Automatic Irrigation System Using IoT & pH Sensor

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Abstract: ***In the present days, the farmers are suffering from severe drought like condition throughout the year. The main objective of this paper is to provide a system leads to automatic irrigation thereby saving time, money & power of the farmers, gardeners in greenhouses etc. Manual intervention is common in traditional farm-land irrigation techniques. This paper presents a technique for Arduino based Automatic Irrigation System. With this automated technology of irrigation, human intervention can be minimized. The moisture sensors is the main component which describe the soil pH property describing the degree of the acidity or basicity, which affects nutrient availability and ultimately plant growth. Thus, the system will provide automation, remote controlling and increased efficiency.***

Keywords: Arduino, pH, Sensors.

1. Introduction

In the present senerio, irrigation systems are manually operated. To use the water efficiently and effectively, a concept of automated irrigation is introduced. Sensor-based irrigation system is based on soil moisture sensor that will measure the level of moisture in the soil and propel the signal to the Arduino and accordingly it will irrigate the crops. The Arduino plays the role of Micro-controller. This will compare the values received from the moisture sensor with the predefined moisture levels already stored in the system. Based on the values received from the sensors, the Arduino will turn the irrigation system ON/OFF. The Arduino will also provide the functionality of calculating the pH value of soil. pH is a term that is used to describe the degree of acidity or basicity. In addition, the moisture sensor is attached so that the water content of he soil is detected. Automatic irrigation system proves to be very helpful for those who travel. If designed and coded properly, the automatic irrigation systems can be very cost effective and can do a lot of water conservation. Watering with a pipe or with oscillator wastes water and none of these method aim plant roots. Automatic irrigation systems can be designed in such a way that gives the required amount of water in a targeted area, and which will promote water conservation too.

1.1 General

This project is about a moisture-sensing automatic irrigation system under closed environment using Arduino UNO. This system reads the moisture content of the soil using a soil moisture sensor and switches on the motor when the moisture is below the set limit of the designated soil under consideration. When moisture level rises above the set point, the system switches off the pump. The status of the motor and the moisture level will be displayed on a 16×2 LCD display.For continuously increasing demand and decrease in the supply of food necessities, it is important for rapid improvement in the production of food technology. Agriculture is only the source to provide this. This is an important factor for human societies to growing and dynamic demand in food production. Agriculture plays an important role in the economy and development, like India. The farmers use to irrigate the land due to lack of water. Irrigation may be termed as the science of artificial submission of water to the dry land or soil for making it suitable for plant growth. Moreover, depending on the soil type, the plant is to be provided with water for better production and yield.

1.2 Literature Survey

In the work by Authors A. N. Arvindan and D. Keerthika [1], the Android smartphone was used as a remote control to make Arduino-based automated irrigation system easy-to-use and an economical one. The design of this system includes a soil moisture sensor that provides a voltage signal proportional to the moisture content in the soil, which is compared with a predetermined threshold value. On the basis of this comparison result, the appropriate data are fed to the Arduino Uno processor, which is linked by the HC-05 module to an Android phone. Android smartphone allows the user easy remote control for the irrigation system to switch on, to the drive motor. The system has the potential to be used in the real-time precision agriculture application.

In the research by the Chandan Kumar Sahu and Pramitee Behra [2], the authors present a prototype for full automation accessing of irrigation motor where Prototype includes numbers of sensor placed in different directions of the farm field. Each sensor is integrated with a wireless networking device and the data received by the “ATMEGA-328” microcontroller, which is an ARDUINO-UNO development board. The RASPBERRY-Pi is used to send messages through internet correspondence to the microcontroller process. The objectives of this paper were to control the water motor automatically and select the direction of the flow of water in a pipe with the help of soil moisture sensor. The information, which is considered as the operation of the motor and direction of water of the farm field, is finally sent to the user using mobile message and e-mail account.

In the paper by D. Baghyalakshmi, Jenimah Ebenezer and S. A. V. Satyamurty [3], the authors have presented the implementation details of WSN based temperature monitoring application. The main feature for the authors' proposed network is to continuously monitor the temperature in the 128 nodes High-Performance Computing Cluster for its smooth functioning. The wireless sensor node sense and transmit the current value of temperature to the base station. This paper explains about performance analysis of the network and the various steps involved in the experimental implementation and maintenance of the temperature monitoring network for High Performance Computing cluster.

