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Intelligent Plant Watering System with Arduino Uno

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Abstract

The working version of this intelligent irrigation system reduces water use by dynamically watering plants based on their requirements. The system calculates water needs by recording soil temperature and moisture using Arduino electronics and soil moisture sensors. Water is released quickly and is saved up to 80% by triggering a solenoid valve. The affordable approach works well for farming, maintaining lawns, and maintaining parks, lowering hazards and streamlining work while conserving water in an era of water constraint. For plant lovers who want to make sure their plants are watered constantly, building a watering system using an Arduino Uno board can be a terrific project. A well-liked microcontroller board known as the Arduino Uno can be configured to operate a number of electronic gadgets.

Keywords: Arduino system, soil moisture sensor, solenoid valve, automation, irrigation systems.

INTRODUCTION

Farmers can save up to 50% of their drinking water by applying the principles that govern modern irrigation systems. This idea focuses on two types of irrigation: classic irrigation techniques like above sprinklers and flood-type feeding systems, whereby wet the lower leaves and stem of the plants. As a result of the considerable quantity of water that is utilized by flood-type systems, the space between the crop rows becomes dry, leaving the farmer to rely on only incidental rainfalls. The modern irrigation system is illustrated in its entirety in the diagram below. Nearly half of the available water sources are put to use or required by standard techniques like sprinklers or surface irrigation. It is possible to provide plants with greater precision watering schedules. The plant damage from insects and disease will be lessened as long as the foliage continues to be dry, which lowers the price of maintenance even more. When the plants are being drained, the dry rows between them will cause recurring federations. This kind of method makes it possible to apply fertilizers simultaneously lowering the expense associated with it. Comparing current technologies with overhead sprinkler systems, the erosion of soil and wind are greatly reduced. The features of the soil will determine how a plant that gains moisture will drip in its root zone. Dripping became a prevalent technique since it will cut down on significant water losses both also increasing yields and reduce labor costs. The information will be specified to the user (farmer) once all the components have read the signals that are input by the controller and sent signals as output.

SOIL MOISTURE SENSOR

While both direct (soil sample) and indirect (soil moisture sensing) approaches can be used to detect the present state of soil water, direct methods are less often employed for irrigation scheduling since they are intrusive, labor-intensive, as well as unable to offer quick feedback. To give repeated moisture readings over time that can be used for irrigation management, soil moisture probes can be permanently planted at representative places in an agricultural area. Since most devices need to be in close association with the soil matrix, it can be challenging in coarse soils, extra caution must be

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used when employing them. The largest number of volumetric sensors now on the market that are right for irrigation are capacitance. This particular type of sensors assesses the soil bulk permittivity (or dielectric constant), which governs the speed of an electromagnetic wave or pulse into the soil. The value of the permittivity of a composite medium like soil, which is made up of various components including minerals, air, and water, is made up by the particular contributions of each element. The total permittivity of the soil, or volume permittivity, is primarily controlled by the level of liquid water since its dielectric constant is significantly greater than that of any other soil constituent. The dielectric methods use empirical relationships (calibrated) between the water volume in the sample and the sensor output signal (time, frequency, impedance, and wave phase). Because of their quick measurements (nearly instantaneous), lack of upkeep, and potential to automate continuous readings, these techniques are becoming more and more common (Figure 1).

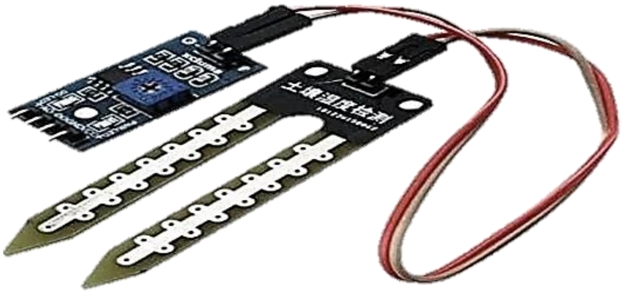

Figure 1. Soil moisture sensor.

ARDIUNO UNO

Arduino is a free and open-source platform for experimenting that is built on user-friendly both software and hardware. Arduino boards have the ability to gain inputs, such as light from a sensor, a user tapping a button, or a tweet, and convert those into outputs, such as starting a motor, turning on an LED, or sharing anything online. By showing a set of instructions to the micro controller on the board, we can direct your board’s behaviors. To do this, we employ the Arduino Software (IDE), using Processing, and the Arduino Programming Language (based on wire). The Uno board can be powered by either a separate electricity source or through an USB connection. Automatic selection of the electric source is made. An AC-to-DC adapter (wall wart) or a battery will offer external (non-USB) power. By inserting a 2.1 mm center-positive plug into the board’s power jack, the adapter can be included in it. The POWER connector’s Gnd and Vin output headers can accept battery leads for assembly. A 6-to-20-volt external power can be used for the board to work properly. However, the 5V pin may give less than 5V if a little over seven volts are supplied, and the board might grow unstable. Employing more than 12V could cause the voltage regulator to overheat and harm the circuit board. The typical voltage range is 7 to 12 volts (Figure 2).

