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Automatic Watering System using Soil Moisture Sensor and RTC timer with Arduino

Know the Plant and Grow the Plant

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Abstract: *In daily operations related to farming or gardening, watering is the most important practice and intensive task. No matter whichever weather it is, either too hot and dry or too cloudy and wet, you want to be able to control the amount of water that reaches your plants. Our work demonstrates the efficient use of Internet of Things for the traditional agriculture. For implementation of automatic plant watering system, we have used combination of pipes and pump/motor. It shows the use of Arduino UNO, RTC and soil moisture sensor, monitored and controlled smart irrigation systems, which is also cost-effective and simple. Arduino microcontroller checks soil moisture level using soil sensor. By this people should know about how much water is present in the soil, if the moisture content is less than specified threshold which is predefined according to particular plant's water need then desired amount of water is supplied. To help out the need of watering the plant even in your absence for long span like 10-15 days, we also worked on timer based automatic watering system. It helps you to set the timings when you would wish to water the plant and leave the place without having any concern on your plants, because our work helps you in watering the plants in your absence at exact time that you want. We hope that through this prototype we all can enjoy having plants, without being worried about absent or forgetfulness of watering them.*

Keywords: Automatic Watering System

I. Introduction

1.1 Objective and Goal of the Project

An automation of irrigation systems has several positive effects. Once installed, the water distribution on fields or small-scale gardens is easier and does not have to be permanently controlled by an operator. There are several solutions to design automated irrigation systems. Modern big-scale systems allow big areas to be managed by one operator only. Sprinkler, drip or subsurface drip irrigation systems require pumps and some high tech-components and if used for large surfaces skilled operators are also required. Extremely high-tech solutions also exist using GIS and satellites to automatically measure the water needs content of each crop parcel and optimize the irrigation system. But automation of irrigation can sometimes also be done with simple, mechanical appliances: with clay pot or porous capsule irrigation networks or bottle irrigation (see also manual irrigation).

We all know that plants are very beneficial to all human beings in many aspects. Plants helps in keeping the environment healthy by cleaning air naturally and producing oxygen. Many people love to have plants in their backyard. But due to civilization and insufficiency of place many people used to grow plants in mould or dirt, pot, and placed on the windowsill. These plants are dependent on conventional breeding - watering, and provide the right amount of sun to sustain life and growth. In busy schedule of day-to-day life, many time people forget to water their plants and due to this, plants suffers many disorders and ultimately died. In addition, the world's biggest problem in modem society is the shortage of water resources, agriculture is a demanding job to consume large amounts of water. It is very essential to utilize the water resources in proper way.

1.2 Objectives

- The main objective of this work is to control the water application.
- As well saving our time is major purpose.
- To save the plants from being dry and improve their lifetime.

1.3 Problem Statement

Knowing when and how much amount to water plants, are two major important aspects of plant watering. During day-to-day activities many people often forget to water their plants and thus it becomes challenging for them to keep their plants healthy and alive. Based on the above background, we thought that it is necessary to implement the automated system which will take care of plants considering all the different aspects of home gardening system (for system based on household purpose) and helps them to grow healthy. Therefore, our project aims to implement a simple system, using soil moisture sensor for watering a small potted plants with minimal human intervention.

1.4 Motivation

In the current situation, water shortage due to increased exploitation has urged to develop a new technology which can save water from wasting and therefore there will be a smart way to check the loss of water. The purpose of this idea is to make the water planting system smart, autonomous, and efficient, to optimize the water supply to the plants to decrease manual intervention. It observes soil, climate, dehydration conditions and plant water consumption and automated adjustment of the water schedule. Irrespective of human presence the plant survives on its own. Therefore, smart water planting system has become a major concern so that a smart device can be given to the owner who can maintain productivity of plant.

1.5 Challenges

Hence as far as our project deals with automating the water and waste water management systems is concerned, many smaller initiatives have been seen. But large scale demonstrators and completely integrated solutions are still in conception. Some technical challenges related to these systems are sensor/ probe designs energy consumption and efficiencies of field devices, real time sensing, robust communication infrastructure, seamless integration of technologies, redundancy of networks, reliable data transfer in case of both surface and underground sensors, time synchronization, security, prediction and data gathering mechanisms for better building of measurement models etc. Sequence of system scenario has been not easy to decide to function. The controllers to the Arduino were quite challenging, because a single mistake can damage any electrical part. It was not easy to write the software for the Smart Irrigation System and reading the values using sensors and upload it in software to run the system and to predict the values to water or not and finally completed with perfect results.

