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IoT Based Autonomous Irrigation System

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ABSTRACT

The earth's most important aspect responsible for supporting life is water. Although there is plenty of water available on the earth, we cannot fully utilize it as most of it is in the form of oceans. It seems fascinating that only 3 percent of the earth's water is fresh, out of which most of it is frozen in ice caps. Humans have developed methods for cultivation of crops and production of livestock called as agriculture. As agriculture revolves around water usage in order for the plants to grow, there comes the need to utilize the available water effectively. The ever-increasing enhancements in technology over the years have made significant changes on how things are done. The introduction of Internet of Things has made it possible for different devices to work in sync, gather and exchange information that can either be monitored real-time or logged for further use. Hence, using this technology in irrigation may not only reduce the manual labor of farmers but also help in saving water by controlling the usage.

KEYWORDS: *agriculture, farmers, water, technology, internet of things*

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INTRODUCTION

Agriculture has been into practice since a long time; it has been an important method for production of food. Water is mainly used for irrigation in the agriculture practice and thus it needs to be saved as much as possible to prevent water scarcity. Irrigation must be controlled in order for a better yield. Various sensors and micro-controllers make it easy to supply water in a controlled manner, and information related to the real-world environment can be perceived and acted upon. The schedule for watering the crops on the agricultural field or a controlled environment can be set-up and implemented with little to no human effort. This gives another option for implementing the system in a small garden with a few plants and monitoring soil moisture content. For the system to be remotely accessible, information related to the entire field or garden can be stored into a database in the back-end as well as a web portal in the front-end. Sensors, micro-controllers and other devices are linked successfully to the web portal, thereby enabling the user to easily monitor the environment. Whether it is used on an agricultural field or a controlled environment like garden, autonomous irrigation will be a great help in planning the irrigation activity and controlling water usage promptly. The internet is a medium from where all the information related to water usage is accessed by the user. A website allowing the user to plan the irrigation schedule, monitor the flow of water, display the status of soil is built. This web portal also includes aspects like setting up user profiles, selecting schedules for different types crops/plants and creating/modifying routines as required for irrigation. Hence, demand for this system will increase in the coming years as the population is increasing rapidly.

I. Proposed System

A. Architecture

For the purpose of integrating sensors and other devices necessary to build the system that may function probably without any manual assistance, a design and layout should be built, by which there is a clear understanding of what should be done. The general idea behind incorporating sensors with a micro-controller is that there is a proper co-operation between devices that are actually taking the real-world environment as an input and performing several operations upon the data that is acquired.

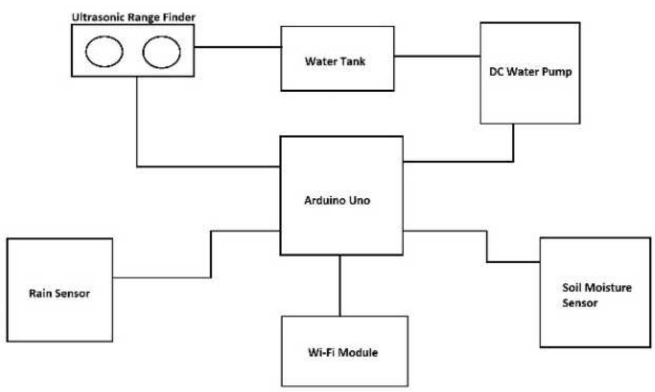

Fig. 1 Hardware Layout

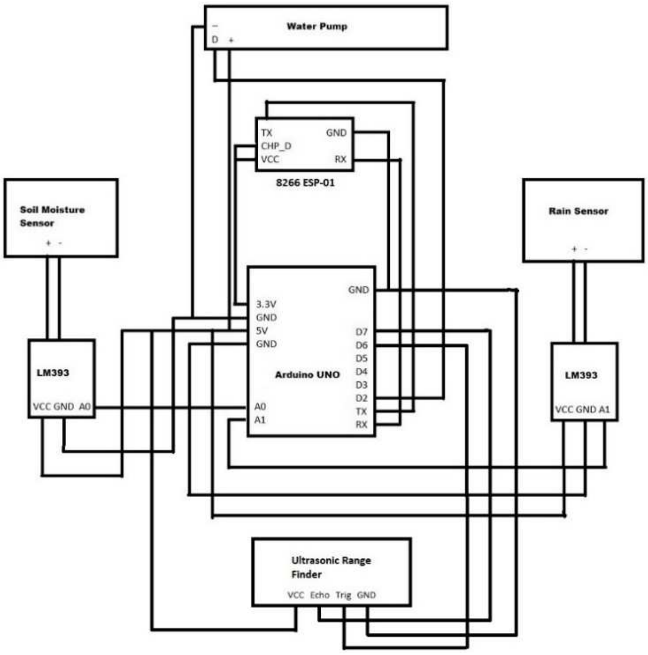

Fig. 2 Architecture

The system includes Arduino UNO with the ATMEGA328P IC along with soil moisture sensor for gathering data regarding moisture content in the soil, a rain sensor for detecting rainfall intensity (required when implemented in an open environment), a water pump for supplying water whenever required, and finally an ultrasonic range finder to keep track of the availability of water in the tank. The ultrasonic sensor uses sound waves to detect the distance; it can be used to detect water level without the need to submerge it inside water. This gives an edge over other water level sensors that are required to be submerged inside of water, thereby making it easy to keep track of water usage.

