Microcontroller Based Automatic Irrigation and Fertilisation System Using Soil Moisture Sensor and Ph Sensor

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Abstract: Farmers are reportedly facing a lack of rain and water. The main aim of the paper is the automatic irrigation solution for farmers. This helps to save them precious time and resources. Conventional irrigation technology requires more human action. Human interference can be reduced to a degree with the proposed automatic irrigation and fertilisation technologies. There is still a chance to reduce risks and make work more meekly thanks to the development of technology. The devices focused on integrated and micro controllers have enormous resolutions to voluminous challenges. By using a sensor micro controller system, the proposed programme accurately controls irrigation systems for agriculture. In the field, sensors are mounted to measure PH of a field and relative humidity that transports the signal to the computer for the calculation of crop water requirements.

Keywords: Moisture sensor, Rain sensor, pH sensor, Relay, Microcontroller

1. Introduction
Power deficiency is one of the world's main challenges today, and irrigation is a challenging activity requiring plenty of water [1]. A specialised delivery method which is responsive to groundwater uses is also relevant. In order to run an irrigation system, smart irrigation systems evaluate and measure existing moisture, conserve water when required and minimise excess water consumption [2]. Tensionmetric and volumetric approaches are very basic and are used on the basis of soil moisture irrigation management [3], but these phases are bound to a unique soil type-specific water curve. Moreover, for suitable performance, the sensors used require repetitive maintenance [4]. A hardware part is used by the system, which is threatened by inconsistencies Ecological circumstances. A real-time remote monitoring camera module was developed and tested to plan cotton irrigation for a real-time, intelligent moisture content and soil pH measurement sensor using components [5]. This method is unique to a specific particular crop and thus its use is limited. Appropriate irrigated agriculture is crucial for successful water management in crop production, particularly during food insecurity [6]. The amount of water required for irrigation, the frequency of irrigation and fertilisation are incredibly significant. There must be a correct irrigation scheduling technique to increase effective water use [7].

India enjoyed ample water supplies until quite recently. Yet, because of population increase and unsustainable uses of water sources, the need for water has been higher than supply [8]. Water supply is in a state of difficulty. If this situation continues, then the nation will face extreme water shortages.
So, there's an immediate need for water management [9]. The water needs of the plant or the crops are not controlled during irrigating crops [10]. Even if the soil is wet, drainage is often given, which is not consumed by the plants and is thus lost [11]. A system for tracking the plant's water needs therefore is necessary. If the construction of the Smart Irrigation System is completed, so the operational cost of maintenance workers is minimised [12]. This paper presents a simple means of automating the irrigation and irrigation by a micro-controller of small potted or manually limited crops [13].

2. Proposed System
The device proposed which is shown in Figure 1, is very useful for agriculture. The soil’s fertility plays an important part in the calculation of the eminence of the soil, and it reflects its plant life. Soil fertility is determined by the sum of macro- and micronutrient presence, water molecules, pH, etc. Since each crop, soil nutrients are depleted and hence have to be replenished. Fertilizers are added to the soil to sustain nutrient levels in the soil in the event of insufficiency. Ultimately, farmers choose to estimate the volume of fertiliser and manually raise it. Adding fertilisers to the correct quantity, however, is of great importance as excess or inadequate addition of fertilisers may damage the plant and can decrease yield patterns and promises of technology to provide a solution to the above issue. While programmed methods for sowing, weeding, field reaping, etc. [14]. None of the methods aimed at maintaining soil fertility is formulated and implemented. The suggested scheme seeks to recover mineral quantities such as nitrogen, phosphorous, and potassium in the soil by measuring the amount of nutrients available. Chemical processes determine the presence of nutrients and enumerate those using sensors. In order to prevent excess / deficient soil fertilisers, an automated system for the regulated addition of fertilisers has been created. Figure 1 is the proposed system's block diagram. The Arduino Uno inputs are related to three sensors: humidity, rain and pH. As Arduino’s built-in ADC is an analogue moist sensor, its digital resistance (0-1023) is converted.

Dry soil is the highest resistance, and wet soil the least resistance. If the soil is dry, the moisture sensor resistance value is high, so that if it exceeds the threshold, the system will be triggered and a switch will be flipped on and off. This is true to wet soil in contrast. The pH sensor tests the soil pH content and provides the appropriate fertiliser volume.

![Figure 1: Block Map of the system proposed](image)

3. Hardware Components
3.1. Soil Moisture Sensor
Soil moisture content is measured on the basis of the dielectric soil constant (soil bulk permissiveness), as the soil's volumetric water content. The dielectric continuous can be seen as the capacity of the soil to transfer electricity. With a rising water content of the soil, the dielectric constant
of the soil increases. This is due to the fact that the water refractive index is much greater than the other components of the soil, including air [15]. Thus, dielectric constant calculation provides an estimated water content estimation. It contains an electrode pair used to calculate the power of the mud. The increasing the power, the less moisture the soil generates. Moisture sensor and how it is tested using arduino is shown in Figure 2.

