Highly Efficient Smart Irrigation System Using Data Logging

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Introduction

In recent years, climate patterns of most regions have been affected by global climate changes. Agriculture, as an occupation for many, has been through tumultuous times and as such there have been significant moves to use irrigation methods to substitute the dependency on rainfall for crop cultivation. Conventional methods of irrigation have at times led to changes in soil alkalinity thus affecting crop yield. These methods are more dependent on human judgment and effort and as such, cultivated lands can suffer from either over irrigation or under irrigation. The amount of water to use is determined by various factors like soil type, type of plant, area climate, and topography among others. Water scarcity hinders normal growth development of crops. Similarly, too much water has the same effects on the plants.

When land is over-irrigated, there is reduced plant health thereby resulting in salinity. It will affect the next crop that will be planted in the same field. Excess water also results in leaching and reduces nutritive value of the soil. Therefore, proper management of water levels in any crop field is paramount. While traditional methods of irrigation require great human touch and time consuming, with the current advancements in technology, data collection can significantly help in regulating when and how much water is to be administered at a particular crop field. At the end of my research, I would like to see a scenario where the farmers do not have to guess on when or where to plant their crops. Combining the benefits of the Wireless Sensor Networks (WSN) and the Internet of things (IoT) can be a great solution. Internet of things feature objects with IP address for internet connection and the communication that happen between these objects and other devices or systems that are web enabled (Shiraz & Yogesha, 2014). Wireless Sensor Networks comprises of several sensor nodes that are deployed to a particular area to keep data on a specific phenomenon in a given area (Ferdoush & Li, 2014).

Sensor nodes are tiny devices that are programmed to do specific tasks and to send and receive data on particular functions. Sensor networks have been put in practice in different fields including aeronautics, automotive engineering, and industrial manufacturing. The smart irrigation system is useful because there will be less dependency on natural rainfall and human judgment on the amount of water to be administered to the soil. Farmers will be able to use data collected on the soil type, moisture content, humidity, and local environment temperature to determine proper water administration. Therefore, this will lead to improved crop production and considerably save time and energy. The overall result is improved global food safety.

Hypothesis

Proposed Solution

The problem described above requires a solution that will primarily provide two things; accurate information about soil data that is independent of human judgment and an easy way to control the irrigation system. In the current year and age, smart control systems need to be implemented in a lot more areas because of the changing lifestyle. The proposed solution, therefore, provides an answer to all the needs by making use of Internet of Things (IoT). The method makes use of miniature environmental sensors that use the collected data to make an instant judgment on when to switch the system on and off. The information sent by these sensors are stored in the cloud system as an update to the analysis of real-time ground data (Pavithra & Srinath, 2014). A smart analyzer makes an informed review on the new data and compares it to the information in the database which works hand in hand with the IMD weather forecasts and gives back feedback proposing the next step to be taken.

The proposed intelligent irrigation system uses a technology that makes independent judgments according to the current conditions, hence optimizing the utilization of useful

resources like water, electricity, and labor. In so doing, the farmer will be able to increase his or her net produce since there will be minimum wastages. With the information collected that contains the soil data and other critical environmental factors, users will be able to make their pre-determined irrigation schedules based on the crop type and the soil quality. The farmer is also provided with the ability to override the pre-determined activities based on their preference. They can do so using any smart gadget, and the good thing about this project is that there is no software installation required to implement the smart irrigation. A simple Web Browser can be used, and the results will be as expected. The only time a mobile app is required is when the farmer wants to control the water pump remotely. The end user receives the status of all irrigation and related activities via their mobile phones or registered emails.

Expected Outcomes

Installation of sensors that give information about the state of the soil will alleviate the issue of farmers over-irrigating or under-irrigating their farms. That issue being sorted, the problem of salinity will be done away with, hence ensuring that every crop that gets irrigated in that field will reach its maximum production rate. The long-term impacts realized from this project will be food security and improvement of the living standards of many farmers since their profits will rise.

Implementation

To implement this project, a Raspberry PI, IoT, soil moisture sensors and temperature sensors will be needed. Rasbian OS is initially set up in the SD card in accordance with the guidelines in the Raspberry PI website (Naik et al., 2017). The SD card is then slotted into the Raspberry PI, and then the mouse, monitor, keyboard, and the Wi-Fi adapter are all connected to

their respective ports. The Raspberry PI system is then connected to power using the micro USB cable.