B. Interfacing Sensors and Micro-controller

The main aim of interfacing sensors with the micro-controller is to make sure that the sensors are utilized effectively as per the need. The Arduino UNO in this case is programmable and thus provides support for fetching the sensor readings. These readings will then be transferred over the internet in the database as well as displayed on the web portal in real-time. Once the micro-controller is interfaced with sensors, there is a need for a Wi-Fi module in order to transmit the fetched data. The ESP-01 8266 is responsible for this.

The Setup function for Wi-Fi Module:

```
void setup() {
Serial.begin(115200);
    espSerial.begin(115200);
    espSerial.println("AT+RST");
    showResponse(1000);
    espSerial.println("AT+CWMODE=1");
    showResponse(1000);
espSerial.println("AT+CWJAP=\""+ssid+"\",
\""+password+"\"");
    showResponse(5000);
    Serial.println("Setup completed");
    }
    Function for fetching readings form Sensors:
    void loop()
    {
    int soilmoisture = analogRead(A0);
    int rainsensor = analogRead(A1);
        Serial.println(soilmoisture);
        Serial.println(rainsensor);
        }
```

Transmitting data fetched from sensors:
GET /insert.php?id=1&s=2&r=2&m=1 HTTP/1.1\r\n

The Arduino UNO along with the 8266 supports GET; It is used to transmit readings directly to the web portal over the internet to the specific website while making entries onto the database.

C. Database Design & Web Portal

As data fetched from the sensors becomes ready to be transmitted over the internet, it should be sent to an appropriate website and must be stored in a properly designed database.

Database can be created using MYSQL as per the need. However, a schematic should be created for the database to be correctly designed based on the requirement.

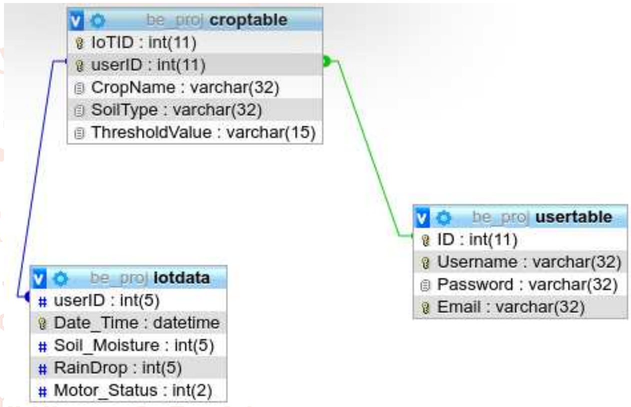

Fig. 3 Database Design

Furthermore, the need for designing a UI (User Interface) at the front end will enable the user to monitor the fetched and stored data with ease. The GUI (Graphical User Interface) would be a website accessible from a desktop computer or any other mobile device that supports internet connectivity. This is essential as there are a variety of internet connected devices today and the user experience should not be compromised.

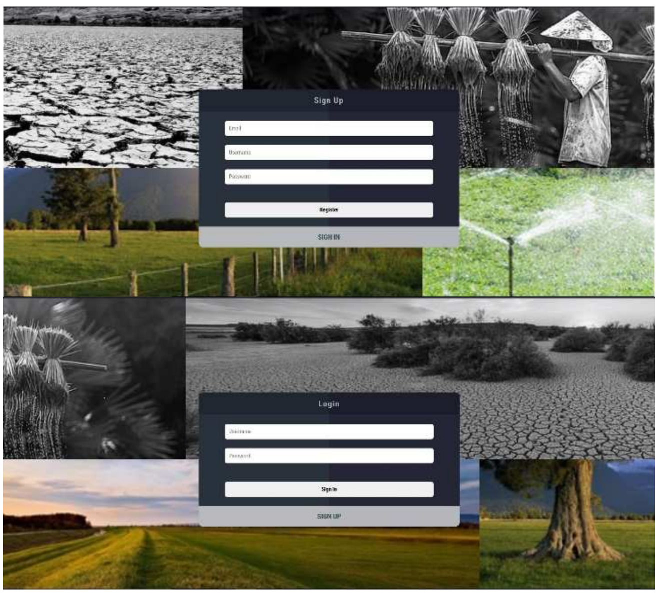

Fig. 4 User Registration & Login Page

Lastly, allowing the user to view data obtained from the hardware unit in an easiest way is to display it in the form of graph. Web design technologies such as HTML, CSS and JavaScript are used for making the front end easily accessible and attractive for the end user. The hypertext pre-processor (PHP) helps in building logic at the back end. The portal will not only allow the user to monitor in real-time but also control the pump motor. The pump motor can be in AUTO state for automatic operation and OFF state while switched off. The ultrasonic sensor will be active when the pump is in either of the states in order to monitor the water level of the tank and keep track of water being used.

