SOFTWARE REQUIREMENT SPECIFICATION

AUTOMATIC GARDENING SYSTEM

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In this modern and fast paced world, people are losing out many hobbies which were once followed in the past. How often do we hear people saying that their current set of hobbies include philately, solving jigsaw puzzles or scrapbooking? Not a lot. One such dying hobby is ‘gardening’. Not only is it slowly phasing out as a hobby but people seem to care less about it today. But there are a certain group of people who ardently follow gardening and also people who use the concepts of gardening in agriculture. Even though it is something to cherish as a leisure, some problems do exist even then. Some of the frequently occurring are:

- Is it possible to automatically water the plants when we are on a vacation or do we have to bother our neighbours? Sometimes the neighbours water the plants too much and the plants end up dying anyway.

- There exists timer based devices which water the soil on a set interval. But they do not sense the soil moisture and the ambient temperature to know if the soil actually needs watering or not.

- Is it possible to know if the soil actually needs to be watered? Irregular watering leads to mineral loss in the soil and might end up rotting the plants.

- Is it possible to manually water the soil from remote location?

The answer to all the above questions are ‘YES’. It is indeed possible to tackle all the above problems with our idea, i.e. the ‘Automatic Gardening System’, details of which are included in the following document.

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Purpose

The purpose of devising the ‘Automatic Gardening System’ is to water the plants automatically even when there is no human presence. This ensures that the plants are watered adequately and not over-watered.
The best part of this system is that it doesn’t use the traditional timer based systems, rather it uses a soil moisture sensor which senses the amount of moisture in the soil and according to the pre-set threshold value decides whether to water the plants or not.
This simple setup ensures that the plants are always in the perfect condition and watered according to their needs.

1.2 Product Scope

The ‘Automatic Gardening System’ can be applied to normal household gardening schemes or when improved further, can be applied to larger gardening schemes or even agricultural fields to facilitate its use.
It can be further extended in the agricultural field by combining the drip irrigation system with it.
This cost effective system can be implemented using cheap components available readily and doesn’t require vast technical knowledge to setup or maintain.

1.3 Technologies Used

This system is purely based on the concept of IoT (Internet of Things).
Simple analog components are used to setup this system and interfaced with a working code on the Arduino Uno board.

2. OVERALL DESCRIPTION

2.1 Product Perspective

This product is based on IoT and follows its principles. This product helps users to maintain a proper gardening system wherein the plants will be watered according to the levels of moisture in the soil.

The following are the main features of the 'Automatic Gardening System':

- Automatic plant watering which requires no human presence
- Capability to sense moisture and water plants accordingly
- Scope of varying required moisture values for different plants
- Can be extended to multiple plants using drip watering method
- Scope of enhancement which can enable remote sensing

2.2 Operating Environment

This system can be used in normal climatic conditions and it can work in temperatures up to 45ºC. It can be implemented for a single plant which can be further extended to multiple plants.

2.3 User Documentation

Setting up this system is pretty basic and anyone can do it without any hassles.
It can be done in the following steps:

- Install the soil moisture sensor in the soil around the plant taken into consideration
- Place the submersible motor into a container (preferably a bucket) that holds enough water to water the plants for a longer duration
- Direct the open ended nozzle of the pipe to the base of the plant
- Give power supply to the system board and place it in a dry area
- The system will do the rest of the job

