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Smart Irrigation System

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Abstract: *With the water requirements in irrigation being large, there is a need for a smart irrigation system that can save about 80% of the water. This prototype aims at saving time and avoiding problems like constant vigilance. It also helps in water conservation by automatically providing water to the plants/gardens depending on their water requirements. It can also prove to be efficient in Agricultural fields, Lawns & Parks. As technology is advancing, there is always a chance of reducing risks and making work simpler. Embedded and micro controller systems provide solutions for many problems. This application precisely controls water system for gardens by using a sensor micro controller system. It is achieved by installing sensors in the field to monitor the soil temperature and soil moisture which transmits the data to the microcontroller for estimation of water demands of plants.*

Keywords: *Soil Moisture, Temperature, Moisture Sensor, Resistance Temperature Detector (RTD), Relay, Microcontroller.*

I. Introduction

In the present era one of the greatest problems faced by the world is water scarcity and agriculture being a demanding occupation consumes plenty of water. Therefore a system is required that uses water judiciously. Smart irrigation systems estimate and measure diminution of existing plant moisture in order to operate an irrigation system, restoring water as needed while minimizing excess water use.

The soil moisture based irrigation control [1] uses Tensiometric and Volumetric techniques, which are relatively simple but these quantities are related through a soil water characteristic curve that is specific to a soil type. Also the sensors used require routine maintenance for proper performance. Intelligent automatic plant irrigation system [2] concentrates watering plants regularly without human monitoring using a moisture sensor. The circuit is build around a comparator Op-amp (LM324) and a timer which drives a relay to switch on a motor.The system uses a hardware component, which is subjected to variation with the environmental conditions.

A real-time wireless smart sensor array for scheduling irrigation[3] prototyped a real-time, smart sensor array for measuring soil moisture and soil temperature that uses off-the-shelf components was developed and evaluated for scheduling irrigation in cotton.

This system is specific for a crop and hence its usage is limited.Proper scheduling of irrigation is critical for efficient water management in crop production, particularly under conditions of water scarcity. The effects of the applied amount of irrigation water, irrigation frequency and water use are particularly important. To improve water efficiency there must be a proper irrigation scheduling strategy. So our project devices a simple system, using a microcontroller to automate the irrigation and watering of small potted plants or crops with minimal manual interventions.

II. Why Need This Ststem

Until quite recently, India enjoyed abundant water resources. But population growth and overexploitation has led to a situation where the demand for water is exceeding supply.

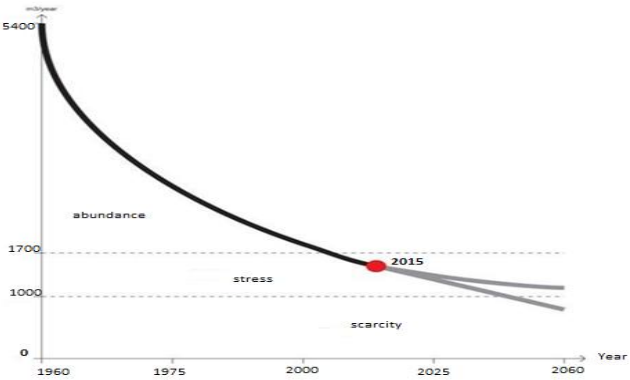

Fig1: The graph shows exponential decrease of water per capita.

From the graph we currently notice that the water availability is in stress. If this rate continues, then we would face severe water scarcity. So there is an urgent need to conserve water. During manual irrigation, the water requirement of plants/crops is not monitored. Even when the soil is moist enough, water is still provided. This water is not absorbed by the plants and thus is wasted. Hence a system is to monitor the water requirements of the plant is needed. Also Smart Irrigation System installation means decreased operating expense by maintenance personnel.

III. Syetem Overview

This prototype monitors the amount of soil moisture and temperature. A predefined range of soil moisture and temperature is set, and can be varied with soil type or crop type. In case the moisture or temperature of the soil deviates from the specified range, the watering system is turned on/off. In case of dry soil and high soil temperature, it will activate the irrigation system, pumping water for watering the plants.

The block diagram of smart irrigation system is represented in Fig1. It consists of a microcontroller (ATmega328) which is the brain of the system. Both the moisture and temperature sensors are connected to the input pins of the controller. The water pump and the servo motor are coupled with the output pins. If the sensors depart from the predefined range, the controller turns on the pump. The servo motor is used to control the angular position of the pipe, which ensures equal distribution of water to the soil. An LED indicator indicates the status of the pump.