II. LITERATURE SURVEY

2.1 Arduino Based Automatic Water Planting System using Soil Moisture Sensor

[Hriday Chawla, Praveen Kumar March 15,2019] This research paper is about the automatic water planting system using a moisture sensor which senses the humidity level of the soil. Depending on the moisture or humidity level of the soil, water pump is being set on or off. This research is being done using Arduino on Arduino ide. This research has increasing demands in agriculture sector. Using this system farmer can easily monitor usage of water according to crops they use. By using this method, they can cultivate crops more easily and it reduces the labor. It also helps to maintain the health of the crops and also increase the production by farmers. In this research, we also tested this system on soil for few days and noted its effective results.

Research Gap: In our project, soil moisture sensor senses the moisture level of the soil. If soil will get dry then sensor senses low moisture level and automatically switches on the water pump to supply water to the plant. As plant get sufficient water and soil get wet then sensor senses enough moisture in soil. After which the water pump will automatically get stopped.

2.2 A Review and Proposed Automated Irrigation System using Soil Moisture Sensor and Android App

In this author (Laxmikant Jayprakash Goud) proposed "A Review and Proposed Automated Irrigation System using Soil Moisture Sensor and Android App" This Application will work with the help of Hardware. Hardware which required is Sensors, Controller, GSM Kit (Global system for mobile communication). First, the sensor will place in the field. As per its name it will detect the moisture present in the soil. This produces a voltage level in terms of output. As Machine will only understand the language of voltage, this voltage will be acquired by the controller and it will produce output. In this way sensor and controller will work together to produce the moisture level. After getting the voltage levels, it decides how much water supply needed by the soil. The work of GSM is to allow user to handle the water Sources at the remote location. As well as it will notify user at the time whether actually water supply is started or not. In this way user can handle water supply if he is not physically present there.

Research Gap: In our project we are not using any android application instead we use Arduino, relay, LED, motor, soil moisture sensor and timer module. The soil moisture sensor reads the moisture level in the soil through Arduino and provide the water to the plant if the moisture level in the plant is less than the threshold value and timer module is present to release the sufficient amount of water required for the plant for every 24hours.

2.3 Design of Remote Monitoring and Control System with Automatic Irrigation System using GSM-Bluetooth

In this paper Purnima, S.R.N Reddy, "Design of Remote Monitoring and Control System with Automatic Irrigation System using GSM-Bluetooth", proposed artificially supplying water to land where crops are cultivated. Traditionally hand pumps, canal water and rainfall were a major source of water supply for irrigation. This method has led to severe drawbacks like under irrigation, over-irrigation which in turn causes leaching and loss of nutrient content of soil. Changing environmental conditions and shortage of water have led to the need for a system which efficiently manages irrigation of fields. Automated irrigation system is a machine-based system, which automates the irrigation of land by combining various software and hardware approaches together for field irrigation. This paper deals with a detailed survey of various GSM based automated farm irrigation systems. GSM serves as an important part since it is responsible for controlling the irrigation facility and sends them to receiver through coded signal. Our study is concentrated on comparison of various GSM approaches.

Research Gap: Here we are adding Arduino Uno, Soil Sensor, Timer module and relay without using GSM, we are using an Arduino microcontroller to control and sense the thing in the projects such as sense or measure the moisture level in the soil we are using soil moisture sensor. The soil moisture sensor is a sensor which varies the value when it contacts the soil. if the value is less than threshold value then soil moisture sensor will send the signal to relay to on the motor pump, then motor will release required amount of water to the plant. Relay module is used to control the on and off of the DC watering pump by opening or closing the electric path that passes to the watering pump. It is controlled by the code from the Arduino software.

2.4 A survey on Automatic Irrigation System using Wireless Sensor Network

Nattapol Kaewmard et al., 2014 describe the design of an automated irrigation system using WSN including soil moisture sensor, air temperature sensor and air humidity sensor in order to collect environmental data and controlling the irrigation system. By using smart phone, the irrigation system uses values to turn on/off the solenoid valve. The irrigation system control water by sending and receiving control commands from smart phone application via the internet. Result shows that proposed AIS is useful, cost effective and provides better performance than conventional system.

Research Gap: In our project we are using Arduino to read soil moisture level to check whether it is less than the fixed threshold value or not. Our model will supply the water to the plants only if the soil moisture level is less than the threshold value. So, we are not collecting any environmental data except soil moisture. And our system is not integrated with android app. And irrespective of the soil moisture level our system will water the plants for every 24 hours.

2.5 A Real time implementation of a GSM based Automated Irrigation Control System using drip Irrigation Methodology.

In Veena Divya,k, AyushAkhouri "A Real time implementation of a GSM based Automated Irrigation Control System using drip Irrigation Methodology" deal GSM based Irrigation Control System, which could give the facilities of maintaining uniform environmental conditions. For this, a software stack called Android is used for mobile devices that include an operating system, middleware and key applications. The Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language. Mobile phones have almost become an integral part of us serving multiple needs of humans. This application makes use of the GPRS feature of mobile phone as a solution for irrigation control system. This system covered lower range of agriculture land and not economically.