2.4 Software Interfaces

This system is built on Arduino Uno and the code is written in C/C++ with its specific syntax, and the working code is mentioned below:

```
#define threshold1 600 // Defining thresholds
#define wateringTime 5000 //5 seconds
int plantSensor1 = A0;    //sensor pins
int value1 = 0;  //initializing sensor value & variables
int value2 = 0;
int pumppin = 7; //water pump control pin
int threshold = 0;
void watering1();
void setup()
{
  Serial.begin(9600);
  pinMode(pumppin, OUTPUT);
  digitalWrite(pumppin, LOW); //pump off at initial

threshold = map(threshold1, 1023, 0, 0, 100);
Serial.print(“Threshold: ”);
Serial.print(threshold);
Serial.println(“%”);
}
void loop()
{
  value1= analogRead(plantSensor1);  //Reading values from sensot
  //Serial.println(value1);  //Displaying values on serial monitor for debugging
  value2 = map(value1,1023,0,0,100);
  Serial.print("Moisture : ");
  Serial.print(value2);
  Serial.println("%");
  delay(2000);
     if(value1 >= threshold)
     {
       watering1();  //control watering operations
     }
     else
     {
    Serial.println("Enough Moisture Watering Not Needed");
 }
}
void watering1()
{
    Serial.println("Watering Plant");
    digitalWrite(pumppin, HIGH); //Pump onn
    delay(wateringTime); //Watering Time
    Serial.println("Watered!");
    digitalWrite(pumppin, LOW); //Pump off
    delay(5000); //Wait till extra water flows out
    Serial.println("Taking next reading...");
    delay(15000); //wait for 15 seconds, this will let the water set in
}
```

2.5 Hardware Interfaces

The following hardware components are used in the system:

SR. NO.	NAME OF COMPONENT	SPECIFICATION	QUANTITY
1.	Arduino Uno Board	-	1
2.	Soil Moisture Sensor (FC-28)	5V, 3.5mA	1
3.	Water Pump	5V	1
4.	Resistor	1K ohm	1
5.	Transistor	2N2222A	1
6.	LED	-	1
7.	Connecting Wires	-	As per requirement

The hardware component 'Soil Moisture Sensor' used is further discussed in detail:

- Soil Moisture Sensor:

  In this system, the sensor FC-28 is used. This sensor measures the volumetric content of water inside the soil and gives us the moisture level as output. The sensor is equipped with both analog and digital output, so it can be used in both analog and digital mode.

  WORKING: The soil moisture sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value. When there is more water, the soil will conduct more electricity which means that there will be less resistance. Therefore, the moisture level will be higher. Dry soil conducts electricity poorly, so when there will be less water, then the soil will conduct less electricity which means that there will be more resistance. Therefore, the moisture level will be lower.

  SPECIFICATIONS:

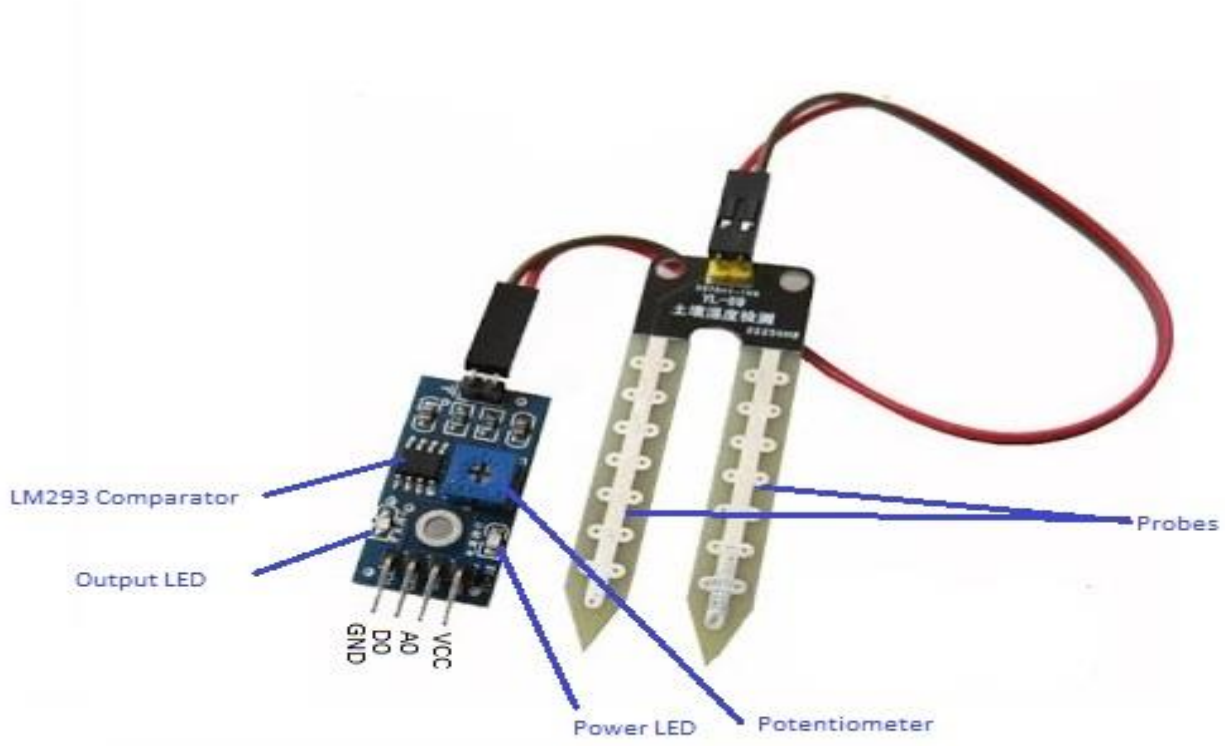
Input voltage	3.3-5V
Output voltage	0-4.2V
Input current	35mA
Output signal	Both analog and digital

