PUNE INSTITUTE OF COMPUTER TECHNOLOGY,
DHANKAWADI PUNE-43.

A Report On

Smart Plant Watering System

SUBMITTED BY

Apoorva Khuspe (3143)
Mrugakshi Chidrawar (3152)
Akash Patil (3156)

CLASS: TE-1

GUIDED BY

PROF. A. A. Jewalikar

ISO 9001: 2015 Certified

COMPUTER ENGINEERING DEPARTMENT
Academic Year: 2018-19

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1. PROBLEM STATEMENT

Design an automatic plant watering system that uses arduino and a soil moisture sensor and notifies the user about the soil's moisture levels and water pump status.

2. INTRODUCTION

Among daily operations, watering the plants is one of the most important cultural practice and the most labour-intensive task. No matter what weather it is, either too hot and cold or too dry and wet, it is very crucial to control the amount of water reaching the plants. So, it will be effective to use an idea of automatic plant watering system which waters plants when they need it. An important aspect of this project is that: "when and how much to water" .

To reduce the manual activity of watering plants, an idea of plant watering system is adopted. The method employed monitors the soil moisture level continuously and decides whether watering is needed or not, and how much water is needed for the plant.

Essentially, system is designed and programmed in such way that the soil moisture sensor senses the soil's moisture level at a particular instance of time and if the moisture level of soil is less than the specified value of threshold (which is predefined according to the particular plant's water need), then the desired amount of water is supplied till it reaches the predefined threshold value.

The system reports its current soil moisture status and sends an alert to the user. The user can view the soil moisture status on his/her mobile through the Virtuino application.

2.1 Motivation

Now-a-days, in this age of advanced technology and electronics, the lifestyle of humans should be smart, simpler, easier and much more convenient. Therefore, there is a need for many automated systems in human's daily life routine to make life easy. Here, an idea of one such system named as automatic plant watering system is very useful. As many people are facing a lot of problem watering the plants in the garden, especially when they are away from their homes. This model uses sensor technologies with microcontroller in order to make a smart switching device to help millions of people.

3. SOFTWARE AND HARDWARE REQUIREMENTS

1) Arduino UNO
2) Soil moisture sensor
3) Soil moisture sensor module
4) 5-12V water pump

5) L293D motor driver
6) ESP8266 WiFi module
7) Jump wires
8) 9V Battery
9) Arduino IDE

4. THEORY

4.1 Arduino UNO

The Arduino UNO is an open-source microcontroller board. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0.

4.2 Soil Moisture Sensor

Soil moisture sensor measures 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.

4.3 L293D Motor Driver

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. The L293D IC receives signals from the microprocessor and transmits the relative signal to the motors.

4.4 ESP8266 WiFi Module

The ESP8266 is a low-cost Wifi microchip with full TCP/IP stack and microcontroller capability. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections.

4.5 Submersible Water Pump

A submersible pump is a device which has a hermetically sealed motor close-coupled to the pump body. The whole pump is submerged in the fluid to be pumped. The main advantage of this type of pump is that it prevents pump cavitation, a problem associated with a high elevation difference between pump and the fluid surface. Submersible pumps push water to the surface.

5. WORKING OF THE SYSTEM

In its most basic form, the system is programmed in such a way that soil moisture sensor which senses the moisture level from the plant at particular instance of time, if moisture level of the sensor is less than the specified value of threshold which is predefined according to the particular plant than the desired amount, then water is supplied to the plant till it's moisture level reaches the predefined threshold value.

The smart plant watering system uses a soil moisture sensor which keeps track of the current soil moisture of the plant. This moisture data is sent to the Arduino UNO where it's further analysis takes place. The arduino UNO receives the soil moisture sensor data and depending on its values switches the water pump ON or OFF. The user specifies the soil moisture threshold beforehand in the arduino program such that if the moisture value falls below this threshold, the pump is automatically switched ON and remains ON till the soil moisture value reaches the desired amount for that particular plant.