2.6 Impact of the automatic control of closed circuits rain gun irrigation system on yellow corn growth and yield.

In Mansour Impact of the Automatic Control Of Closed Circuits Rain gun Irrigation System On Yellow Corn Growth And Yield" this research paper deals of automatic control of closed circuits drip irrigation system as a modified irrigation system on yellow corn crop vegetative and yield parameters under (KSA) Saudi Arabia conditions at Al-Hasa region. The field experiment carried out under automatic irrigation system for three irrigation lateral lines 40, 60, 80 m under the following three Drip Irrigation Circuits (DIC) of: a) one manifold for lateral lines or closed Circuits with one Manifold Of Drip Irrigation System (CM1DIS); b) closed circuits with two manifolds for lateral lines (CM2DIS), order to compensate for ETC and salt leaching requirement and take more power.

2.7 Protected culture in Morocco

Jin-Li: Dept. of Electronics and Information Engineering Huazhong University of Science and Technology, "Filter Design and Optimizing based on a Neural Network" To improve irrigation water use efficiency, reduce cost of irrigation water, this paper discussed the design of wireless sensor network and Internet technology of farmland automatic irrigation control method. Emphasis on an analysis of the routing protocol of sensor network nodes to achieve the system hardware and software design, middleware, and applications such as mobile phone or wireless PDA of internet of things, will constitute a variety of sensors intelligent network, thus enhancing the overall automation system and monitoring levels. The final analysis of the network in the Internet based on the agricultural plants of farmland water-saving irrigation system integrated approach. User use mobile phones or wireless PDA can easily soil moisture content of online monitoring and control to realize the irrigation automation. As a new internet of things information network , for most types of agricultural materials, agricultural products through the Internet of Things will be fresh growth state, response to environmental changes, storage preservation, distribution and quality and safety of equipment, machinery, With the development of internet of things, its technology has been widely applied to all aspects of agricultural production, water-saving irrigation involves engineering, agriculture, biology, automation, communications, and many other technologies. water-saving irrigation automatic control system based on wireless sensor using the sensor and set the conditions and the receiver communication, control irrigation systems, valves open, close, so as to achieve the purpose of automatic water-saving irrigation.

2.8 Design and Implementation of Automatic Plant Watering System

In this research paper by P. Archana and R. Priya [4], the authors proposed a technique in which the humidity and soil moisture sensors are placed in the root zone of the plant. Based on the sensed values, the microcontroller is used to control the supply of water to the field. However, their system does not intimate the farmer about the field status.

2.9 WSN Based Temperature Monitoring for High Performance Computing Cluster

In the paper by D. Baghyalakshmi, Jenimah Ebenezer and S. A. V. Satyamurty [5], the authors have presented the implementation details of WSN based temperature monitoring application. The main feature for the authors' proposed network is to continuously monitor the temperature in the 128 nodes High-Performance Computing Cluster for its smooth functioning. The wireless sensor node sense and transmit the current value of temperature to the base station. This paper explains about performance analysis of the network and the various steps involved in the experimental implementation and maintenance of the temperature monitoring network for High Performance Computing cluster.

2.10 A Smart Irrigation System to Automate Irrigation Process Using IOT and Artificial Neural Network

In this system can create a device with the help of Arduino and sensors which will collect data related to a crop like humidity, temperature, pH value and moisture sensor. Using an artificial intelligent the collected data will be analyze. Then we will able to generate result with a very high accuracy.

In this system is subdivided into three different sections. In first section dealing with the IoT based device which will deal with collecting the data which will be on different collection. Second section is including an artificial neural network model which will analyse the collected data in previous section then depending upon result it will decide automatically on/off the irrigation system. In third section web app and android app store the data related to the crop like moisture level, temperature level, humidity, pH level which will help researchers to develop efficient module.

III. Requirements

3.1 Hardware Requirements

- Arduino UNO – Microchip ATmega328P (Operating Voltage: 5 Volts Input Voltage: 7 to 20 Volts Digital I/O Pins: 14)
- Soil moisture sensor module– 3.3v - 5v Operating Voltage (VDC) - 3.3 ~ 5, PCB Dimension - Approx.3cm x 1.5cm, Soil Probe Dimension - Approx. 6cm x 3cm, Cable Length (cm) – 20
- Submersible Pump - 180V-230V, 1.85 M, 18W and an attachable pipe of 32mm – 110mm with required length.
- Relay – (1 or many channel), 5V DC, 100ma Load - 250v 10a AC or 30v 10a dc
- Power supply – AC socket 220V
- RTC DS3231 - AT24C32 IIC Precision RTC (Operating voltage - 3.3 - 5 .5 V
- Clock chip: High-precision clock chip DS3231
- Clock Accuracy: 0 - 40 centigrade range, the accuracy 2ppm, the error was about 1 minute) with a lithium coin battery of 3v – 5v
- D type USB cable
- Breadboard & Jumper wires - Male-to-Female, Male-to-Male, Female-to-Female.