  PIN OUT: The Soil Moisture sensor (FC-28) has four pins:

- VCC: For power
- A0: Analog output
- D0: Digital output
- GND: Ground

The module also contains a potentiometer which will set the threshold value and then this threshold value will be compared by the LM393 comparator. The output LED will light up and down according to this threshold value.

A pin out diagram is shown as follows:



INTERFACING FC-28 IN ANALOG MODE:

To connect the sensor in the analog mode, we will need to use the analog output of the sensor. When taking the analog output from the soil moisture sensor FC-28, the sensor gives us the value from 0-1023. The moisture is measured in percentage, so we will map these values from 0 -100 and then we will show these values on the serial monitor. One can further set different ranges of the moisture values and turn on or off the water pump according to it.

2.6 External Forces

2.6.1 Dependencies

First and fore-most this system requires constant power supply to function.
Secondly, the soil moisture sensor needs to be in perfect working condition and installed in the soil properly.
Next, the water pump should be functional and submerged in adequate amount of water and water should be available at all times to water the plants.

2.6.2 Constraints

As the water pump used here is of a low power rating, the distance up to which it can pump water is a little over 3 feet. It means that at a time a maximum of 3 plants can be handled using this system.

3.SYSTEM FEATURES

3.1 Functional Requirements

The system should water the plant whenever it senses the moisture level of the soil to be below 41%.
If the moisture level is equal to or above 41%, the system must refrain from watering the plant so as to avoid over-watering.
This threshold value can be varied for different plants according to their required ambient moisture levels.

