Smart Irrigation System

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Abstract :

In the present era one of the greatest problems faced by the world is water scarcity and agriculture being a demanding occupation which consumes plenty of water. Therefore a system is required that uses water judiciously. India is an agricultural country, wherein about 70% of the population depends on agriculture. Farmers have wide range of diversity to select suitable fruits and vegetables crops. However, the cultivation of these crops for optimum yield and quality produce is highly technical. It can be improved by the aid of technological support. The management of irrigation can be improved using automatic watering system. A system that will help a farmer to know his field status in his home or he may be residing in any part of the world. It proposes an automatic irrigation system for the agricultural lands. Currently the automation is one of the important roles in the human life. It not only provides comfort but also reduce energy consumption, increase efficiency and time saving. Now the industries are using automation and control machine which are expensive and not suitable for using in a farm land. So here we design a smart irrigation system in low cost which can be utilized by Indian farmers.

Keyword: Arduino, Soil Sensor, Wi-Fi Module, Prototype, Moisture Depletion.

I. Introduction

Agriculture is the backbone of all developed countries. It uses 85% of available freshwater resources worldwide, this percentage continues to be dominant in water consumption because of population growth and increased food demand. Due to this, efficient water management is the major concern in many cropping system in arid and semi-arid areas. An automated irrigation system is needed to optimize water use for agricultural crops. The need of automated irrigation system is to overcome over irrigation and under irrigation. Over irrigation occurs because of poor distribution or management of water. Under irrigation leads to increased soil salinity with consequent buildup of toxic salts on the soil surface in areas with high evaporation. To overcome these problems and to reduce the manpower, smart irrigation system has been used. Improving irrigation efficiency can contribute greatly to reducing production costs, making the industry more competitive and sustainable. Through proper irrigation, average crop yields can be maintained (or increased) while minimizing environmental impacts caused by excess applied water and subsequent agrichemical leaching. Recent technological advances have made soil water sensors available for efficient and automatic operation of irrigation systems. Automatic soil water sensor-based irrigation seeks to maintain a desired soil water range in the root zone that is optimal for the plant's growth.

II. LITERATURE SURVEY

[1] Alberto Pardossi , Luca Incrocci (2009) published a paper on Root Zone Sensors for Irrigation Management in Intensive Agriculture which dealt with sensors in different root zones for different crops.

[2] Archana and Priya (2016) proposed a paper 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. This system doesn't intimate the farmer about the field status.

[3] G.Parameswaran and K.Sivaprasath (2016) 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 personal computer.

[4] Ray-Shyan Wu, Jih-Shun Liu, Sheng-Yu Chang andFiaz Hussain (2017) proposed a paper for Modeling of Mixed Crop Field Water Demand and a Smart Irrigation System which indicated that the field storage in the end block of the study area was lower than the wilting point under the 50% reduced irrigation water scenario. The original irrigation plan can be reduced to be more efficient in water usage, and a 50% reduction of irrigation can be applied as a solution of water shortage when drought occurs.

[5] Sonali D.Gainwar and Dinesh V. Rojatkar (2015) proposed a paper in which soil parameters such as pH, humidity, moisture and temperature are measured for getting high yield from soil. This system is fully automated which turns the motor pump ON/OFF as per the level of moisture in the soil.

III. PROBLEM STATEMENT

The conventional irrigation system is manually operated and it is based on real-time weather and soil conditions observed manually. Water schedule driven by Heuristics based on the experience of the farmer, which is highly dependent on manual labor. The main problem faced by farmers is water scarcity due to less rainfall. The farmers sometimes have to water the field in odd hours due to variation in supply. There are also chances of overwatering and under watering in few circumstances due to human error.