The system also notifies the user about the soil moisture levels of his/her plant with the help of graphs on the Virtuino App. This data is uploaded on the application using the ESP8266 wifi module. The module helps upload the current soil moisture level to the app over the internet. It provides a real time feed to the user about the plant's water needs from any location in the world.

In the system, the arduino and motor driver are powered with the help of batteries. The L293D Motor Driver drives the water pump and is responsible for turning the pump ON or OFF. The arduino is loaded with a program which specifies the soil moisture thresholds, code for turning the pump ON or OFF by sending high voltage or low voltage respectively and statements for uploading the data to the app using ESP8266.

6. EXPERIMENTAL SETUP

6.1 Architecture Diagram

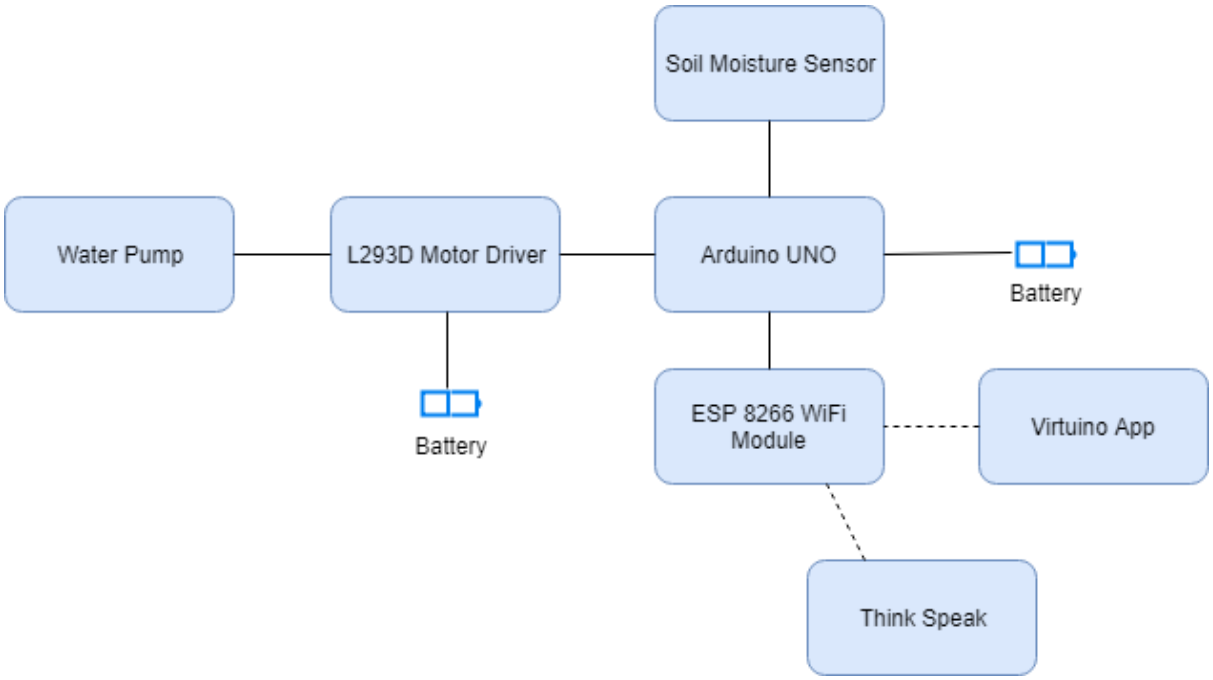

Figure 1: Architecture Diagram

6.2 Connections

Component 1	Pin	Pin Description		Pin	Pin Description	Component 2
Arduino Uno	A0	Analog Read		A0	Analog Data	YL – 38 Soil Moisture Sensor Module
	5V	Vcc		Vcc	-	
	GND	Ground		GND	Ground	
Arduino Uno	8	Digital I/O		A2	Input 2	L293D Motor Driver connected to Water Pump
	GND	Ground		A1	Input 1	
	5V	Vcc		ENA	Enable	
	GND	Ground		GND	Ground	
Arduino Uno	3 (Rx)	Receiver		Tx	Transmitter	ESP8266
	4 (Tx)	Transmitter		Rx	Receiver	
	3V3	3.3 V		Vcc	-	
	3V3	3.3V		CH_PD	Chip Enable	
	GND	Ground		GND	Ground	