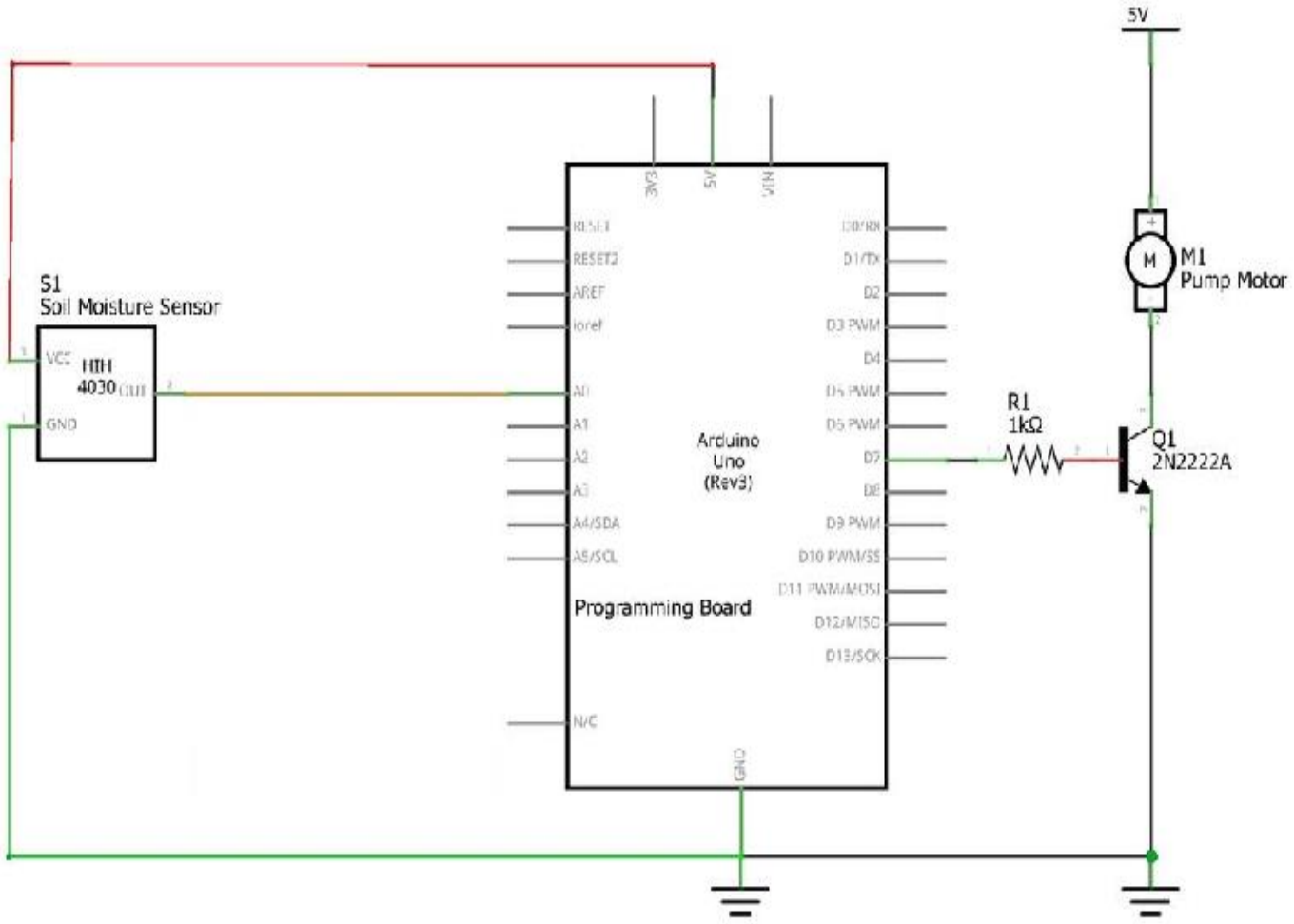
3.2 Non-functional Requirements

- Accessibility: The system is easy to setup and accessible to all user documentation of which is mentioned before
- Disaster Recovery: In case of a faulty sensor, there are chances of water over-flowing, chances of which are very unlikely. In such unlikely cases, it is recommended to turn off the system so as to prevent the plants from rotting
- Capacity: It can handle up to 3 plants at a time
- Robustness: When installed in a dry location, this system can provide longevity
- Reliability: This system is reliable enough to work in small home gardens

