filter to remove the noise produced by the sensor. The system monitors the exact information through the interfaces of screens of PCs and LCDs[3].

Using the Artificial Neural Network controller, irrigation is automated and the problems are controlled through this process[4]. This system is compared with a controller which switches on and off, but its drawbacks are shown abruptly that it fails in this process as it is raised as a limitation. As the ANN controller doesn't require prior system knowledge and it has the inherent ability to save and reduce the consumption of resources[5].

There is also an automated pumping system station based totally upon the level of soil moisture content in the agricultural field[6]. This proposed system has the specific following features which are closed circuit, automatic irrigation system with temperature sensor and controlled flow of water throughout the field. Through this system, the users can be able to access sophisticated information about the level of humidity and temperature and make it systematic and structured[7]. But the important information regarding the soil moisture content is not passed on.

Another system with a wireless sensor network is integrated and incorporated with ZigBee[8]. It transmits the level of moisture and the temperature of the soil. The data is then transmitted to a specified web server with the help of GPRS over a cellular network[9]. Through this system, the data can be monitored and controlled easily. This is done through interactive Graphical user design[10].

3. Proposed System

Despite India being the Second Largest irrigated Country in the world, there is only one-third of the cultivated area guarded under the umbrellas of proper and constant irrigation. In countries where rainfall is unreliable and erratic, we need to implement the most efficient ways of irrigation to utilize the available resources in hand.

Thus, to assure effectiveness and efficiency in water consumption for agricultural fields, We propose a Smart Irrigation system called "AGRI- AUTOMATA" to help the existing and budding young farmers to mechanize the process and undergo convenient farming. By this, we equip farmers to make use of technology for increasing their productivity status. Fig 1 presents the workflow of proposed system.

To improve farming more smartly and efficiently, AGRI- AUTOMATA fixes an objective towards sustainable development of production. By computerized Irrigation, we try to minimize the level of water consumption and also to improve overall yield using Internet of things technology. Agri-Automata mechanizes the field practices by embedding a device with various sensors, Wi-Fi Modules, Microcontroller, NodeMCU, etc. Our system focuses on providing technical assistance by fetching live data (like Temperature, Humidity, Soil Moisture, etc)to the producers/ farmers thereby making it easier for them to effectively monitor the environment. We provide a simple-to-use Adafruit IO Interface for the farmers to manage irrigation.

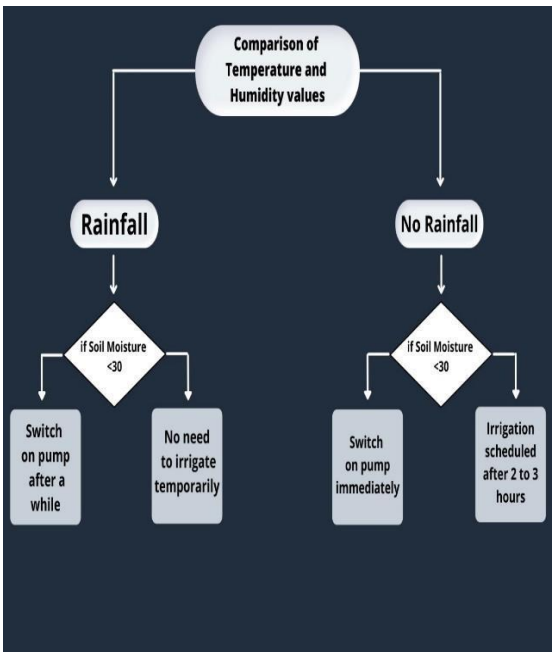

Fig.1. Workflow of Proposed System

The proposed architecture is presented in this section. Our circuit diagram consists of four sensors namely: LDR, Soil Moisture Sensor, DS18B20 Sensor Probe, DHT11 that are connected with 12V LEDs, 12V submersible Water pump, Two TP122 transistor, 7805 Voltage Regulator. Temperature and Humidity values from the environment are obtained by DHT11 sensor. DS18B20 probe is utilized to acquire Soil Temperature.

This interface helps the farmers to envisage, comprehend and inspect live data of irrigation in every aspect of farming. It examines the threshold estimates of temperature, Humidity and Soil Moisture. Once the thresholds are met, the automation of water pumps comes into the picture. At regular intervals, these water pumps are automatically switched on to fulfill the water requirements of every crop in the field. It is also possible for the farmer to schedule the irrigation on a timely basis by evaluating the live data that is fetched on their interface. The choice of irrigation can be made both manually and mechanically in the Agri-Automata module.