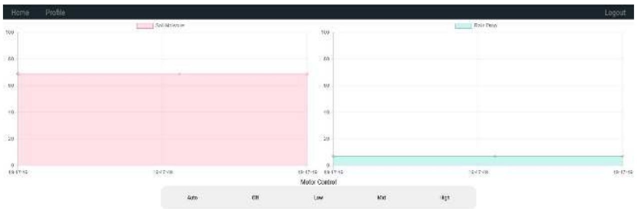

Fig. 5 Real-time Monitoring

For mobile devices, a progressive web app makes accessing the portal easy. Due to this one can view the status of the garden or a field on the preferred mobile device without any compatibility issue. Progressive web app makes it easy for the user to directly access the portal from the home screen of the mobile device.

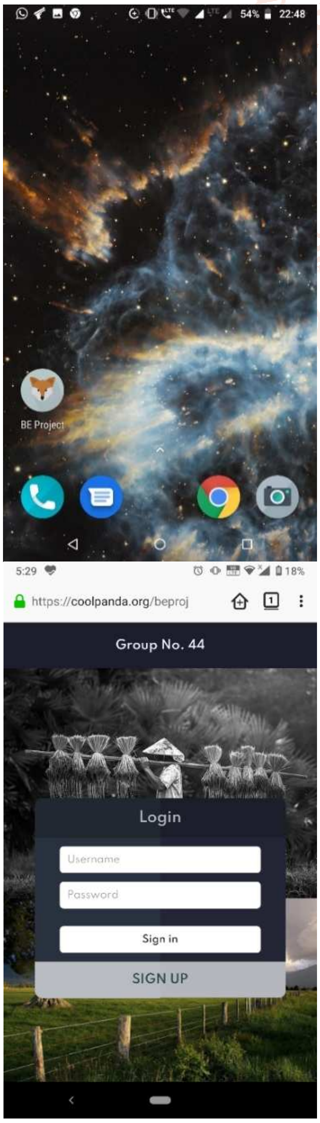

Fig. 6 Progressive app viewed on mobile device

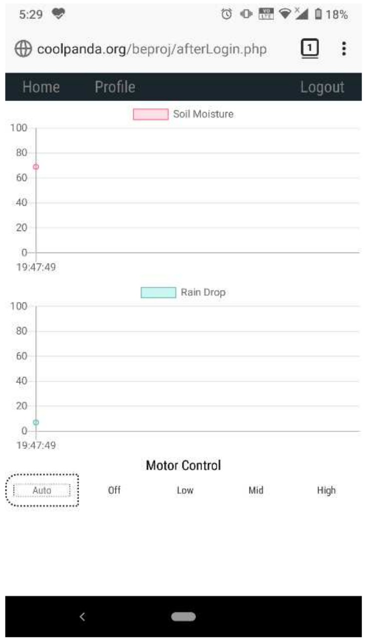

Fig. 7 Real-time view on mobile device

II. Related Works

Sr. No	Author/Year	Concept	Remarks
1	Shweta B. Saraf, Dhanashri H. Gawali /2017	IoT Based Smart Irrigation Monitoring and Controlling System	The concept behind this work is is focus on making irrigation a smart process by monitoring.
2	Dweepayan Mishra, Arzeena Khan, Rajeev Tiwari, Shuchi Upadhyay /2018	Automated Irrigation System-IoT Based Approach	This paper focuses on the concept behind reducing manual labour required for irrigation.

III. Summary

The proposed implementation will be useful for small as well as large areas giving the users e.g. farmers, gardeners, etc. the luxury of monitoring their fields as well as controlling the environment associated with them, either it is few acres agricultural field or a small garden. Upon having control over the irrigation process, one can save water to a great extent. The data obtained by sensors can further be used for predicting the yield on a particular soil, thereby suggesting the crops that can be grown. Overall, this system may also be used to schedule watering of plants/crops on a daily or weekly basis.

IV. Conclusion

Thus, the implemented system solves different real-world problems by incorporating hardware devices which are in sync with each other, partially manging and controlling the environment they are associated with. A user-friendly GUI makes it easier by displaying the necessary functionalities and allowing users to interact with the hardware unit. Ultimately, the manual labour is reduced with added precision as the micro-controller operates based on fixed constraints in order to balance the responses needed to control interfaced sensors and deliver prompt service to the end user.

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