In another research by A. K. Tripathy, A. Vichare, R. R. Pereira, V. D. Pereira, and J. A. Rodrigues [4], the authors proposed systems mainaim is to implement a cost-effective automated gardening system. This system helps in solving the above problem by being efficient and using fewer resources. The system exploits cost efficient soil moisture, light and temperature sensors to decide when and how much water will be provided for a specific type of plant under consideration.

In the paper by R. M. Aileni [5], the author presents a mobile application for healthcare, which process data from humidity and temperature sensors. The mobile app is based on cloud computing SaaS (software as a service) cloud computing model. The cloud-computing infrastructure based on sensors is used in this paper for deploying an application, which provides patients monitoring (moisture, temperature or blood pressure). The data is sent and stored in a dedicated server for being analyzed later by doctors or caregivers. The advantages of sensor-cloud also come from using PaaS (platform as a service) and IaaS (infrastructure as a service) models.

In another research by P. Archana and R. Priya [6], the authors proposed a technique in which the humidity and soil moisture sensors are placed in the root zone of the plant. Based on the sensed values, the microcontroller is used to control the supply of water to the field. However, their system does not intimate the farmer about the field status.

In the paper by Sonali D. Gainwar and Dinesh V. Rojatkar [7], the authors proposed a fully automated system in which soil parameters such as pH, humidity, moisture and temperature are measured for getting a high yield from the soil. In this system, the motor pump switches ON/OFF as per the level of moisture in the soil. However, the current field status is not intimated to the farmer.

In another paper V. R. Balaji and M. Sudha [8], the authors proposed a paper in which the system derives power from sunlight through photo-voltaic cells. This system doesn’t depend on electricity. The soil moisture sensor has been used and based on the sensed values PIC microcontroller is used to ON/OFF the motor pump. Weather forecasting is not included in this system

In the research by C. H. Chavan and P. V. Karnade [9], the authors proposed a smart wireless sensor network for monitoring environmental parameters using Zigbee. These nodes send data wirelessly to a central server, which collects data, stores it, and allows it to be analyzed then displayed as needed and also be sent to the client mobile. Weather forecasting and nutrient content is not determined in this system.

In the paper by G. Parameswaran and K. Sivaprasath [10], the authors proposed a smart drip irrigation system using IOT in which humidity, temperature and pH sensors are used. Irrigation status is updated to the server or local host using a personal computer. However, the farmer can’t access the field condition without internet.

2. Theoretical Background

Irrigation is the artificial application of water to the land or soil. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and revegetation of disturbed soils in dry areas and during periods of inadequate rainfall. When a zone comes on, the water flows through the lateral lines and ultimately ends up at the irrigation emitter (drip) or sprinkler heads. Many sprinklers have pipe thread inlets on the bottom of them, which allows a fitting and the pipe to be attached to them. The sprinklers are usually installed with the top of the head flush with the ground surface. When the water is pressurized, the head will pop up out of the ground and water the desired area until the valve closes and shuts off that zone. Once there is no more water pressure in the lateral line, the sprinkler head will retract back into the ground. Emitters are generally laid on the soil surface or buried a few inches to reduce evaporation losses. Healthy plants can transpire a lot of water, resulting in an increase in the humidity of the greenhouse air. A high relative humidity (above 80-85%) should be avoided because it can increase the incidence of disease and reduce plant transpiration. Sufficient venting or successive heating and venting can prevent condensation on plants surfaces and the greenhouse structure. The use of cooling systems during the warmer summer months increases the greenhouse air humidity. During periods with warm and humid outdoor conditions, humidity control inside the greenhouse can be a dare task. Greenhouses located indry, desert environments benefit greatly from evaporative cooling systems because large amounts of water can be evaporated into the incoming air, resulting in significant temperature drops.

2.1 System Design

The microcontroller based system is designed in such a way that it turns the motor on and off on detecting the moisture content of the soil. A GSM module acts as a transmitter and receiver, which can be used to view the readings and stats of the sensors and the moisture level of the soil.The aim of the system is to monitor the moisture content of the soil using a soil moisture sensor. The objective is to turn the pump ON when the soil moisture falls below a certain reference value. Next objective is to display the status of the soil and the tank using a 16×2 LCD.

3. System Design

Arduino is the main control centre. From where moisture sensor, Xbee transmitter and pH sensor are connected .The values shown by the moisture sensor is calculated, and if the value is less than the reference value, the pump will start; otherwise, it will not perform. The Xbee is used to control the system remotely. Again, if the water level in the tank is low, it will be refilled back. The block diagram of the proposed system can be represented as shown in Figure 1.

