

## **MICROCONTROLLER BASED AUTOMATIC PLANT WATERING SYSTEM**

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### **ABSTRACT**

Watering the plant is the most important cultural practice and one of the labor intensive tasks in daily greenhouse operation. Watering systems ease the burden of getting water to plants when they need it. Knowing when and how much to water is two important aspects of watering process. To make the gardener works easily, the automatic plant watering system is created. There have a various type using automatic watering system that are by using sprinkler system, tube, nozzles and other. This system uses watering sprinkler system because it can water the plants located in the pots. This project uses Arduino board, which consists of ATmega328 Microcontroller. It is programmed in such a way that it will sense the moisture level of the plants and supply the water when required. This type of system is often used for general plant care, as part of caring for small and large gardens. Normally, the plants need to be watered twice daily, morning and evening. So, the microcontroller has to be coded to water the plants in the garden or farms about two times per day. People enjoy plants, their benefits and the feeling related to nurturing them. However for most people it becomes challenging to keep them healthy and alive. To accommodate this challenge we have developed a prototype, which makes a plant more self-sufficient, watering itself from a large water tank and providing itself with artificial sunlight. The pro-To type reports status of its current conditions and also reminds the user to refill the water tank. The system automation is designed to be assistive to the user. We hope that through this prototype people will enjoy having plants without the challenges related to absent or forgetfulness.

**KEYWORDS:** Automatic Watering System, Arduino-Board Sensor, Soil Moisture Sensor, Micro Controller, Temperature Sensor

### **I. INTRODUCTION**

The continuous increasing demand of food requires the rapid improvement in food production technology. In a country like India, where the economy is mainly based on agriculture and the climatic conditions are isotropic, still we are not able to make full use of agricultural resources. The main reason is the lack of rains & scarcity of land reservoir water. The continuous extraction of water from earth is reducing the water level due to which lot of land is coming slowly in the zones of un-irrigated land. Another very important reason of this is due to unplanned use of water due to which a significant amount of water goes to waste. This problem can be rectified if we use microcontroller based automated irrigation system in which the irrigation will take place only when there will be acute requirement of water.

### **II. NEED OF AUTOMATIC IRRIGATION [7]**

Automatic irrigation systems are convenient, especially for those who travel. If installed and programmed properly, automatic irrigation systems can even save you money and help in water conservation. Dead lawn grass and plants need to be replaced, and that can be expensive. But the savings from automatic irrigation systems can go beyond that. Watering with a hose or oscillator wastes water. Neither method targets plant roots with any significant degree of

precision. Automatic irrigation systems can be programmed to discharge more precise amounts of water in a targeted area, which promotes water conservation.

### III. BLOCK DIAGRAM AND WOKING [7]

In this project we use two functional components. One is soil moisture sensor and other is water pump. Here we used Arduino Board where programmed is done by using Arduino IDE software. Soil moisture sensor sense the level of moisture in the soil and temperature sensor which sense temperature of soil. The motor/water pump supplies water to the plants.

The Arduino Uno can be powered via an external power supply which can come either from an AC-to-DC adapter or battery and use USB connection. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

#### 3.2 Programming [4]

The Arduino Uno can be programmed with the ArduinoIDE software. The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. This guide is for students in ME 2011, or students anywhere who are confronting the Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources.

The Duemilanove board features an Atmel ATmega328 microcontroller operating at 5 V with 2 Kb of RAM, 32 Kb of flash memory for storing programs and 1 Kb of EEPROM for storing parameters. The clock speed is 16 MHz, which translates to about executing about 300,000 lines of C source code per second. The board has 14 digital I/O pins and 6 analog input pins. There is a USB connector for talking to the host computer and a DC power jack for connecting an external 6-20 V power source, for example a 9 V battery, when running a program while not connected to the host computer. Headers are provided for interfacing to the I/O pins using 22 g solid wire or header connectors.

The Arduino programming language is a simplified version of C/C++. If you know C, programming the Arduino will be familiar. If you do not know C, no need to worry as only a few commands are needed to perform useful functions. An important feature of the Arduino is that you can create a control program on the host PC, download it to the Arduino and it will run automatically. Remove the USB cable connection to the PC, and the program will still run from the top each time you push the reset button. Remove the battery and put the Arduino board in a closet for six months. When you reconnect the battery, the last program you stored will run. This means that you connect the board to the host PC to develop and debug your program, but once that is done, you no longer need the PC to run the program.