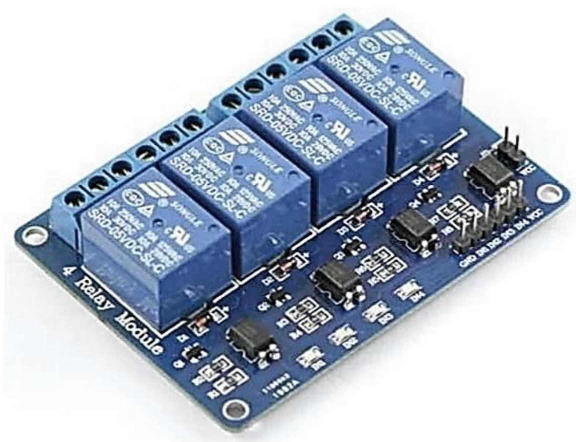

Figure 2. Arduino UNO.

SOLENOID VALVE

There are numerous diverse valve design options. The fluid pathways and ports in standard valves might be numerous. An example of this would be a 2-way valve, resulting in two ports. If the valve is open, the ports are connected and flow can pass between them; if the valve is closed, the ports are parted ways. Normally open (N.O.) valves are those that are open even when the solenoids are not powered. Similar to this, if the valve closes even when the solenoids are not powered, it is known as a normally closed (N.C.) valve. Also, there are 3-way and more intricate designs. An exhaust port and a supply port can frequently be linked by a 3-way valve, which has three ports in aggregate (Figure 3).

Figure 3. Solenoid valve.

FOUR CHANNEL 5 V RELAY MODULE

Each channel on this board's four-channel, low-level 5 V relay link requires a 15 to 20 mA driver current. It can be made use of to control a variety of high current appliances and industrial. High-current relays that operate under AC250V WA or DC3OV 10 A are set up in it. It has a typical interface that a small computer can directly control. For reasons of safety and to avoid ground loops while interacting with a microcontroller, this module is physically segregated from the side that supplies high voltage (Figure 4).

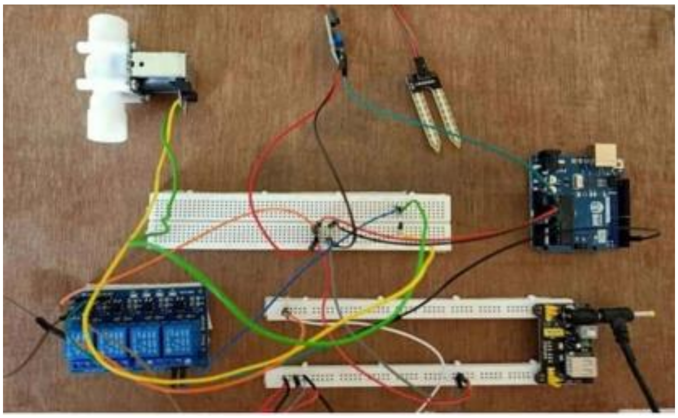

Figure 4. Relay module.

BREAD BOARD

Before establishing any circuit design, a breadboard is used to quickly develop and test circuits. ICs and resistors, along with other circuit components, can be positioned into the breadboard’s numerous holes.

The bread board capabilities metal strips that link the holes on top of the board and go bottom the board. The metal strips hang as is depicted below. The holes in the other columns are connected vertically, whereas the holes in the top and bottom rows are connected sideways (Figure 5). Figure 6 and Figure 7 represent the overall model of the system.