Figure 2: Connections

6.3 Setup

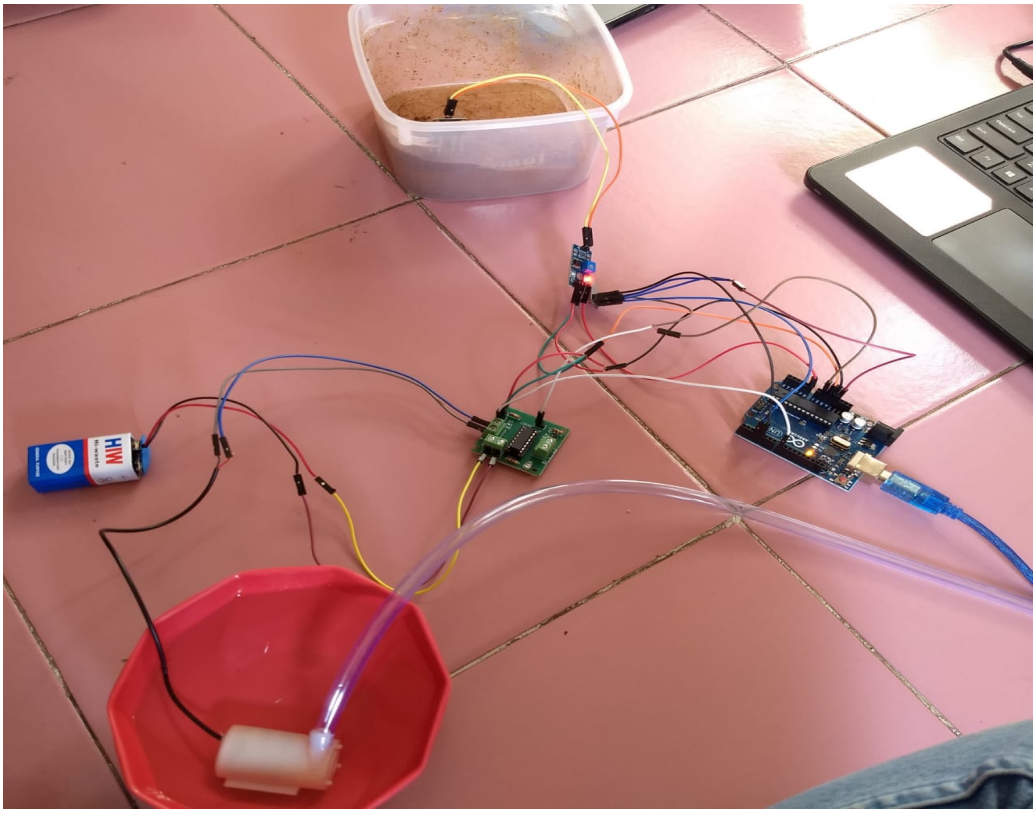

Figure 3: Setup

7. COMPONENTS AND SETUP COST

COMPONENTS	COST
Arduino UNO	450
Soil Moisture Sensor	125
5-12v Submersible Water Pump	150
L293D Motor Driver	150
ESP8266 Wifi Module	200
Jumper Wires	45
9v Battery	20
Pipe	10
TOTAL	**1150**

Table 1: Components cost

8. CHALLENGES

8.1 Debugging

After assembling the components, sometimes the system did not work. So the task of debugging was carried out to check if the correct connections were done. This process was carried out until all the errors were removed.

8.2 Loose Connections

Even though the connections made were correct, sometimes the model did not work because of loose wire connections. The connections were made tight in order to make the model work.

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