The next step will require the sensors to be installed on the farm and located in strategic positions. The sensors, which are powered by 5V batteries, will be used to relay the soil data. The Arduino board is interfaced with these sensors to the required analog pins. The Arduino board and Raspberry PI are then interconnected using a USB cable. The Arduino board reads the soil data relayed by the sensors, and the Raspberry PI processes it (Kumbhar & Ghatule, 2013). The field data will be collected at regular intervals and sent to the cloud where Raspberry PI will access the information, process it and execute the respective commands automatically.

Audience

The target audience of this project proposal is all farmers who are using the manual techniques of irrigation. The project will be able to help them maximize their potential by ensuring that their resources are correctly used. The bodies that will be able to implement this project are the agricultural authorities and other organizations that support the farmers in one way or the other. They can help the farmers access the required materials for the project and start the process. The opposing proposals from the audience might be the fact that the project has only been tested on a single plant mode, which, of course, is different from a real-life setting where there are a lot of crops distributed over a large field. Having a lot of sensors might, therefore, lead to system failure. Such worries from the audience will be removed by incorporating sensor failure to the system so that erroneous operation will be eliminated. Given that it will be used on a large farm, there might be an instant variation of the field parameters, but this will be removed by installing an intelligence system which will diagnose and make an analysis on any sudden changes.

Proposed Research and Discussion

Based on the already completed research, this project will be able to monitor the dynamics of the soil data including the moisture and the pH level. Its decision making is based on the historical database of the already collected soil data of a given area. However, further research needs to be done to develop new sensors that can measure the soil conditions and the specific weather conditions of a given region. Such move will ensure that there is effectiveness in the field measurements. It is also imperative to research on the creation of an intelligent database that will comprise of information of every specific type of crop. Also, information given by agricultural expert analysts will be integrated into the system to ensure quality results.

References

Ferdoush, S., & Li, X. (2014). Wireless sensor network system design using Raspberry Pi and Arduino for environmental monitoring applications. Procedia Computer Science, 34, 103-110.

The idea of the wireless sensor network is beneficial in the modern day, given the fact that almost everything now needs a remote controller. In this source, this idea is expounded, and examples are given on the same. I used the information in it come up with the remote control system implemented in this project.

Kumbhar, S. R., & Ghatule, A. P. (2013, March). Microcontroller based controlled irrigation system for plantation. In Proceedings of the International MultiConference of Engineers and Computer Scientists 2013Volume II.

In this source, the arrangement of the necessary modules is provided to the readers. The integration of the sensors and the mobile device to the system is well articulated. It will be useful for this research because it expands on the idea of the arrangement of these modules.

Naik, P., Kumbi, A., Hiregoudar, V., Chaitra, N. K., Pavitra, H. K., Sushma, B. S., ... & Kuntanahal, P. (2017). Arduino Based Automatic Irrigation System Using IoT. International Journal of Scientific Research in Computer Science, Engineering and Information Technology, IJSRCSEIT, 2(3).

The project described in this source uses an Arduino-based system to integrate the sensor data and that sent by the user. My research makes use of Raspberry Pi2 and Arduino board. Therefore, the information in this source still came handy. It gave an idea of how the control module should be set so that maximum benefits are drawn.

Pavithra, D. S., & Srinath, M. S. (2014). GSM based automatic irrigation control system for efficient use of resources and crop planning by using an Android mobile. IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN, 2278-1684.

In this source, there is an in-depth description of how to implement GSM in projects similar to the smart irrigation system. At the moment, this idea is used in projects like gate and temperature controls. It consists of computer communication interfaces and a power supply system. In this research, the idea from this source will be used in creating a system that will enable the user to receive and send information to the servers concerning the level of soil factors like moisture.

Shiraz Pasha, B. R., & Yogesha, D. B. (2014). Microcontroller based automated irrigation system. The International Journal Of Engineering And Science (IJES), Volume3, (7), 06-09.

The information in this source explains how each sensor works; how they are set and the expected outcomes. The in-depth description of each sensor is important when one is designing a system that is highly dependent on them. In this research, therefore, the information about the working and configuration of all sensors used was found.