#### 3.3 What You Need for a Working System [4]

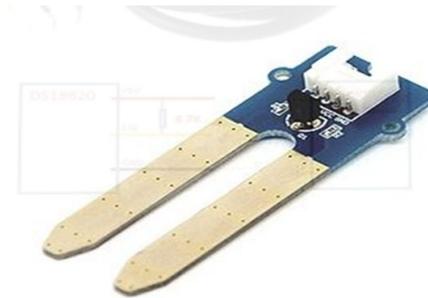
- Arduino Duemilanove board
- USB programming cable (A to B)
- 9V battery or external power supply (for stand-alone operation)
- Solder less bread board for external circuits, and 22 g solid wire for connections

- Host PC running the Arduino development environment. Versions exist for Windows, Mac and Linux

### 3.4 Moisture Sensor [6]

Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments can be used by farmers or gardeners.

Soil moisture sensors typically refer to sensors that estimate volumetric water content. Another class of sensors measure another property of moisture in soils called water potential; these sensors are usually referred to as soil water potential sensors and include [tensiometers](#) and gypsum blocks.



**Figure 3.4.1: Soil Moisture Sensor**

#### Sensor Installation

A single sensor can be used to control the irrigation for many zones (where an irrigation zone is defined by a solenoid valve) or multiple sensors can be used to irrigate individual zones. In the case of one sensor for several zones, the zone that is normally the driest, or most in need of irrigation, is selected for placement of the sensor in order to ensure adequate irrigation in all zones.

Some general rules for the burial of the soil moisture sensor are:

- Sensors should be buried in the root zone of the plants to be irrigated, because this is where plants will extract water. Burial in the root zone will help ensure adequate turf or landscape quality. For turf grass, the sensor should typically be buried at about three inches deep.
- Sensors need to be in good contact with the soil after burial; there should be no air gaps surrounding the sensor. Soil should be packed firmly but not excessively around the sensor.
- If one sensor is used to control the entire irrigation system, it should be buried in the zone that requires water first, to ensure that all zones get adequate irrigation. Typically, this will be an area with full sun or the area with the most sun exposure.
- Sensors should be placed at least 5 feet from the home, property line, or an impervious surface (such as a

driveway) and 3 feet from a planted bed area.

- Sensors should also be located at least 5 feet from irrigation heads and toward the center of an irrigation zone.
- Sensors should not be buried in high traffic areas to prevent excess compaction of the soil around the sensor.

### 3.5 Water Pump

A small pump plus a driver. A driver is to provide enough current for the pump, my application needs a spray distance about one meter, so this pump is enough. But if you need to make a system that needs a large spray range, you may need larger pumps, or even a pressurized device to make the projectile even farther, such as the watering system in a tea garden.



**Figure 3.5.1: Water Pump**

### 3.6 GSM Modem

Short Message Service is GSM techniques to transfer data from distant places such as from one area to the area of the same city or from another city .In our project we are using SMS technique to instant or quick transfer of data or notice to the required destination. It is a convenient facility of the GSM network. A message consisting of a maximum of 160 alphanumeric characters can be send to or from a mobile station. If the subscriber's mobile unit is powered of f or has left the coverage area, the message is stored and offered back to the subscriber when the mobile is powered on or has reentered the coverage area of the network. This function ensures that the message will be received.



**Figure 3.6.1: GSM Modem**

### 3.7 TEMPERATURE SENSOR [1]

DS18B20 Waterproof Digital Thermal sensor.

#### Specifications

- The probe based on temperature sensor DS18B20 chip
- High quality stainless steel tube encapsulation waterproof, moisture proof to prevent rust
- Stainless steel shell 6x50 mm
- Power supply range: 3.0V to 5.5V
- Operating temperature range: -55°C to +125°C (-67°F to +257°F)
- Storage temperature range: -55°C to +125°C (-67°F to +257°F)
- Accuracy over the range of -10°C to +85°C:  $\pm 0.5^\circ\text{C}$ .
- No other components, unique single bus interface
- Output lead: Red (VCC), Yellow (DATA), Black(GND)
- Cable length: 100 cm

### IV. ATMEGA 328P MICRO CONTROLLER DESCRIPTION

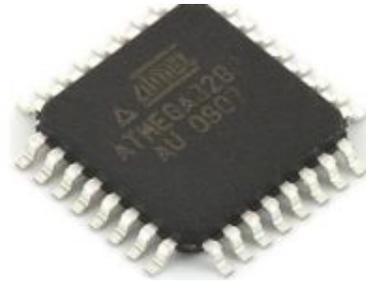
The high-performance Atmel picoPower 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.