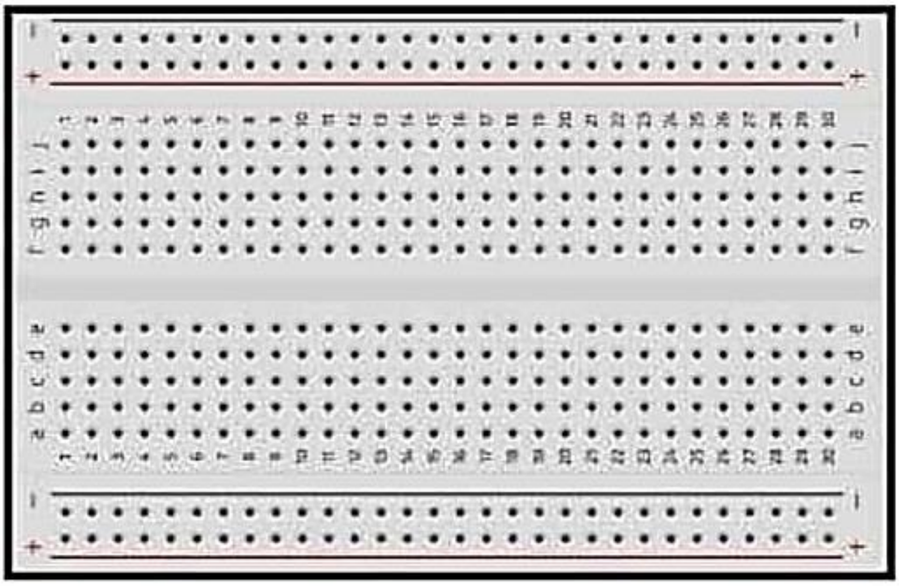

Figure 5. Bread board.

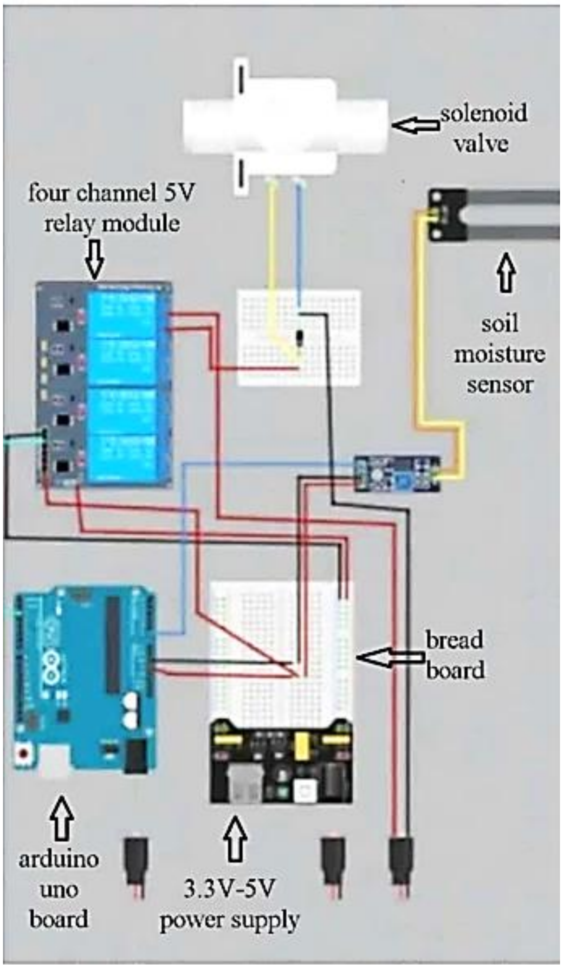

Figure 6. Model of the proposed system.

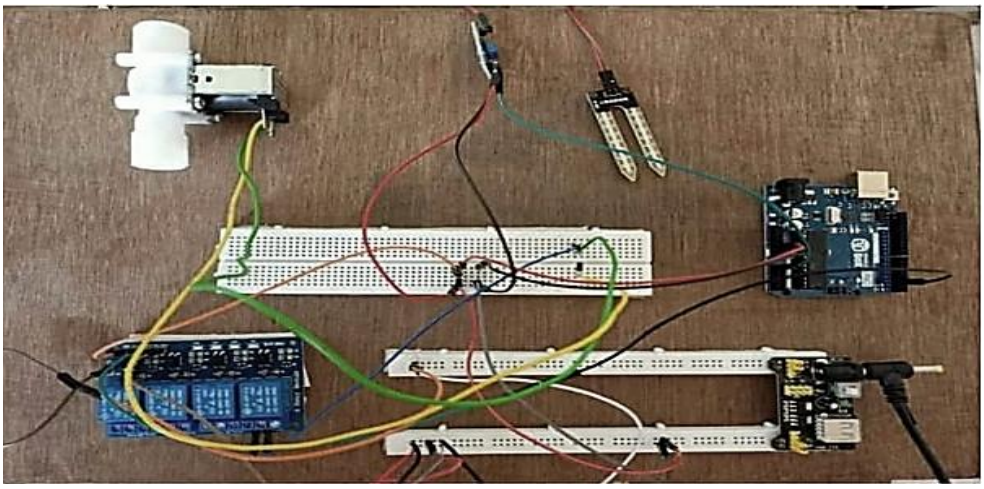

Figure 7. Schematic diagram.