IV. PROTOTYPE

Components

a. **Arduino:** An open source platform which consists of both a physical programming circuit board (Micro controller) and a piece of software (Integrated development Environment).The Microcontroller used here is an Arduino UNO. The UNO is a Microcontroller board. The UNO can be programmed with the Arduino software.

b. **Soil Moisture Sensor:** Soil Moisture sensor is used to measure the moisture content present in the soil. The Soil Moisture Sensor (SMS) is a sensor connected to an irrigation system controller that measures soil moisture content in the active root zone before each scheduled irrigation event and bypasses the cycle if moisture is above a user defined set point.

c. **Wi-Fi Module:** The ESP8266 Wi-Fi module is a self - contained SOC (System on Chip) with integrated TCP/IP (Transmission Control Protocol/Internet Protocol) protocol stack 0= that can give any microcontroller access to any WiFi network. Each ESP8266 module comes preprogrammed meaning, it can be simply hooked up to Arduino device to get Wi-Fi ability. This module has a powerful enough onboarding process and high storage capacity that allows it to be integrated with the sensors and other application specific devices.

d. **Submersible Water Pump:** A submersible pump (or sub pump, electric submersible pump) is a device which has a hermetically sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped. The main advantage of this type of pump is that it prevents pump cavitations, a problem associated with a high elevation difference between pump and the fluid surface. Small DC Submersible water pumps push fluid to the surface as opposed to jet pumps having to pull fluids. Submersibles are more efficient than jet pumps. It is usually operated between 3v to 12v.

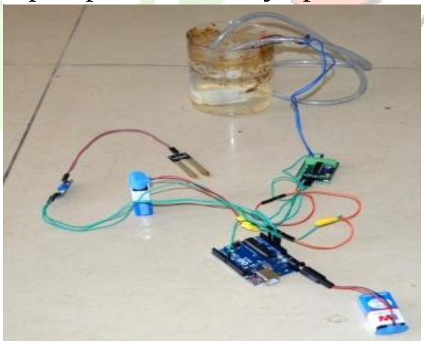

Fig-1: Prototype

V. SYSTEM DESIGN

The system works in real time and depends on soil sensor. The soil sensor detects the moisture present in the soil. A threshold is preset in the prototype depending on the soil and crop type. When the moisture falls below the set threshold the system turn the pump ON, thereby supplying water to the crops, as soon as the moisture in the soil reaches above the threshold the water supply will stop. The entire system is automated therefore no human intervention is required. The system will automatically supply the water depending on the moisture present in the soil. The complete process can be overviewed through an application on our smart phone.

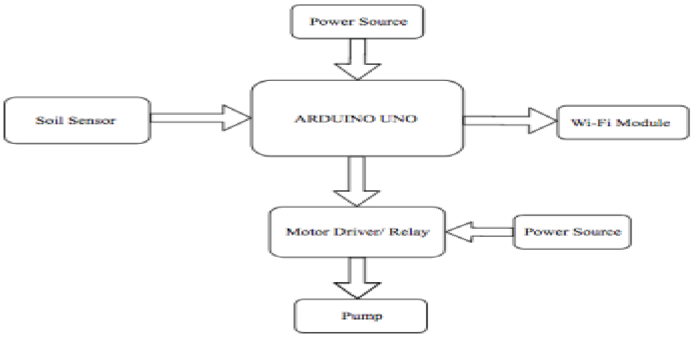

Fig -2: Block Diagram

VI. TESTS CONDUCTED AND RESULTS

a. Gravimetric Test

1) Clean and dry the weighing tin+lid and weigh to 0.01 g (W1). Select a representative quantity of moist soil in the amount specified by a test. Where not otherwise specified use at least 30 g. Place the sample in the weighing tin and replace lid. Weigh the tin and contents to 0.01 g (W2).
2) Remove the lid and place the tin with contents and lid in the oven and dry to constant weight between 105 °C and 110 °C.
3) Remove the tin with contents from the oven, replace the lid and place the whole in the desiccators to cool.
4) Weigh the tin and contents to 0.01 g (W3).
The moisture content present in soil is given by

$$\frac{W2 - W3}{W3 - W1} * 100$$

Where,
W1 = Weight of tin (g)
W2 = Weight of moist soil + tin (g)
W3 = Weight of dried soil + tin (g)

Gravimetric Test Results

The test was conducted for red soil, Black soil and laterite soil in three trials and the results are given in the below table(s)