4. DESIGN

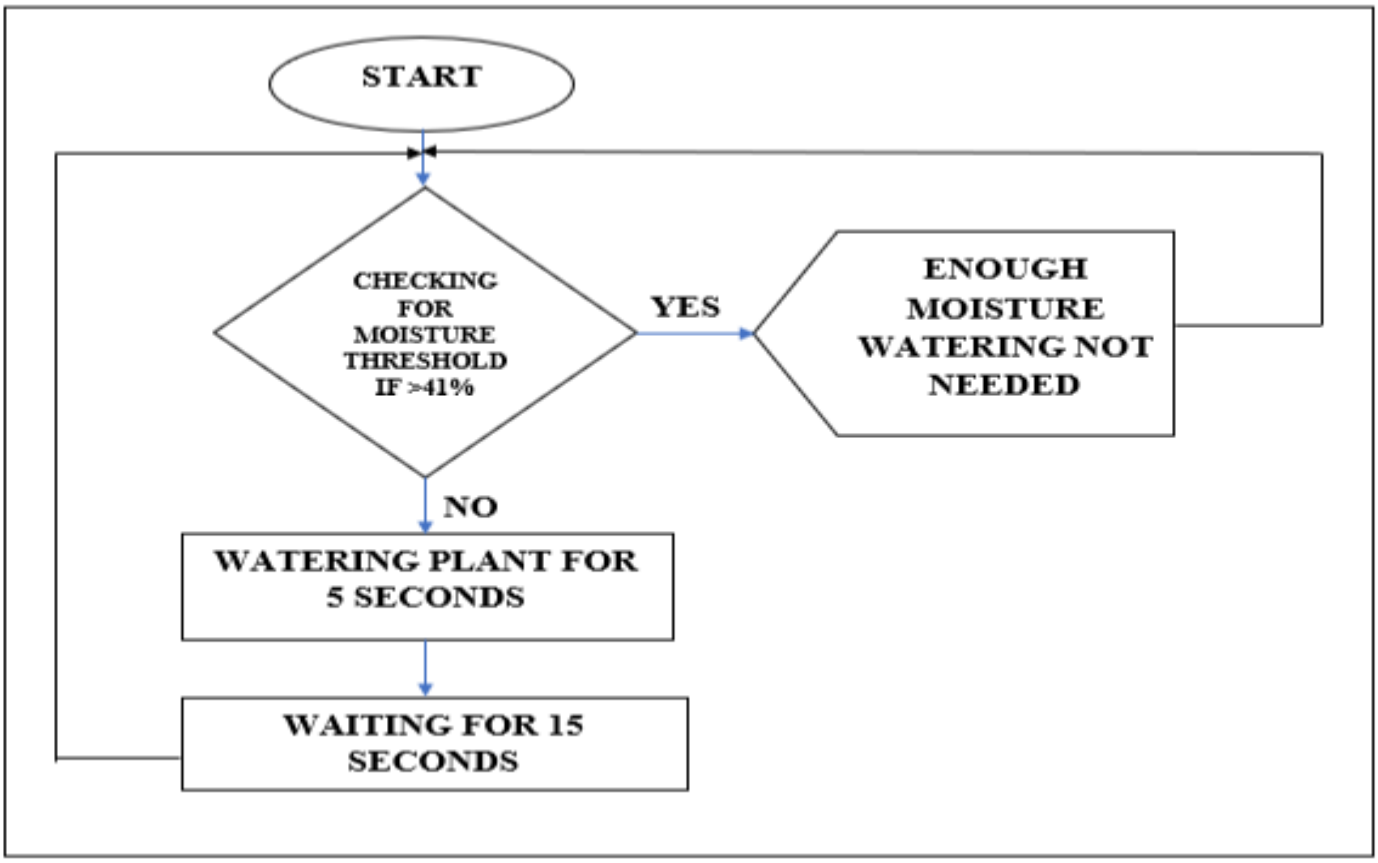
4.1 Component Diagram

The component diagram of the system is as follows:



