

Arduino Based Soil Monitoring System for Suitability of Rice Plantation

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Abstract:

In the past few years, technology has grown to the summit. The use of computers and electronic devices has been applied in almost every aspect of human life. It has thus led to the idea of the soil monitoring system. This paper is about soil monitoring system for suitability of rice plantation which would use a smartphone and a web application to enable the farmers to get information about their field for suitability of rice plantation from a remote location. The system has three components: an Arduino microcontroller and other sensors to collect site data, an ethernet shield to transfer collected data to the web database, a web server to handle the obtained data and a web client and a smartphone to get the valuable information from the processed data. The paper focuses on the features and design of the proposed system.

Keywords: Soil Monitoring, Smart Agriculture, Arduino, Smart Rice Plantation

1. Introduction

The world is moving towards the era of automation with the main motto of easing human life. A soil monitoring system for suitability of rice plantation aims at automating the farmer's life through the use of current technology. To provide the appropriate information about the field to the farmers without the necessity of visiting to farm each time is the main theme of the soil monitoring system. Such an automation in the agricultural sector is also called smart agriculture.

In the current age, most of the efforts are put on wireless technology for data transfer and cloud computing for data storage. The main wireless technologies used in soil monitoring system are GSM, Internet, Cloud, and Bluetooth. Each technology has its own merits and demerits. But Internet based soil monitoring systems have much more merits than other wireless technologies. The main merit is that the end user gets reliable service as they can be able to monitor their farm by sitting in front of a computer or by looking into their smartphones from anywhere in the world.

2. Literature Review

After the research in the agricultural field, researchers found that the yield of agriculture goes on decreasing day by day. Use of technology in the field of agriculture plays an important role in increasing the production as well as in reducing the extra manpower efforts. Some of the researches tried for the betterment of farmers and provided the systems that use technologies which are helpful for increasing the agricultural yield. Some of such researches carried out in the field of agriculture are summarized here.

Simon and Jacob (2012) proposed that the wireless sensor network for crop monitoring in the paddy fields of kuttanad(India) can be applied because the soil of the paddy fields is salty and is extremely acidic. This acidity of the soil is considered a major problem which retards the production

of rice in the area. The best solution to overcome this problem which reduces the acidity and increase the production. So, the pumping of water to and from the field is the major activity from plowing to harvesting. Further, they added that Electro-mechanical sensors in the mesh networking and through ZigBee communication could be automated systems which monitor the water level and regulate the water. It can send messages to the farmers. They suggested ZigBee-technology because of its low-cost, low-power consumption, low data-rate, two-way wireless networking standard that is aimed at control and sensor applications which is suitable for operation in harsh radio environments and in isolated locations. [1]

N. G. Shah *et al.* (2008, April) developed a system for precision irrigation using sensor network mainly aimed for monitoring soil moisture and estimating vaporization by considering soil moisture, soil temperature and relative humidity as the critical parameters for measurement. The objectives of the system were to provide precision agriculture and irrigation, to increase the agricultural production, to provide a precise monitoring system and to use resources at the fullest extends so as to give an efficient system. The system was analyzed for 3-4 months for calculating evapotranspiration rate. For more precise results, the system should be analyzed for a 3-4 season. [2]

G. Mendez *et al.* (2011, January) developed a Wi-Fi based smart sensor network for agricultural environment. They considered temperature, humidity, light intensity, air pressure and soil moisture as main parameters. The objectives were to reduce cost and effort of incorporating wiring, to enhance flexibility and mobility for the system. The system was useful for transferring and logging the data from various nodes. [3]

M. Haefke *et al.* (2011, May) developed a ZigBee based smart sensing platform for monitoring environmental parameters such as temperature, relative humidity, pressure and sunlight with the use of microcontroller which serves as a smart weather station. The research was based on characteristics such as the use of low cost equipment, accurate sensors and flexibility in data handling. Use of X Bee module provided the wider range and reduced the current consumption of the circuit. [4]

3. Materials and Methods

This study is primarily concerned with the soil monitoring system which uses the Internet for interaction between the android mobile application, web application and the on site arduino based monitoring system module. The paper will shed light on the features & design of the system.