3.2 Software Requirements

- Arduino IDE – 1.8.16 (recommended)
- The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board.
- Central Processing Unit (CPU) – Intel Core i5 6th Generation processor or higher. An AMD equivalent processor will also be optimal.
- RAM – 4 to 8 GB minimum, 16 GB or higher is recommended.
- Operating System – Ubuntu or Microsoft Windows 10.
- 5 GB free disk space
- Python – 3.10.0 (used Jupyter notebook for implementation – any Python IDE is sufficient)

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IV. System Design

4.1 Automatic Watering System using Soil Moisture Sensor – Prototype

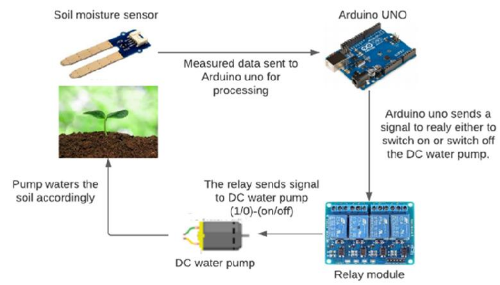

Figure 1: Prototype for AWS using sensor

4.2 Flowchart for soil moisture sensor module

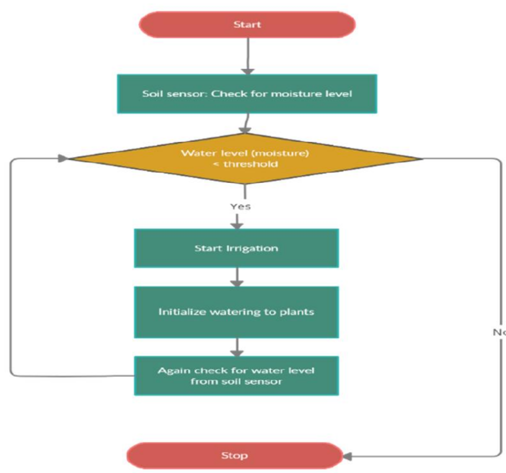

Figure 2: Flowchart for AWS using sensor

4.3 Automatic Watering System using RTC DS3231 – Prototype

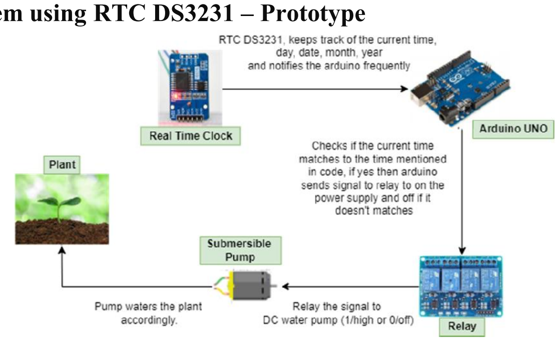

Figure 3: Prototype for AWS using RTC

4.4 Component Description

A. Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input / output pins (of which 6 can be used as PWM outputs), 6 analog inputs, 16 MHz ceramic resonator, USB connection, power jack, ICSP plug, and a reset button. It contains everything needed to support the microcontroller; simply use the USB cable or power it with a AC-to-DC adapter or battery is connected to a computer begins.

B. Moisture Sensor

Soil moisture sensor measures the soil water content. Soil moisture probe consists of a plurality of soil moisture sensors. Soil moisture sensor technology, commonly used are:

- Frequency domain sensor, such as a capacitive sensor.
- Neutron moisture meter, characteristic of the use of water in the neutron moderator.
- Soil resistivity. In this particular project, we will use the soil moisture sensors which can be inserted into soil to measure the soil moisture content.

C. Water Pump / DC Motor

Water is used to perform a specific task of artificially pumping. It can be controlled by an electronic microcontroller. It can be on 1 triggered by sending the signal and turned off as needed. Artificial process is called Water Pumping. Station. There are many varieties of pumps. This project we would like to use a DC motor.

D. Relay module

Relay is an electrically operated switch. Many relays for switching solenoid mechanism mechanically operated, but can also be used for other principles of operation. Relays are widely used in early computers to telephones and perform logical operations.