#### Features

- 28-pin AVR Microcontroller
- Flash Program Memory: 32 Kbytes
- EEPROM Data Memory: 1 Kbytes
- SRAM Data Memory: 2 Kbytes
- I/O Pins: 23
- Timers: Two 8-bit / One 16-bit
- A/D Converter: 10-bit Six Channel
- PWM: Six Channels
- RTC: Yes with Separate Oscillator

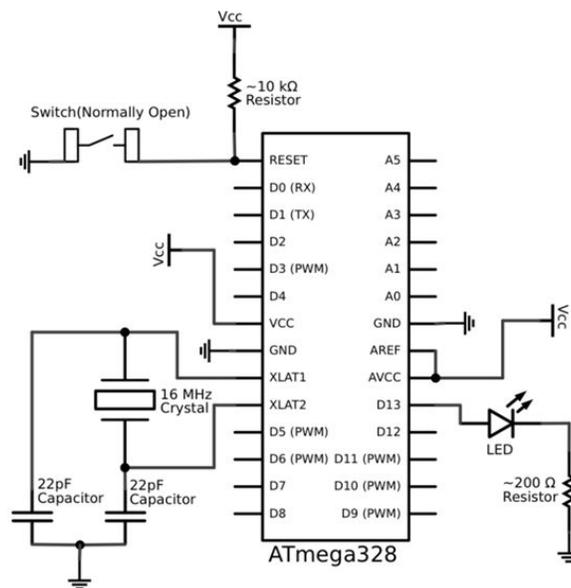
- MSSP: SPI and I<sup>2</sup>C Master and Slave Support
- USART: Yes
- External Oscillator: up to 20MHz

A serial programmable USART, a byte-oriented 2-wire Serial Interface, an SPI serial port, a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), a programmable Watchdog Timer with internal Oscillator, and five software selectable power saving modes.



**Figure 4.1: ATMEGA 328**

EEPROM access much slower than other internal RAM



**Figure 4.2: Pin Configuration**

## V. ARDUINO IDE TOOL

Interface almost anything; the best choice for beginners – this is the Arduino UNO board. Using an ATmega328P microcontroller and 14 I/O pins, Arduino UNO is one of the most popular development boards in robotics and electronics as well. We take a look around and select the best tutorials to start working with the board. From tutorials to setup Arduino UNO, and up to blink an LED or how to control a robot wirelessly using an Android phone. This article is a good starting point and a good introduction to Arduino UNO board.

## Steps for Using Arduino IDE

### Step 1

Arduino microcontrollers come in a variety of types. The most common is the Arduino UNO, but there are specialized variations. Before you begin building, do a little research to figure out which version will be the most appropriate for your project.

### Step 2

To begin, you'll need to install the Arduino Programmer, aka the integrated development environment (IDE).

### Step 3

Connect your Arduino to the USB port of your computer. This may require a specific USB cable. Every Arduino has a different virtual serial-port address, so you'll need to reconfigure the port if you're using different Arduinos.

### Step 4

Set the board type and the serial port in the Arduino Programmer.

### Step 5

Test the microcontroller by using one of the preloaded programs, called sketches, in the Arduino Programmer. Open one of the example sketches, and press the upload button to load it. The Arduino should begin responding to the program: If you've set it to blink an LED light, for example, the light should start blinking.

### Step 6

To upload new code to the Arduino, either you'll need to have access to code you can paste into the programmer, or you'll have to write it yourself, using the Arduino programming language to create your own sketch. An Arduino sketch usually has five parts: a header describing the sketch and its author; a section defining variables; a setup routine that sets the initial conditions of variables and runs preliminary code; a loop routine, which is where you add the main code that will execute repeatedly until you stop running the sketch; and a section where you can list other functions that activate during the setup and loop routines. All sketches must include the setup and loop routines.

### Step 7

Once you've uploaded the new sketch to your Arduino, disconnect it from your computer and integrate it into your project as directed.

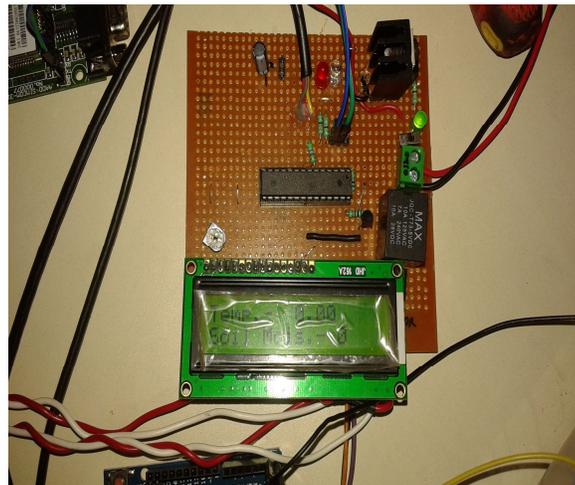


**Figure 5.1: Arduino**

### Step 9

Upload the program now; simply click the "Upload" button in the environment. Wait a few seconds - you should see the RX and TX LEDs on the board flashing. If the upload is successful, the message "Done uploading." will appear in the status bar.