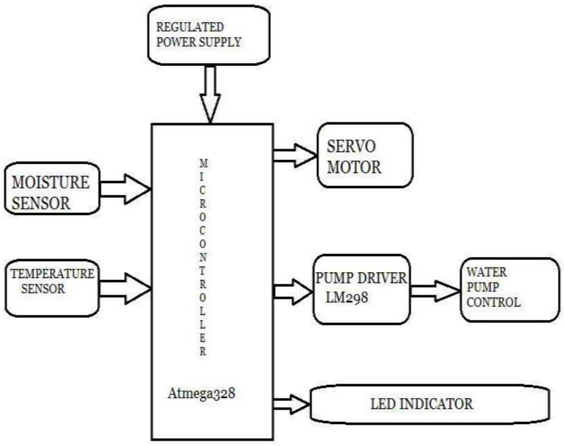

Fig2: block diagram of smart irrigation system

This system can be implemented on a large scale for farming purposes, which can further prove to be more advantageous. Owing to prevailing conditions and water shortages, the optimum irrigation schedules should be determined especially in farms to conserve water.

IV. Project Description

Hardware Components:

1) Soil Moisture Sensor- soil moisture sensors estimates the soil volumetric water content based on the dielectric constant (soil bulk permittivity) of the soil. The dielectric constant can be thought of as the soil's ability to transmit electricity. The dielectric constant of soil increases as the water content of the soil increases. This response is due to the fact that the dielectric constant of water is much larger than the other soil components, including air. Thus, measurement of the dielectric constant gives a predictable estimation of water content. It consists of a pair of electrodes to measure the resistance of the soil. Greater the resistance, lower the moisture content of the soil.

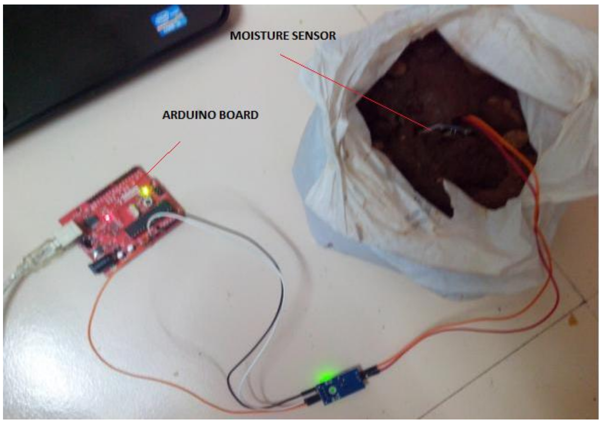

Fig3: Moisture sensor connected to the input pin of the microcontroller

2) Temperature Sensor- A Resistance Temperature Detector(RTD) is used to measure temperature as a function of resistance. As the temperature of the soil increases, the resistance of the soil also increases. RTDs readings are more accurate and more repeatable.

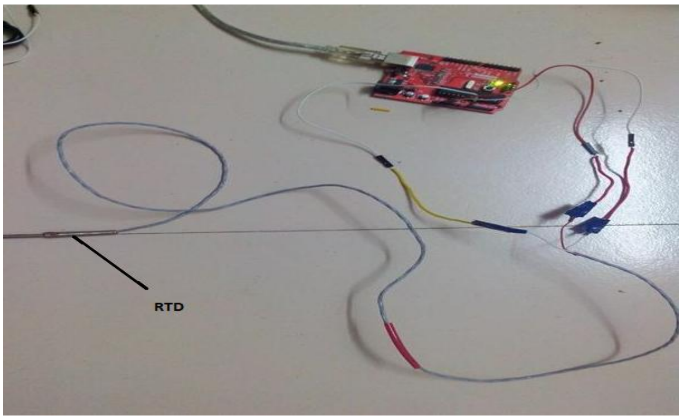

Fig4: RTD connected to the input of the microcontroller

3) Relay- it is used to switch on/off the pump according to the watering requirement of the soil.

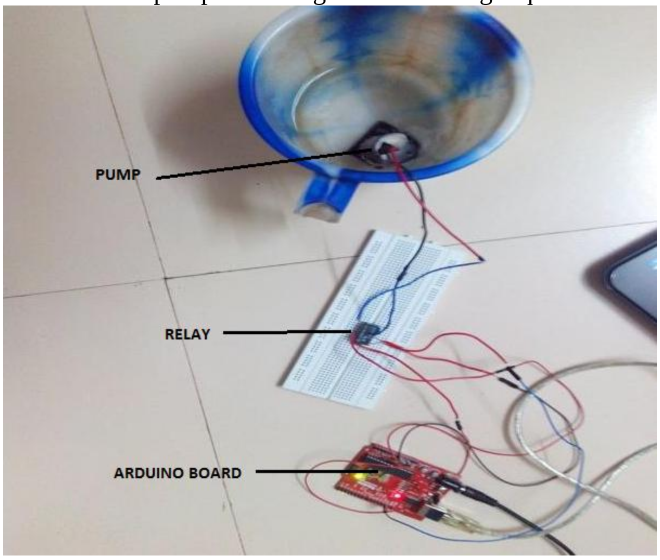

Fig5: interfacing Arduino with pump and relay

4) Servo Motor and Rotating Platform- to take the water pipe to water the target plot. In order to control the spray distance and angle, we use a servo motor.

