IJARCCE

ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Vol. 10, Issue 11, November 2021

DOI: 10.17148/IJARCCE.2021.101125

Smart Irrigation System

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Abstract: Water scarcity is one of the most important natural resource problems to be paid more attention to. Traditional agriculture methods required more water supply due to which irrigation was introduced in 6000 B.C. in the Middle East's Jordan Valley. Due to the development of new technology and introduction to Internet of Things (IoT) many problems can be efficiently handled. Embedded and microcontroller systems provide solutions for many problems. The smart irrigation system has become a new trend in the field of agricultural irrigation. This paper proposes a soil moisture sensor-based smart irrigation system. This can be implemented by installing soil moisture sensors in the agriculture field to monitor the moisture level in the soil which in turn transfers the data to the microcontroller to evaluate the water demands of plants.

Keywords: Soil Moisture Sensor, Microcontroller, Smart Irrigation, Arduino Uno

I. INTRODUCTION

Agriculture is undoubtedly the huge livelihood provider in India. With an increase in population, agricultural production needs to be increased and in order to support greater production in farms, the requirement of the amount of fresh water used in irrigation also rises. Currently, agriculture accounts for 83% of the total water consumption in India [1]. Haphazard use of water leads to unintentional wastage of water. This insinuates that there is an urgent need to develop systems that prevent water wastage without inflicting unnecessary pressure on the farmers.

With effortless obtainability, inexpensive and open-source Arduino boards alongside cheap moisture sensors, it is feasible to create devices that can keep a track of moisture content and accordingly irrigate the fields as an when needed. The proposed system makes use of microcontroller Arduino UNO which allows the farmers to keep track of the status of the sensors installed in the farm by knowing the sensor values thereby, making the farmer's work much easier by turning on the pump. If the sensor value crosses the threshold value, then the motor pump will remain shut down otherwise it will start again automatically also display the same on the LCD screen.

II. LITERATURE SURVEY

With an intention to save water and one step towards smart irrigation system, [2] helps to monitor the amount of soil moisture and temperature by setting a predefined range of soil moisture and temperature which can be varied with soil type or crop type with some exceptions where the watering system is turned on/off. In case of dry soil and high soil temperature, the irrigation system will be activated. The circuit is built on a comparator Op-amp (LM324) and a timer.
[3] The UI is designed using PHP through which the farmer can monitor the embedded system installed on the farm. All the data collected from the embedded system is hosted online.
[4] Raspberry Pi is used in this prototype model for making the system compact and sustainable. The system has a sensor measuring the moisture of the soil and has switches relay which controls the solenoid valve according to the requirement.
[5] This system has a Raspberry Pi controlling the electromagnetic valve changes, directing the water in the required area. The motor is switched on automatically when the valve is open enabling the farmer to know the status of the farm field while being away from the field.

III. PROPOSED SYSTEM

Smart irrigation is controlled by autonomous means which automatically controls the total irrigation system irrespective of the farmer's presence in the farm field and display messages on the screen about changes in the farm field which require no worker for operating, and also less waste of water with compared to earlier methods.

This prototype incorporates both hardware and software components. A predefined range of soil moisture and temperature is set that can be varied with soil type and crop type. REES52 soil moisture sensor along with LM393 comparator module is placed in soil for analysis. If the moisture of the soil varies from the predefined range, the

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watering system will be switched on/off accordingly. In the condition of heavy rain, the micro-controller will shut down the motor pump.

A. Block Diagram:

The block diagram of smart irrigation system is illustrated in Fig. 1. It consists of a microcontroller (Arduino UNO) which is the brain of the system. The moisture sensor is connected to the input pins of the microcontroller via the LM393 comparator chip and the water pump is connected with the output pins. If the sensors vary from the predefined range, the controller switches on/off the pump according to the soil requirement. The USB plug on the Arduino is primarily responsible for transmitting the data obtained from Arduino and is displayed on the serial port monitor.