## VI. IMPLEMENTATION PART

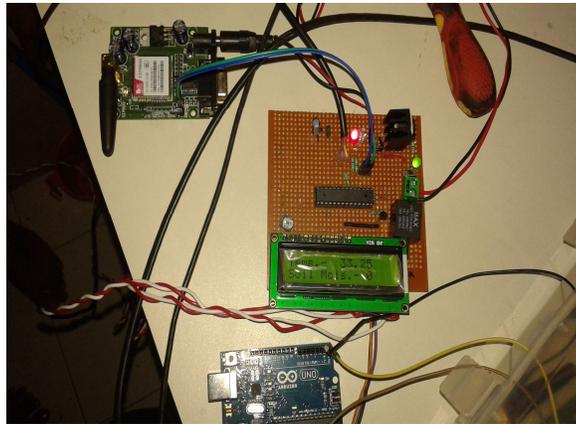


**Figure 6.1: LCD Display Initial Values**

In this Image with the help of LCD display we display the information about the temperature of the soil using the sensors used in our project. LCDs allow displays to be much thinner than cathode ray tube (CRT) technology. LCDs consume much less power. Initially the temperature is zero as shown in figure. The Part requires 12V power and the microcontroller required only 5V so the power can be step down with the help of register. There are two LED lights red light is blink when temperature is high and green light is blink when temperature is low. And if there is no such condition is occurs the no light is glow. The information related to the temperature is send to the users mobile through GSM module.



**Figure 6.2: Water Pump**



**Figure 6.3: LCD Display Values after Sensing Data from Soil**

When we turn on the motor the water will automatically go to the plants root. It will take around one minute. We also can reduce this time with the help of program. And the temperature will be displayed on the LCD display. When soil moisture sensor is dipped into the soil then the moisture of soil is also displayed. While dipped in the soil take care that the soil moisture sensor is not fully dipped.



**Figure 6.4: GSM Modem**

A **GSM modem** is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. In our System GSM modem is use for the sending information about the temperature to the user's mobile. In our system we use SIM900 for the communication. This GSM modem is a highly flexible plug and play quad band **SIM900A** GSM modem for direct and easy integration to RS232 applications. Supports features like Voice, SMS, Data/Fax, GPRS and integrated TCP/IP stack.

## VII. ADVANTAGE OF PROPOSED SYSTEM OVER PREVIOUS MODEL [7]

**Less Hardware Involve:** This proposed system consist of less hardware as compared to the previous model hence it is compact as compared to the previous system.

**Cost Efficient:** This proposed stem is more cost efficient than the previous system this claim is made on the fact that the proposed system does not need the heavy and expensive hardware for implementation.

## VIII. BASIC ADVANTAGES [8]

**Saves Water:** Studies show that this type of automated irrigation system consumes 40-50% less water as compared to the traditional system.

**Improves Growth:** Ideal growth condition is been provided when small amount of water is been applied over large amount of time. This smart irrigation system extends watering time for plants, and provides ideal growth condition.

**Save Time:** In this sprinklers moving and setting is not required hence it saves time and timer delay as per the environmental condition can be added for automatic watering.

**Adaptable:** This smart irrigation system can be adjusted and modified according to the changing environment.

**Simpler Method:** It is simple to operate it starts by designing the map of your garden and marking the location of planting. Then the required distance is been measured for length of plastic tubing so that the desired area can be reached.

## IX. CONCLUSIONS

Thus the “ARDUINO BASED AUTOMATIC PLANT WATERING SYSTEM” has been designed and tested successfully. It has been developed by integrated features of all the hardware components used. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Thus, the Arduino Based Automatic Plant Watering System has been designed and tested successfully. The system has been tested to function automatically. The moisture sensors measure the moisture level (water content) of the different plants. If the moisture level is found to be below the desired level, the moisture sensor sends the signal to the Arduino board which triggers the Water Pump to turn ON and supply the water to respective plant using the Rotating Platform/Sprinkler. When the desired moisture level is reached, the system halts on its own and the Water Pump is turned OFF. Thus, the functionality of the entire system has been tested thoroughly and it is said to function successfully.

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