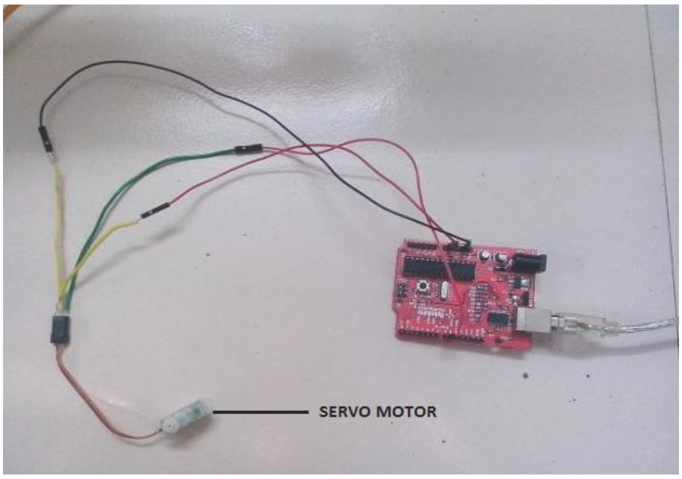

Fig6: Sevo motor connected to the Arduino Board

Hardware Design:

In our model, we are demonstrating watering of only one pot, so a single moisture sensor and temperature sensor is used. Depending on the number of pots, the number of moisture sensor and temperature sensor to be interfaced with the board will vary. When the soil moisture sensor is interfaced with the board , the sensor reports values of resistances of the soil in which it is immersed into. As soil moisture sensor is analog, an inbuilt ADC in Arduino is used to convert into its digital form (0-1023), which represents resistance. Dry soil will have the maximum resistance and wet soil will have least resistance. Similarly, The temperature sensor (RTD) reports values of temperature in terms of resistance. If the temperature of the soil is high, then the sensor reports high value of resistance and vice versa. The servo motor is programmed to rotate from 0 to 180 degree. It is a 3.3V motor and does not require any driver. The rotating platform is attached on the motor to provide a base for the movement of the pipe. If the soil is dry, temperature sensor and moisture sensor values will be high, so the pump is turned on using a relay and switched off when the values reach a threshold .The vice versa is applicable for moist soil.

Software Design:

The software used in our project is Arduino. It provides a number of libraries to make programming simple. In our prototype, the controller AtMega328 is programmed in Arduino. The program in Arduino designates a preset range of resistance value in digital format (ranging from 0 to 1023) for both the moisture and the temperature sensor. Any aberration from the set range switches on/off the pump, to water the plants.

V. Advantages Of The System

This technology is recommended for efficient automated irrigation systems and it may provide a valuable tool for conserving water planning and irrigation scheduling which is extendable to other similar agricultural crops. Maximum absorption of the water by the plant is ensured by spreading the water uniformly using a servo motor. So there is minimal wastage of water. This system also allows controlling the amount of water delivered to the plants when it is needed based on types of plants by monitoring soil moisture and temperature.This project can be used in large agricultural area where human effort needs to be minimized. Many aspects of the system can be customized and fine tuned through software for a plant requirement.

VI. Result

The smart irrigation system was tested on a garden plant. The plant's water requirement is 600-800mm a day and temperature requirement of the soil ranges from 50^{o}C- 100^{o}C. In the Arduino code, the moisture and temperature range were set as 300-700 and 450-800 respectively (which delineates the corresponding resistance value in digital format). Moreover this system proves to be cost effective and proficient in conserving water and reducing its wastage.

VII. Conclusion

In the present era, the farmers use irrigation technique through the manual control, in which the farmers irrigate the land at regular intervals [5].This process seems to consume more water and results in water wastage.

Moreover in dry areas where there is inadequate rainfall, irrigation becomes difficult. Hence we require an automatic system that will precisely monitor and control the water requirements in the field. Installing Smart irrigation system saves time and ensures judicious usage of water. Moreover this architecture uses microcontroller which promises an increase in system life by reducing power consumption.

VIII. Future Scope

Our project can be improvised by adding a Webscaper which can predict the weather and water the plants/crops accordingly. If rain is forecasted, less water is let out for the plants. Also, a GSM module can be included so that the user can control the system via smart phone. A water meter can be installed to estimate the amount of water used for irrigation and thus giving a cost estimation. A solenoid valve can be used for varying the volume of water flow. Furthermore, Wireless sensors can also be used.

Acknowledgement

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