E. RTC – DS3231

Timer module is comprised of RTC (real time clock) module (RTC – DS3231). The RTC maintains seconds, minutes, hours, day, date, month, and year information. The date at the end of the month is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24-hour or 12-hour format with an AM/PM indicator. Two programmable time-of-day alarms and a programmable square-wave output are provided. Address and data are transferred serially through an I2C bidirectional bus. A precision temperature-compensated voltage reference and comparator circuit monitors the status of VCC to detect power failures, to provide a reset output, and to automatically switch to the backup supply when necessary. Additionally, the RST pin is monitored as a pushbutton input for generating a reset externally.

4.5 Modules Description

A. Relay Module

The relay module is a switch that controlled by an electromagnet. It is used to control the on and off of the DC watering pump by opening or closing the electric path that passes to the watering pump. It is controlled by the code from the Arduino.

B. Moisture Sensor Module

A moisture sensor is used to sense the level of moisture content present in the irrigation field. It has a level detection module in which we can set a reference value. This circuit can be used with analog probes that produce a voltage proportional to soil moisture. The moisture content of the soil is found by using the soil moisture sensor which produces an equivalent output voltage proportional to the conductivity between the two probes. The module has a built-in potentiometer for sensitivity adjustment of the digital output (DO). You can set a threshold by using a potentiometer; So that when the moisture level exceeds the threshold value, the module will output LOW otherwise HIGH.

C. Timer Module

The DS3231 is a low-cost, extremely accurate I2C real-time clock (RTC) with an integrated temperature compensated crystal oscillator (TCXO) and crystal. The device incorporates a battery input, and maintains accurate timekeeping when

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main power to the device is interrupted. The integration of the crystal resonator enhances the long-term accuracy of the device as well as reduces the piece-part count in a manufacturing line. The DS3231 is available in commercial and industrial temperature ranges, and is offered in a 16-pin, 300-mil SO package.

The working in this module is as follows, Firstly the condition of timer from when the watering has to happen is being given in loop through Arduino and the rtc is set to current time, when the relay is connected to an external power supply, the loop executes and checks if the current time of conditioned time. If the time matches, power supply is on and the watering happens and similarly the relay will be triggered off, if the loop checks for the stop time and matches and thus, watering does stops.

V. Implementation of System

5.1 Schematic Diagram Automatic Watering System using Soil Moisture sensor with Arduino

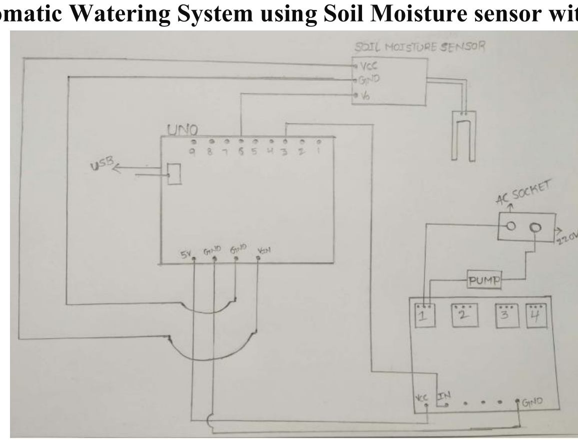

Figure 4: Schematic diagram using sensor

5.2 Schematic Diagram Automatic Watering System using RTC Timer with Arduino

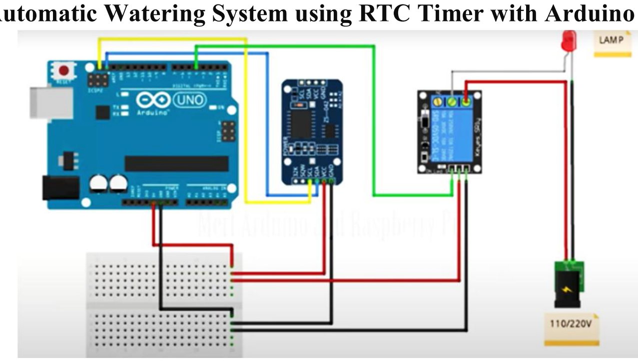

Figure 5: Schematic diagram using RTC

5.3 Implementing Machine Learning Models to predict to either water the plant or not.

- **Dataset link: KAGGLE DATASET**
  (https://www.kaggle.com/nelakurthisudheer/dataset-for-predicting-watering-the-plants)
- **Code link: GOOGLE COLAB IPYNB FILE**
  (https://colab.research.google.com/drive/1SRTKAihKdt2qIvAanFiA1ZxOrQSLv0zL?usp=sharing)

A. Data pre-processing

Extracting independent and dependent variables and Data Splitting. We took a dataset from Kaggle and did some preprocessing and had to clean the dataset in all terms like missing values, removal of unnecessary attributes.

B. Building and training the model

The dataset has been trained using 4 different classification models. Logistic Regression, Random Forest, Decision tree model, Scalar vector machine model.