3.1 Collection of soil factors

The system will have specific sensors, each one capturing data about specific soil factors responsible for deciding the

suitability of rice plantation. The sensors include soil pH sensor, temperature sensor, humidity sensor and soil moisture sensor as per the project scale. All of these sensors are responsible for collecting relevant data from the site and providing the data to arduino in real time. The arduino is then responsible for transferring the data to the web server through the use of ethernet shield.

3.2 Visualization of data

The system is designed to provide visualization of the collected data in the form of a line graph. This visualization helps the farmer to know about their farm status in an effective manner.

3.3 Fuzzy Logic Analysis

Fuzzy logic is an approach to computing based on “degrees of truth” rather than the usual “true or false” or Boolean logic on which the modern computer is based. The idea of fuzzy logic was first advanced by Dr. Lotfi Zadeh of the University of California at Berkely in the 1960s. A fuzzy logic system can be defined as the nonlinear mapping of an input data set to a scalar output data. A crisp input will be converted to the different members of the associated membership functions defined based on its value, so the output of the fuzzy logic controller is based on memberships of different membership function which can be considered as a range of input.

To implement a fuzzy logic technique to a real application required the following three steps:

- **Fuzzification:**

The given input values of the sensor are converted into fuzzy data by mapping to corresponding membership function based on result value. A membership function is used to quantify a linguistic term.

- **Fuzzy Inference Processes:**

The different membership functions generated through result data are combined with control rules to derived fuzzy output. A fuzzy rule is simple IF-THEN rule with a condition and a conclusion. The evaluations of the fuzzy rules and combination of the results of the individual rules are performed using fuzzy set operation which is different from the operation on non-fuzzy sets. The evaluated result of each rule is combined to obtain a final result. This process is called inference.

- **Defuzzification:**

The result obtains after inference is defuzzified to obtain a final crisp output. Defuzzification is performed according to the membership function of the output variables.

Algorithm

1. Define the linguistic variables and terms(initialization)
2. Construct the membership functions(initialization)
3. Construct the rule base(initialization)
4. Convert crisp input data to fuzzy values using membership functions(fuzzification)
5. Evaluate the rules in rule base (inference)
6. Combine the results of each rule (inference)
7. Convert the output data to non-fuzzy values(defuzzification)

3.4 User Notification

The system is also responsible for providing essential notification to the users via an android application.

3.5 Authentication

The android application and web application will be password protected. The user of the application will be provided with a password. The user of the application will have to enter the password each time he wishes to open an application. This will ensure that the application won't be used by any unintended user.

3.6 Proposed Design

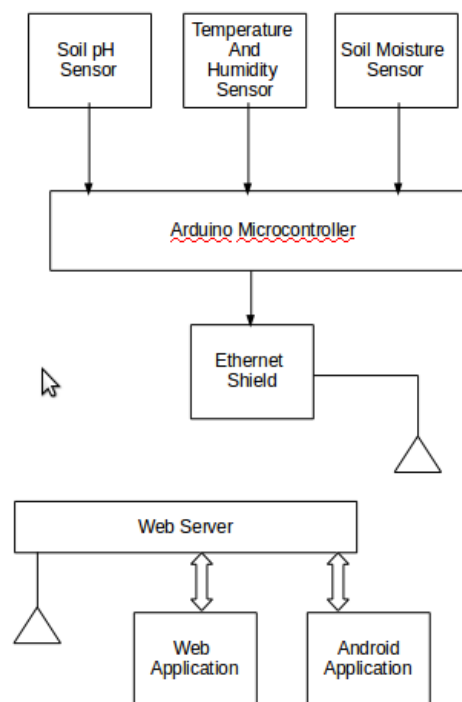


Fig - 1 : Block diagram of Soil Monitoring System for Suitability of Rice Plantation

4. Conclusion

In this paper, we have shown the design and features of a Smart Soil Monitoring System. It is based on Internet service. It requires authentication details as a medium of security, thus preventing the use of the application by unauthorized users. The system also connects with sensors, thus helping in the collection of required data. It includes fuzzy logic for analysis of collected data.

In the future, the system could use more concepts of Artificial Intelligence so as make it more user friendly and increase the automation.

References

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