Table -1: Red Soil

Trial	W1 in gm	W2 in gm	W3 in gm	Moisture Content in %
1	20	95	80	25
2	20	105	90	21.42
3	20	105	82	29.03
			Average	**25.15**

Table -2: Black Soil

Trial	W1 in gm	W2 in gm	W3 in gm	Moisture Content in %
1	20	94	80	23.33
2	20	90	75	27.27
3	20	90	77	22.80
			Average	**24.59**

Table -3: Laterite Soil

Trial	W1 in gm	W2 in gm	W3 in gm	Moisture Content in %
1	20	95	75	36.36
2	20	105	85	30.76
3	20	105	82	37.1
			Average	**34.87**

The prototype was tested for 3 major soil; Red soil, Black soil and Laterite soil. The sensor readings were compared with the results of gravimetric tests to ensure proper working of prototype. The sensor was placed in the soil at the same time the sample was taken for the gravimetric test to get accurate results. Since the sensor works in real-time, it gave instant results. The results shown were noted down. It was also noted that the pump supplied water at specified threshold for these 3 soils.

Table -4: Soil moisture sensor reading for different soils

Sl. no.	Soil Type	Sensor Reading	Moisture Content (By gravimetric test)
1	Red Soil	24	24.15
2	Black Soil	26	24.59
3	Laterite Soil	36	34.87

b. Moisture Depletion in Soil

A plot of land was selected in an open area in our college campus and checked for moisture depletion.

The soil was watered and sensor readings were noted at the same time. Sensor readings were at hourly intervals to check the moisture depletion of the soil. The senor reading is as follows:

Table -5: Moisture Depletion of the soil

Time Interval in hours	Soil Sensor reading
1	86
2	77
3	63
4	56
5	41
6	34

The below graph shows the moisture depletion in the selected area.

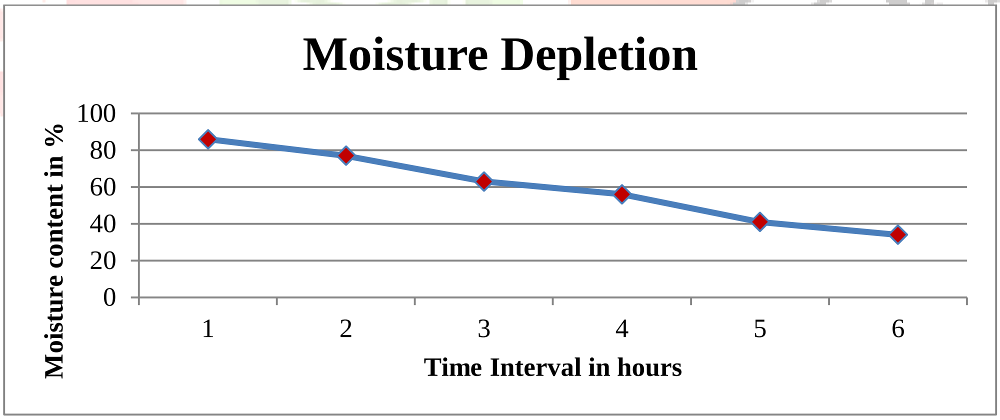

Fig -3: Moisture depletion of the soil

The graph shows the decrease in moisture over the time. Since the selected area was small, the decrease in moisture was rapid. It depends on soil type, rate of evaporation and field capacity. We had set the threshold at 30% as soon as moisture reached below the threshold, the pump started automatically.

VII. CONCLUSION

Irrigation process is the more significant requirement for human's civilization and it is treated as backbone of our country. In the current circumstances saving of water is of high concerned. This work attempts to save the natural resources by continuously monitoring the status of the soil, controlling of water flow and thereby reduce the wastage.

The farmers can be greatly benefitted by this system which would reduce the labour charges and increase the efficiency in farming. By modernizing the farming techniques we get high yields and increase the living standards of farmers. It will be very useful in arid and semi-arid areas.

Based on tests conducted and application of the prototype in various areas, we conclude that this system can be implemented in our country with some more research and development. It will prove to be beneficial to the farmers.

VIII. References

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