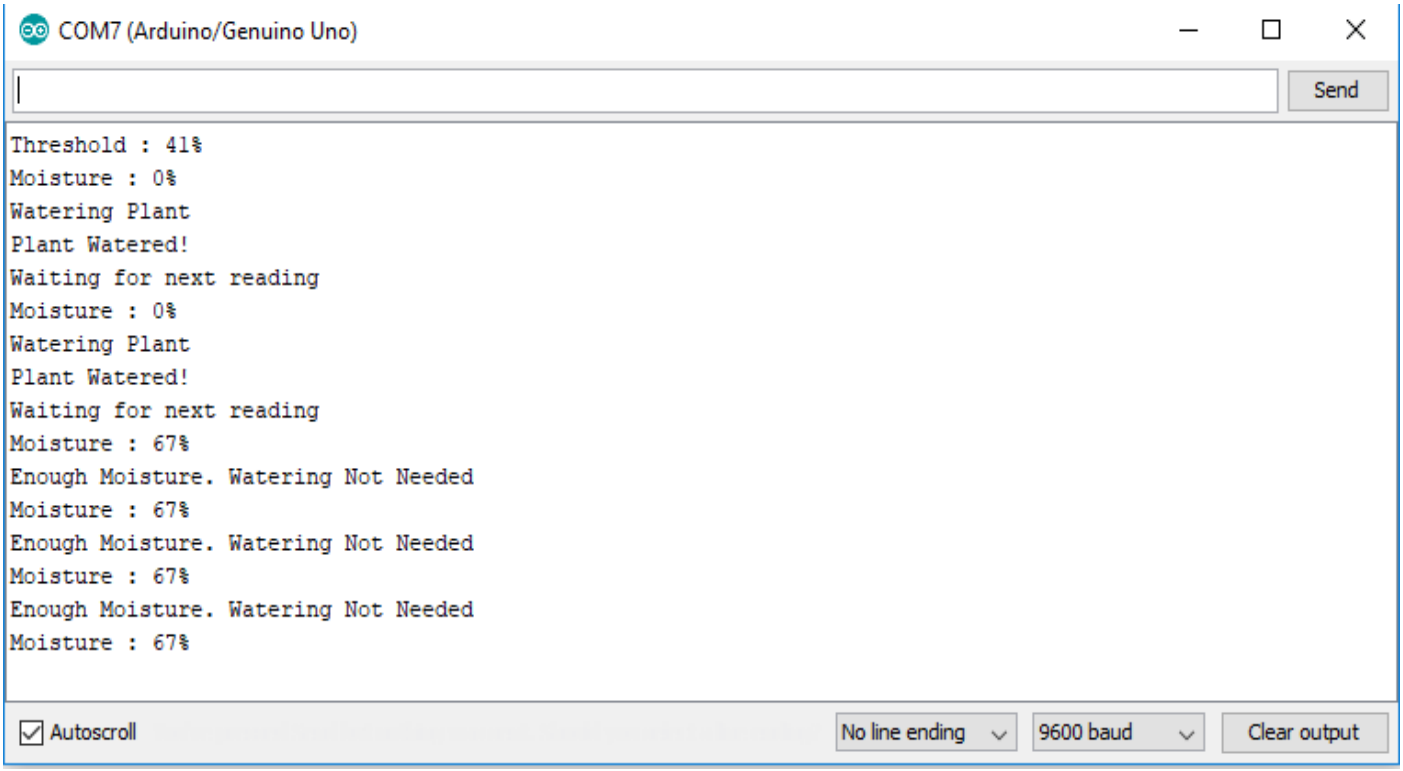
4.2 Data Flow Diagram

The data flow diagram of the system is as follows:



5. GUI

A runtime screenshot of the serial monitor is as follows:



6.FUTURE SCOPE

This system can further be developed to expand its utility. Some of the extensions that can be done in order to do this are:

- Creation of Internet of Plants: Create an IOT framework which will help connect plants of similar variety across the world to get connected
- Connect the Arduino wirelessly with the Raspberry Pi home server so that the plants can be monitored remotely
- Remote monitoring and watering of plants: Use a GSM based add-on board for remote operation
- Use an efficient power supply: Use solar power as the power needed is low
- Use a weatherproof case: Since the device will be used outside, a weatherproof case is required to house the electronic components

7. CONCLUSION

The ‘Automatic Gardening System’ is an efficient way to water the plants as per their requirement. It’s easy to setup nature, in addition to zero to little maintenance makes it easy to use for anyone.
This system saves a lot of water and ensures that all the plants have a long life.
As it has a wide scope of development, this system can be further customised to suit the needs of users in not only gardening but also agricultural field.

8. REFERENCES

- www.instructables.com
- www.circuitstoday.com
- www.villanovau.com
- www.stackoverflow.com
- www.electronicsforu.com