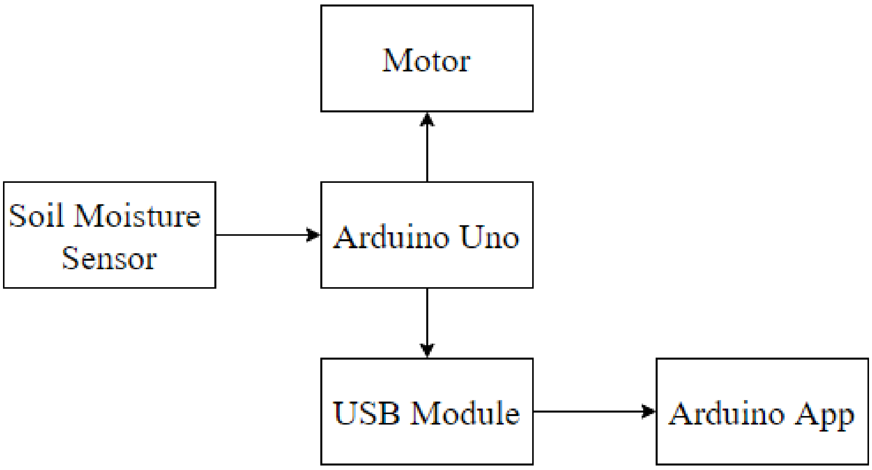

Fig. 1 Block Diagram

B. Flow Chart:

The flow chart of smart irrigation system is illustrated in Fig. 2. Once the system is plugged ON it initializes all components and sets the soil moisture level to its default value. Then the soil moisture sensor connected to the Arduino UNO senses the moisture level in the soil. The Arduino IDE software connected to the Arduino UNO via USB module will receive the values from Arduino and display them on the serial port monitor.

Arduino UNO processes the received moisture content data from the sensor and decides about the need of watering the field. The dry soil leads to the water flowing into the field and if the soil is wet the water flow stops. Eventually, this system ensures that the moisture content and availability of water in the field are thoroughly maintained.

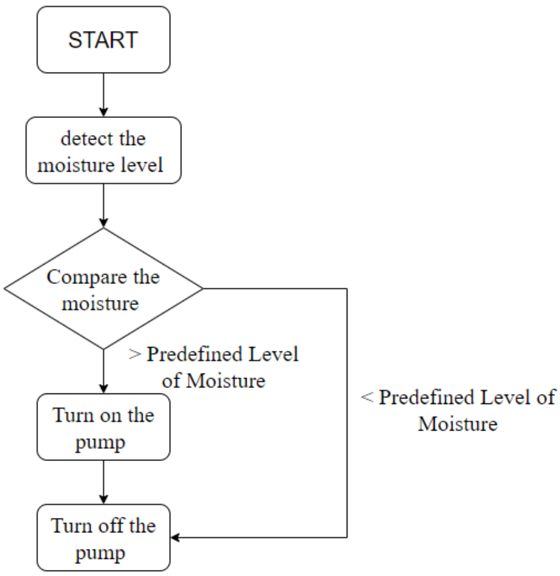

Fig. 2 Flow Chart

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C. Components required:

1. *Water Pump:* This plays the role of pumping, pressurizing, and circulating water. It is a cheap, small size Pump Motor that can be operated from a 3 ~ 6V power supply. It can pump up to 120 litre per hour with a very low current consumption of 220mA.

Fig. 3 Water Pump

2. *Arduino UNO:* Arduino is an easy-to-use hardware and software. This board is able to interpret inputs, for example, light on a sensor, moisture sensor, a finger on a button and turn it into an output - activating a motor, switching on an LED, displaying output online. One can easily tell the board what to do by giving input of a set of instructions to the microcontroller.

Features:
Microcontroller: ATmega328
Operating Voltage: 5V
Input Voltage (recommended): 7-12V
Input Voltage (limits): 6-20V
Digital I/O Pins: 14 (6 giving PWM output)
DC Current per I/O Pin: 40 mA
DC Current for 3.3V Pin: 50 mA
Analog Input Pins: 6
Flash Memory: 32 KB (0.5 KB used by the bootloader)
EEPROM: 1 KB (ATmega328)
Clock Speed: 16 MHz
SRAM: 2 KB (ATmega328)