Each model trained the dataset and has been checked for MSE and R2 score for each model and selected best model to predict the target variable (watering).

C. Random Forest

Random Forest algorithm is one of the machines learning algorithm, belonging to the supervised learning technique. It solves both Classification and Regression problems in machine learning. This technique combines multiple classifiers which solves a complex problem resulting in improved performance of the model also called as ensemble learning concept. Random Forest is a technique that contains number of decision trees on various subsets of the given dataset and takes the average to improve the predictive accuracy of that dataset. Instead of relying on only one decision tree, the random forest algorithm takes the prediction from each tree and based on the majority votes of predictions, it predicts the final output. The greater number of trees in the forest, higher is the accuracy thus, preventing the problem of over fitting.

D. (SVM) Support Vector Machine

Support Vector Machine is a linear model for classification and regression problems. It can solve linear and non-linear problems and work well for many practical problems. The idea of SVM is simple: The algorithm creates a line or a hyperplane which separates the data into classes.

E. Decision Tree

Decision Tree algorithm belongs to the family of supervised learning algorithms. Unlike other supervised learning algorithms, the decision tree algorithm can be used for solving regression and classification problems too.

The goal of using a Decision Tree is to create a training model that can use to predict the class or value of the target variable by learning simple decision rules inferred from prior data (training data). In Decision Trees, for predicting a class label for a record we start from the root of the tree. We compare the values of the root attribute with the record's attribute. On the basis of comparison, it follows the branch corresponding to that value and jump to the next node.

F. Logistic Regression

Logistic regression is named for the function used at the core of the method, the logistic function. The logistic function, also called the sigmoid function was developed by statisticians to describe properties of population growth in ecology, rising quickly and maxing out at the carrying capacity of the environment. It's an S-shaped curve that can take any real-valued number and map it into a value between 0 and 1, but never exactly at those limits.

VI. Results and Discussion

6.1 Data Visualizations

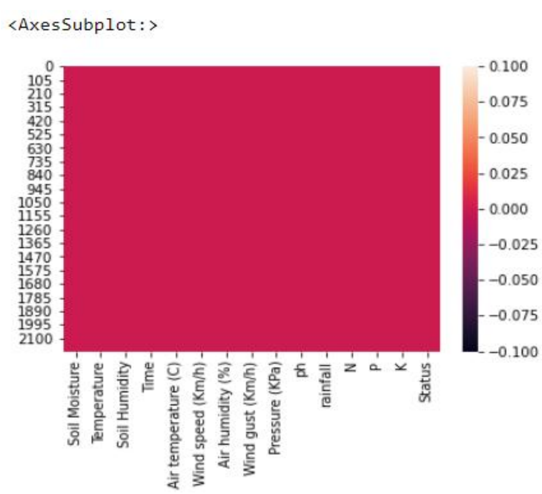

Figure 6: Heatmap representation for null values

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Figure 7: Count and Bar plot for Status (ON and OFF)

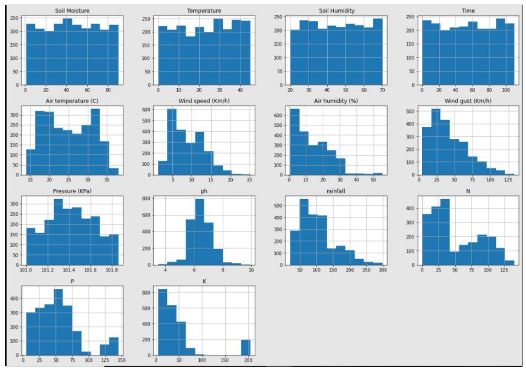

Figure 8: Hist plot for all attributes

6.2 Trained Model MSE and R2 score

```
print("Mean Square error: ")
print("1.Linear Regression            :",mean_squared_error(Lin,y_test))
print("2.Decision Tree Regression     :",mean_squared_error(Dec_tree,y_test))
print("3.Random Forest Regressor      :",mean_squared_error(Random_for,y_test))
print("4.Support Vector Classifier    :",mean_squared_error(s_v_m,y_test))

Mean Square error:
1.Linear Regression          : 0.18709691363581482
2.Decision Tree Regression   : 0.06212121212121212
3.Random Forest Regressor    : 0.059121212121212116
4.Support Vector Classifier  : 0.250136566139686

[ ] print("R2_Score: ")
print("1.Linear Regression            :",r2_score(Lin,y_test))
print("2.Decision Tree Regression     :",r2_score(Dec_tree,y_test))
print("3.Random Forest Regressor      :",r2_score(Random_for,y_test))
print("4.Support Vector Classifier    :",r2_score(s_v_m,y_test))

R2_Score:
1.Linear Regression          : -1.4537559757397722
2.Decision Tree Regression   : 0.750688692543694
3.Random Forest Regressor    : 0.684251721748393
4.Support Vector Classifier  : -429314862923.2707
```

Figure 9: Trained model MSE and R2 scores

Inference: Among all different classification algorithms Decision Tree and Random Forest Classifier are best fit for our dataset because, they both have low mean square error and high R^2 score.