3.1. System functionality

The Smart Cultivation in Agri-Automata uses Wireless Sensor Networks to connect the hardware components for reading and monitoring data in agricultural fields. The components include Node MCU ESP8266, DHT11 sensor, Soil Moisture Sensor, LDR, DS18B20 Waterproof Temperature Sensor Probe, 7805 voltage regulator, TIP122 Transistor, Submersible Small water pump, Resistors and Capacitors, etc. Data from the sensor to the base station is exchanged by gateway units and commands are sent to the actuator for controlling irrigation and water flow in the system. The algorithm is programmed in the microcontroller set up to send commands to the actuator for controlling the flow of water. The information obtained by the sensors is projected to the farmers in their Adafruit IO dashboard. The farmers would be able to see live details such as humidity, Temperature, Soil Moisture, Weather Forecasting along with the past 30 day predictions of these parameters in their dashboards. We use Open Weather Map API, which is a low-cost open-source API for forecasting the Weather during farming.

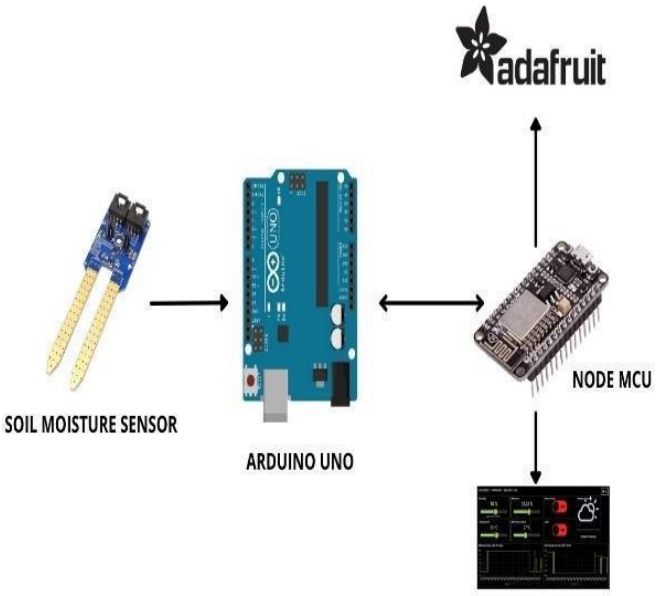

Fig.2. IOT Integration of the IoT device

The Regulation of working behind this project is to connect various components to the Arduino Microcontroller. The Detected soil moisture data from the sensor is passed to the microcontroller for controlling the water pump. If the resultant data is lesser than a threshold estimate, Then the NodeMCU transfers a signal to the relay unit, which will then automate the water pump to release the water to the crops. Once the water delivered meets the requirement of the crop, it automatically stops. The Control of the entire system lies in the power supply and the input voltage of the NodeMCU should range from 7V to 12V.

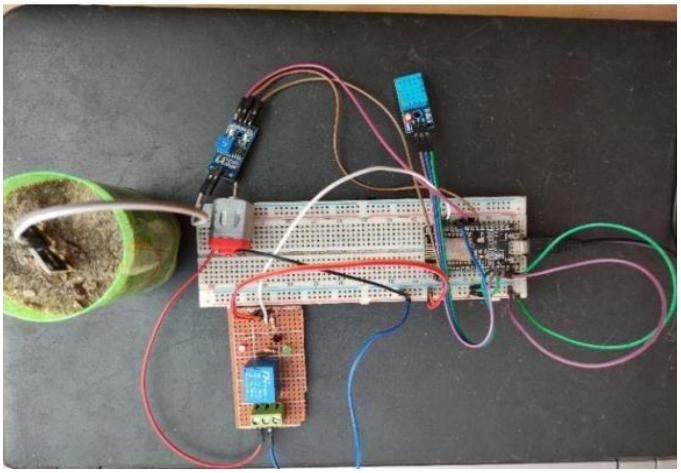

Fig.3. Experimental setup of proposed system setup

Agri-Automata manages to monitor the whole agricultural field from a remote place by utilizing IoT technology. Our system does not consider environmental changes for reading data from the sensors. We also include cameras to capture the images of crops and monitor their quality for rich production. Thus, by providing the farmers with timely and précised data, Agri-Automata, if implemented on a larger scale can transform the backbone of our Nation and can feed the hunger of millions.

4. Conclusion and Future Enhancements

Agriculture networking technology will have a significant impact on determining the future paths of agricultural development in addition to being an essential component of modern agricultural development. Integrating the Internet of Things with agricultural automation has many benefits in terms of efficacy, feasibility, and precision compared to the traditional way.In the upcoming years, it is projected that IoT will continue to develop, improving their effectiveness, speeding them up, and bringing down their costs. As this system becomes more intelligent, it could be able to predict user actions, rainfall patterns, harvest time, animal intruders on the field, and communicate the information through advanced technologies like IoMT, so that agriculture systems can become independent of human input and output, which will lead to higher quality and huge yields.

We can enhance performance by using the baroscopic and logical information recorded by our device for machine learning. In superior farming solutions, the local area-smart prediction can be made by analyzing soil and climate information to offer better advice about which crops to grow. This paper can similarly be deployed with digital digicam feeds for examining leaf diseases and predicting weed infections around the crop field. As a result, the farmers would skip the consequences to manipulate the ailment from anywhere. The discipline vicinity may be covered by the trespassers via way of means of the deployment of AI and surveillance.

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