![Figure 2: Moisture sensor](image)

3.2. pH Sensor
Reliable, detailed pH measurements in aqueous solutions are made by the CS526 isolated pH probe. It may be immersed in containers, channels, and open conduits or inserted in them. This probe has a serialised TTL output denoting a pH range of 2 to 12. Testing of pH sensor is shown in Figure 3.

![Figure 3: pH sensor pH S](image)

3.3. Rain Sensor
A switching system triggered by rainfall is a rain sensor or climate switch. For rain sensors which are shown in Figure 4, there are two key uses. The first is a water control unit connected to an automatic method of irrigation that enables the system to shut down in the event of precipitation.

![Figure 4: Rain sensor](image)
3.4. Relay
A relay is an energy switchover. Many relays employ an electric motor to drive changes mechanically, but there are also other operating principles included, like solid-state circuits. It is possible to monitor a circuit with another low power signal or to control a single signal through different circuits.

3.5. Pump Motor
Motor is an electronic system that turns mechanical energy into electrical energy, and pump is a mechanical mechanism that translates mechanical energy into work to be performed. The pump is only operated by an engine. The pump is a mechanical system used to shift fluids as shown in the Figure 5.

![Figure 5: 5V DC pump](image)

4. Hardware Design
A single moisture sensor, rain sensor and pH sensor will be included in our prototype. The amount of humidity sensor & pH sensors that can be attached to the panel can vary based on the number of smoother sensor sends resistance values to the soil in which it is engrossed when the water level sensor is attached to the plate. Arduino's built-in ADC is used to transform the soil moisture sensor into its digital form (0-1023), since it is an analogue unit, reflects soil resistance. The highest resistance will be to moist ground and the least resistance to damp soil will be there. The moisture sensor value is high whenever the soil dries, so that the pumps is activated by a switch & disabled when the values exceed the mark. The same is true for the wet dirt. When the surface of the rain sensor detects the water on the rain sensor, the rain sensor will transmit the Arduino warning, and then the engines are shut off, regardless of their state. The pH sensor is switched on to read the pH of the soil, based on the crop requirement.

5. Software Design
In our project, the programme used is Arduino. A variety of libraries are available to make programming simpler. The AtMega328 controller is programmed by Arduino in our prototype. For both the humidity and the pH sensor, the Arduino programme designates a set number of digital resistance values from 0 to 1023. Any aberration in the set range flies to the area of the pump. The flowchart for the proposed system is shown in Figure 6 and Figure 7 explains the circuit connections of the system.

![Figure 6: Flowchart](image)
Arduino is the heart of the project and its brain too. All our components are connected to the Arduino board. The sensors are moisture sensor, rain and pH sensor. A program written for this is burned into the board. The soil moisture sensor is attached to the Arduino analogue pin A2. The readings are compared with the predetermined value of the crop’s requirement then the A2 pin is turned high, if the value is less than the requirement, which turns on the motor 1. If the soil moisture is enough or more then the motor remains in off condition. Next the rain sensor will be connected to second input pin. In case the value is less than 900, then it means there is no rain occurring hence, the motor will be in off condition or in condition, based on the decision made by the moisture sensor. But if the value is greater than 900, regardless of the result of the moisture sensor the motor will be turned off quickly. The Arduino analogue pin A0 is then mounted to the pH sensor. The pH meter sends the value to the board, based on the requirements of the crop the fertilizer is supplied to the crop, by turning on and off the fertilizer pump. This way we are able to supply optimum water and fertilizers to the crop without any manual interruption. Every crop has its own water and nutrient requirement. So we need to change our parameters as required, since the board can be programmed any number of times, we can easily use this for different variety of crops after understanding their requirements.

6. Advantages

It is proposed for effective automation irrigation systems, which can be extended to other comparable agricultural crops by offering a valued water planning and irrigation preparation process. The plant is actively dispersing water with a servo motor to check the intense water absorption. The depletion of water is also negligible. This arrangement also makes it possible to control the water volume supplied to the plants according to the desired soil humidity and temperature according to plant types. This system can be used in huge agricultural areas where human sweat must be reduced. Many system functionality may be changed and perfected by software to fulfil a plant requirement.

7. Results and Discussions

Below shown Figure 8 is the hardware implementation of the proposed system. Here the soil moisture sensor lively monitors the moisture level of the soil. Pump motor will be turned on once if moisture level is below the threshold so that the field will be filled with water. At the same time if the water level is above the threshold then the pump motor gets turned off automatically. And all the above information which is described above is displayed in the LCD display. And pH sensor is also used to note down the pH value of the soil to determine its nature.
Rain sensor is also the key factor which turns the motor on or off. When there is rain then there is no need of pump operations to fetch water to the field.

8. **Conclusion**

To provide sufficient irrigation and fertiliser, three sensors were used. The sensors are linked effectively to Arduino and wireless connectivity is accomplished. Interpretations and investigational experiments indicate that this research offers a systematic approach to the problems of field irrigation. The implementation of such a process in the field would certainly lead to better crop yields and to effective water conservation by reducing use.

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