6.3 Extract the Dependent values and Testing on Trained Data

Extracted values of Soil Moisture and Temperature using soil moisture sensor and temperature sensor

A	B
Soil Moisture	Temperature
50	23
25	32
55	21
15	30
87	22
89	31
38	26
87	19
58	24
77	21

Figure 10: Manually collected values from different plants

These are the values we have noted down using soil moisture sensor and temperature sensor. We fit this dataset into our trained model (Decision Tree) to predict the ON and OFF of motor pump. ‘0’ indicates OFF and ‘1’ indicates ON.

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6.4 Testing the extracted values with original dataset

```
In [30]: #TRAIN TEST DATA
         from sklearn.model_selection import train_test_split
         X1_train,X1_test,y1_train,y1_test=train_test_split(x1,y1,test_size=0.3,random_state=5)

In [31]: from sklearn.tree import DecisionTreeRegressor
         d=DecisionTreeRegressor()
         d.fit(X1_train,y1_train)

Out[31]: DecisionTreeRegressor(criterion='mse', max_depth=None, max_features=None,
                               max_leaf_nodes=None, min_impurity_decrease=0.0,
                               min_impurity_split=None, min_samples_leaf=1,
                               min_samples_split=2, min_weight_fraction_leaf=0.0,
                               presort=False, random_state=None, splitter='best')

In [32]: Dec_tree=d.predict(vyshu)
         Dec_tree

Out[32]: array([0., 1., 1., 1., 0., 0., 1., 0., 1., 0.])

In [33]: d.predict([[18,25]])

Out[33]: array([0.])
```

Figure 11: Predicting using Decision tree classifier

6.5 Demonstration of Automatic Watering System using Arduino

A. RTC Timer Module – DS3231

Figure 12: Timer module with Plant Setup

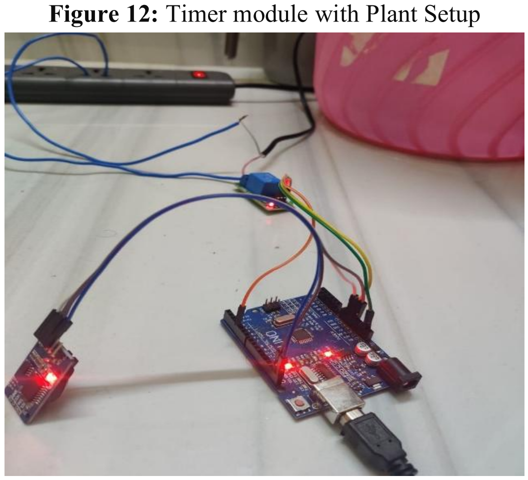

Figure 13: Connections between RTC DS3231 and Arduino UNO

This is our Timer Module set up. We have set our time for water supply from 20:40 (8:40 pm) to 20:42 (8:42 pm). So, the relay will trigger the signal to motor pump ON at 20:40 and motor pump OFF at 20:42 simultaneously.