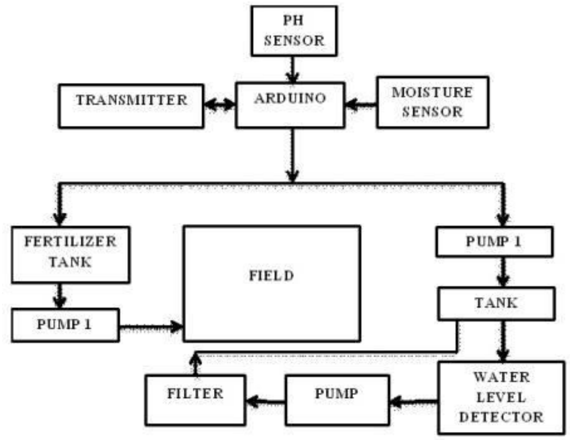

Figure1: Block Diagram

3.1 Circuit operation

The moisture sensor, pH sensor, Xbee transmitter, are connected to the analog inputs of Arduino. Then, from the digital inputs of Arduino, an LCD is connected to display the results. The pumps are connected by a motor drive circuit using diodes IND40007 and BJT. They are connected in reverse bias mode and resistance grounded for protection and to flow current only in one direction only. A float switch and LED are used to indicate the water level of tanks. If the water level of the tank is not sufficient, then with the help of level detector another pump will pull water from underground and allow it to pass through a filter which will purify the water and make it free from impurities and store it in the tank.Then as the tank gets filled up, the pump will automatically turn off by another Arduino working independently of the 1st Arduino connected to the main circuit.Then with the help of Xbee the transmitter sends the data to a remote location for references and evaluations. The moisture sensor will collect the data from the soil and feed it to Arduino, and if the moisture level is low, the pump will activate and water the area. If the moisture level is high; the pump won't turn on. Similarly, the pH sensor will collect the percentage of nitrogen in the soil and will work by providing fertilizer.

The system was designed to keep the cost at a bare minimum as well as efficient system. Arduino is the central to the whole system. Table 1 shows the component list.

Table 1: List of Components

Sl. No.	Components	Range	Quantity
1	Arduino Uno Xbee transmitter	ATmega328P, 5v	1
2	LCD	25C, 64Hz, 5.0V	1
3	Resistor		5
4	BC547	45v, 100mA, 625mW, 300MHz	1
5	Diode		1
6	Pump		1
7	Potentiometer		1
8	LED		2
9	Float Switch		1
10	Moisture Sensor		1
11	Xbee	2.4 GHz, 250 Kbps	2

4. Result and Analysis

4.1 Soil testing

To measure and set the base value for the pump to be activated, we have calculated the resistances of various types of soils. Soils with high water contents will have low resistance as compared to soil with less water. Then we calculated the water content % of each sample of 50gm using wet-dry soil testing as shown in Table 2. It is given by the formula %water = wet soil(weight) - dry soil(weight) / 1000gm per cubic cm.

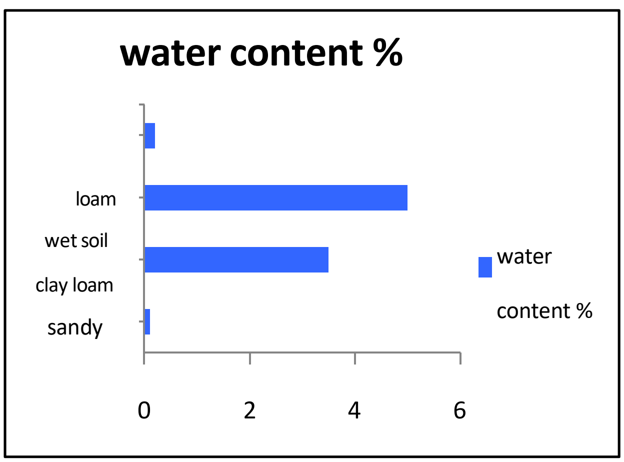

Figure 4: Graph representation of soil testing results

Soil Type	Water Content	Moisture Level
sandy	0.1	Low
low clay loam	3.5	High
wet soil	5	High
loam	0.2	low

Table 2: **Water content testing of different soils**

5. Conclusion and Future Scope

The Cultivation Management System based on cloud is a very effective system for the user, which cultivates the plants on the farm field by this farmer can examine their farm field information and detail from anywhere in between range The proposed monitor tool gives soil moisture details, water level details which can help to increase in productivity by using such automated irrigation system. The proposed system can be extended in future by adding the feature for remotely monitoring sensors that can detect crop growth and livestock feed levels. In the future, adding the features that can remotely manage and control their smart connected other irrigation equipment in the proposed system can be investigated.

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