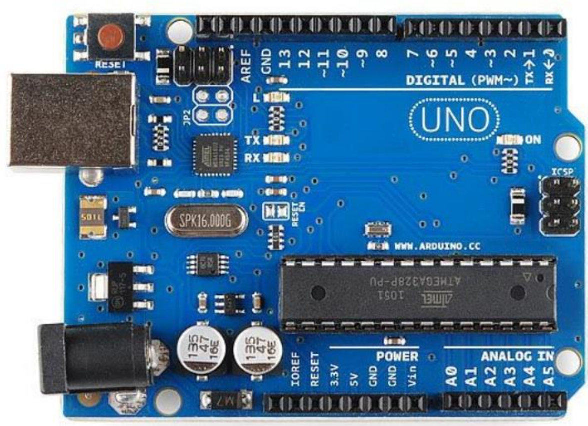

Fig 4. Arduino UNO

3. *Soil Moisture Sensor:* Soil moisture sensor includes 2 conducting plates that operate as a probe and act as a variable resistor together which are used to measure the volumetric content of water. The two probes act as a medium allowing the current to pass through the soil, in turn, which gives the resistance value to measure the moisture value. The sensor when inserted into the water will decrease the resistance and get better conductivity between plates.
Dry soil acts as a poor conductor of electricity and hence in less amount of water, less electricity will be conducted by the soil leading to more resistance. This sensor has digital and analog outputs and also a potentiometer to adjust the predefined level.

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Features
Input Voltage: 3.3–5V
Operating Current: 15mA
Output Digital - 0V or 5V
Output Analog - 0V to 5V

LM393 IC: This module is a DIP comparator IC i.e. the IC has 2 comparators inside one single 8-pin package. It has a wide supply voltage range. LM393 Comparator IC is used as a voltage comparator in this Moisture sensor module. Pin 2 of LM393 is connected to Preset (10KΩ Pot) and pin 3 is connected to Moisture sensor pin. The comparator IC will compare the predefined voltage using the preset (pin2) and the sensor pin (pin3).

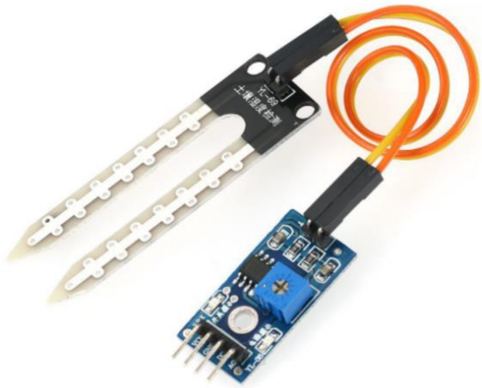

Fig 5. Moisture Sensor

IV. RESULTS

The smart irrigation system was implemented on a garden soil. This system therefore proves to be cost efficient, easy to use and handle saving a lot of water.

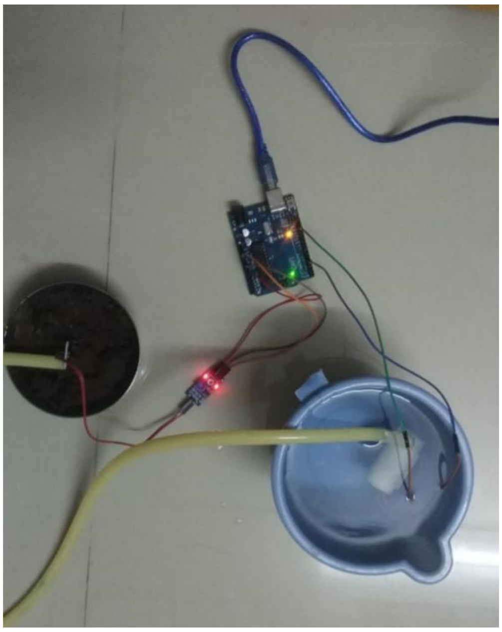

Fig 6. Connection of the system

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V. CONCLUSION

The smart irrigation system executed is easy, feasible, and cost-effective. This system allows cultivation in places having low water levels thereby improving sustainability. Also, human intervention is much reduced by using this smart irrigation system. This project provided an opportunity to study the already existing systems with their features and drawbacks. Agriculture is one of the most water-consuming activities and through this project, it can be concluded that there can be a significant development in the field of farming with the use of IoT and automation.

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