Figure 24: Pump being OFF at 8:39 pm

Figure 35: Pump being ON at 8:40 pm

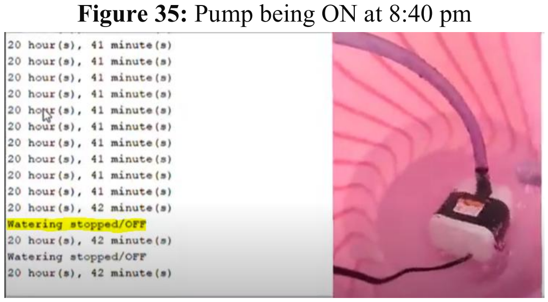

Figure 46: Pump being triggered to OFF again at 8:42 pm

6.6 Soil Moisture sensor module

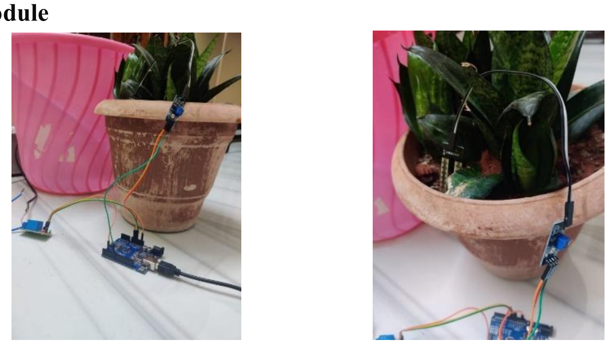

Figure 57: Setup for Soil Moisture sensor

Figure 68: Watering the plant using sensor

If the detected soil moisture sensor value from the plant is less than the threshold value then the relay sends the signal to the pump to ON and pump provide water to the plant. Similarly, If the detected soil moisture sensor value from the plant is greater than the threshold value then the relay sends the signal to the pump to OFF and stop water supply to the plant. In the first case, the plant is completely dry, sensor detected low moisture value and relay has been triggered by Arduino to water the plant. Whereas, In the second case the plant has been already watered and was wet already, So the moisture content is high when detected by the sensor and hence relay doesn't gets triggered by Arduino.

VII. Conclusion and Future Work

The automatic irrigation system was designed to continuously sense the moisture level of the soil. The system responds appropriately by watering the soil with the exact amount of water required and then shuts down the water supply when the required amount of soil moisture is achieved. There are two functional components. They are moisture sensor and motor / pump. Arduino board is programmed using the Arduino IDE software. Soil Moisture sensor is used to detect the soil moisture content. Motor / pump is used to supply water to plants. The reference amount of soil moisture is already fed to the microcontroller beforehand. Irrespective of moisture level the timer module will also supply the water at specific intervals of time that we have fixed in Arduino. The proposal of this project is to provide an automatic water distribution and irrigation system with the help of moisture sensor and timer module. And also reduce the water consumption using this procedure.

The system is ideal for the expensive, rare and luxurious plants which are basically planted in pots. It can also be applied to gardening in the apartments or any space. The whole circuit consumes a low power, which is 200 – 220 mA is total. The main advantage of the system is that it only turns the water pump on when its needed and instantly turns off when the water is sufficient. In this way, it prevents wastage of water and ensures the appliance of water optimally. We have also done timer module which consists more criteria in determining perfect timing for watering once in a day and apply the whole system for plants. As the system is optimized for perfect timing of watering, It may help the plants to remain healthy and grow perfectly. Thus, the system would not only keep the plants alive, but also facilitate to grow up in a healthy way.

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CONTRIBUTION

Reg no.	Name	Contribution
18MIS1020	T JAYASRI	Data visualization, coordinated in prediction, schematic circuit diagram and literature survey
18MIS1024	MANCHIKANTI BHUMIKA	Dataset preprocessing and built 4 machine learning models to train and test dataset, relay module, Partial Documentation
18MIS1026	Y LAKSHMI SAICHARITHA	Circuit connection and component analysis, DS3231 module, conversion sensor values using in-built potentiometer.
18MIS1042	NELAKURTHI SUDHEER KUMAR	Extracted values in real time and data pre-processing, Architecture and system design development on timer module.
18MIS1086	P VAISHNAVI	Arduino coding and Hardware implementation on product development, IDE and simulation controls, Partial Documentation.

APPENDIX

Code for Automatic watering system using Soil Moisture sensor with Arduino

```
int water; //random variable
void setup() {
        pinMode(3,OUTPUT); //output pin for relay board, this will sent signal to the relay
        pinMode(6,INPUT); //input pin coming from soil sensor
}
void loop() {
        water = digitalRead(6); // reading the coming signal from the soil sensor
        if(water == HIGH) // if water level is full then cut the relay
        {
                digitalWrite(3,LOW); // low is to cut the relay
        }else{
                digitalWrite(3,HIGH); //high to continue proving signal and water supply
        }
        delay(400);
}
```

Code for Automatic watering system using RTC Timer with Arduino

```
#include <DS3231.h>
int Relay = 4;
DS3231  rtc(SDA, SCL);
Time t;
\\ Change the time as required
const int OnHour = 17;
const int OnMin = 20;
```

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```
const int OffHour = 17;
const int OffMin = 22;
void setup() {
  Serial.begin(115200);
  rtc.begin();
  pinMode(Relay, OUTPUT);
  digitalWrite(Relay, HIGH); //In this case the relay takes high = 0/OFF and low = 1/ON
}
void loop() {
  t = rtc.getTime();
  Serial.print(t.hour);
  Serial.print(" hour(s), ");
  Serial.print(t.min);
  Serial.print(" minute(s)");
  Serial.println(" ");
  delay (1000);
  if(t.hour == OnHour && t.min == OnMin){
    digitalWrite(Relay,LOW); //On-1
    Serial.println("Watering the plant/ON");
    }
    else if(t.hour == OffHour && t.min == OffMin){
      digitalWrite(Relay,HIGH); //Off-0
      Serial.println("Watering stopped/OFF");
    }
}
```

Snapshots for Reference

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