LITERATURE SURVEY

Bennis, II et al. [1] investigations regarding “using water irrigation systems” For recording irrigation operations, the model comprises sensors for soil moisture, temperature, and pressure. We notably consider the scenario where a system failure takes place such as when the pipes burst or the emitters block. To achieve good QoS performance, we further differentiate from two main traffic levels for the data saved by the WSAN and employ a feasible priority-based routing technique. Results from simulations run on the NS-2 simulator show promising in terms of delay and Packet Delivery Ratio, particularly regarding priority applications.

Joaquin Gutierrez et al. [2] investigated “Using an Automated Irrigation System.” In the present research, a distributed wireless network of temperature and soil moisture sensors has been in place in the plant roots. The point of entry unit manages sensor data, triggers actuators, and sends information to a web application. With the aim to control the amount of water, an algorithm was created deploying sensor threshold values and put into a microcontroller-based bridge.

Sangamesh Malge et al. [3] looked at “a novel, economical smart irrigation system.” The entire irrigation process is handled by a small embedded system device (ESD) in this article. The PICI8F4550 microcontroller, resulting in a GSM module interface, serves as the brain yet several sensors, including those for temperature, level, and rain, operate as the eyes of this ESD. The PIC I8F4550 begins the watering business by turning on the irrigation pump only when the ESD’s eyes evaluate that every detail is within a safe range. The farmer occasionally received feedback about the action taken by the PIC18F4550 from ESD via text message.

Nikhil Agrawal et al. [4]—The topic of “Smart Drip Irrigation Equipment using Solenoid Valve and Arduino” has been researched. The Raspberry Pi uses the Python programming language to organize user commands. ZigBee standard is utilized by Arduino micro controllers for collecting the on/off orders from the solenoid valve. The solenoid valve that and end devices communicate with one another using a star ZigBee topology as its foundation. The solenoid valve performs as a central coordinator, while the end devices are various networks.

Pravina B et al. [5]—“Automatic Irrigation System” was looked examined. ZigBee technology can be used to solve the key difficulty of power efficiency time in the investigation of wireless sensor networks that transmit data. The major goal is to comprehend how data is sent using wireless mediums using WSN and monitoring methods. Design of a computer-controlled irrigation system that takes into consideration considerations like temperature, soil moisture, and air humidity while they are crucial elements in precision agriculture.

Sachs Angel et al. [6] A “Arduino-Based Automated Irrigation System” inquiry was conducted. The paper describes a home automation system for irrigation of crops that is based on a Raspberry Pi, Arduino microcontrollers, and ZigBee and relay boards. In an automatic the irrigation system, a Raspberry Pi serves as a control blocker to regulate motor flow. The Raspberry Pi, also known processes the commands from the Arduino. The Arduino and Raspberry Pi interact by employing a Zigbee module. An effective and reasonably priced computerized irrigation system is shown in this study. We will automate and smart control the watering system through using a moisture sensor. Once built, the system required little upkeep and is simple to run.

Bhagyashree et al. [7]—I did some research on “Smart irrigation system using Arduino.” This study aims to develop a smart irrigation monitoring system with a raspberry. The focus will be on characteristics like temperature and soil moisture. The normal farming approach will be replaced by this system. We will create a system that enables people to monitor their fields from anywhere in the world or from the security of their own households. For the agricultural fields, it suggests an automatic irrigation system. At this time, automation occupies one of the most significant roles in human life. Along with comfort, it also saves time, minimizes energy use, and increases efficiency. Today's industries use control and automation apparatus, which is expensive and unsuitable for use on a farm field. Therefore, it also builds smart irrigation technology here that is easily accessible by Indian farmers. The Raspberry Pi act as the system’s pulsating heart. To ensure that agricultural crops acquire the most water possible, an automated system of irrigation was created. Automated appliance control is possibly caused by automation. This article’s goals included optimizing the water motor control, utilizing a webcam to track the development of plants, and enabling live streaming of a farm on Android mobile devices by Wi-Fi [8].

CONCLUSION

- By using that strategy, one may boost production and ultimately increase profit by save manpower and fuel.
- The automated irrigation system is practical as well as affordable for maximizing current water supplies for productive farming.
- The system would offer an efficient feedback control system which will monitor and regulate all irrigation system actions.
- Monitoring the situation of the plant can also be accomplished with various other factors. In this project, a characteristic called soil humidity is used to preserve track of how the garden behaves.
- But by itself, soil humidity might not be an accurate sign of a plant’s health. In order to enhance the observation process, it needs to have a second instrument.
- This Smart irrigation system indicates that it automates and supervises systems for watering.
- Water for irrigation gets delivered automatically. This system lets in remote control of solenoid Valve and relay boards, offering up the possibility of controlling both electrical and circulation of water.

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