VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Jnana Sangama, Belgaum-590018

A PROJECT REPORT **(15CSP85)** ON

"AUTOMATIC GARDENING SYSTEM"

Submitted in Partial fulfillment of the Requirements for the Degree of

Bachelor of Engineering in Computer Science & Engineering

By

CHANDAN S J (1CR16CS040)

DIKSHITH K (1CR16CS045)

AJAY G (1CR16CS050)

DILEEP REDDY G (1CR16CS051)

Under the Guidance of,

Mrs. RUBINI P E

Assistant Professor, Dept. of CSE

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CMR INSTITUTE OF TECHNOLOGY

#132, AECS LAYOUT, IT PARK ROAD, KUNDALAHALLI, BANGALORE-560037

CMR INSTITUTE OF TECHNOLOGY

#132, AECS LAYOUT, IT PARK ROAD, KUNDALAHALLI, BANGALORE-560037

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

Certified that the project work entitled **"AUTOMATIC GARDENING SYSTEM"** carried out by **Mr. CHANDAN S J** , USN **1CR16CS040**, **Mr**. **DIKSHITH K**, USN **1CR16CS045**, **Mr**. **AJAY G**, USN **1CR16CS050, Mr**. **DILEEP REDDY G**, USN **1CR16CS051,** bonafide students of CMR Institute of Technology, in partial fulfillment for the award of **Bachelor of Engineering** in Computer Science and Engineering of the Visveswaraiah Technological University, Belgaum during the year 2019-2020. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library.

The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

________________	________________	________________
Mrs. Rubini P E	**Dr. Prem Kumar Ramesh**	**Dr. Sanjay Jain**
Assistant Professor	**Professor & Head**	**Principal**
Dept. of CSE, CMRIT	**Dept. of CSE, CMRIT**	**CMRIT**

External Viva

Name of the examiners	Signature with date
1.	________________
2.	________________

DECLARATION

We, the students of Computer Science and Engineering, CMR Institute of Technology, Bangalore declare that the work entitled "**AUTOMATIC GARDENING SYSTEM**" has been successfully completed under the guidance of Asst. Prof. RUBINI P E, Computer Science and Engineering Department, CMR Institute of technology, Bangalore. This dissertation work is submitted in partial fulfillment of the requirements for the award of Degree of Bachelor of Engineering in Computer Science and Engineering during the academic year 2019 - 2020. Further the matter embodied in the project report has not been submitted previously by anybody for the award of any degree or diploma to any university.

Place:

Date:

Team members:

CHANDAN S J (1CR16CS040) ___________________

DIKSHITH K (1CR16CS045) ___________________

AJAY G (1CR16CS050) ___________________

DILEEP REDDY G (1CR16CS051) ___________________

ABSTRACT

The main objective of this paper is to monitor temperature, humidity content and soil's moisture content with the help of temperature sensor, humidity sensor and soil moisture sensor respectively. The IOT system comprising of sensors, nodes, gateways and cloud systems gives the right analyzed information to the farmer or to the user about the irrigation. Internet of Things, Wireless Sensor Networks or Physical cyber systems with actuators and Cloud Computing systems, have been used in various fields in agriculture for efficient usage of resources.

Here in this paper, we implement and experiment for different crops in various climatic or weather conditions that analyze plant growth and provide access to information that can be collected at regular intervals and with less human intervention.

Agriculture is the source of employment for a large number of people in India and has a greater impact on the economy of this country. In this study the system senses the temperature, humidity around the crops and soil moisture content in that particular soil for that particular crop and automatically switches the pump to on/off with respect to data collected and analyzed. When soil moisture gets low or dry, the pump starts watering the crops up to the requirement of the crop. The aim of our work is to reduce water usage and power consumption which in turn will lead to effective use of other resources resulting maximum yield to the farmers.

Keywords: soil moisture, temperature, humidity, smart irrigation.

ACKNOWLEDGEMENT

I take this opportunity to express my sincere gratitude and respect to **CMR Institute of Technology, Bengaluru** for providing me a platform to pursue my studies and carry out my final year project

I have a great pleasure in expressing my deep sense of gratitude to **Dr. Sanjay Jain,** Principal, CMRIT, Bangalore, for his constant encouragement.

I would like to thank **Dr. Prem Kumar Ramesh,** Professor and Head, Department of Computer Science and Engineering, CMRIT, Bangalore, who has been a constant support and encouragement throughout the course of this project.

I consider it a privilege and honor to express my sincere gratitude to my guide
Rubini P E , Asst. Professor , Department of Computer Science and Engineering, for the valuable guidance throughout the tenure of this review.

I also extend my thanks to all the faculty of Computer Science and Engineering who directly or indirectly encouraged me.

Finally, I would like to thank my parents and friends for all their moral support they have given me during the completion of this work.

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Sensors in the fields can ensure the optimal use of available **water** resources. There are many resources available for the agriculture but for their optimal use IOT is necessary.

The following are some of them where IOT can be used,

- Weather forecast to get the weather conditions of the following days
- The level of water and time of flow of water from the dams to canals also needs sensors so that farmers get alerts on time
- **Fertilizer's sensors** can sense and alert farmers if the crop requires more fertilizer or they are less in the soil.
- Sensors can help in detecting crop diseases prior to damage
- The **water motors** can be connected with mobiles.
- The use of environmental sensors to predict weather forecasts can help the farmers in activities like sowing, irrigation, and harvesting.
- Environmental sensors can detect smoke and start the water sprinklers and avoid huge losses.

By these ways we can utilize IOT for betterment of the agriculture.

In our project we want to use the IOT mainly for irrigation purpose, that is usage of sensors to find the temperature,humidity,moisture of the environment of the field.

1.1 IOT INTRODUCTION

A network of Internet connected objects able to collect and exchange data.

IOT is playing prominent role in automation with minimal or no human intervention for completing the tasks.

Basically to explain the IOT let us take the example of smart home. We know how objects in home are connected for automation and pleasure of human like,

- security monitoring capabilities,
- temperature modulation,
- lighting controls,
- Sound modulation,
- Visual monitoring and modulation,
- Entertainment etc

IOT is used in every field these days, from local to international levels.

It is that useful and broader in the modernized world.

As India is truly agricultural based and 69% of it is villages, It is phenomenal to use IOT in agriculture. IOT can be used in agriculture for higher reliability and minimal human intervention of farmers. Many test cases are discussed in the next section. IoT monitoring technology allows farmers to continuously track resources, monitor water, fuel and feed tanks and improve upon crop and agriculture asset health, labour , and time costs.

IoT in agriculture consists of sensors, processing, connectivity, gateway and cloud solutions optimized in their working according to specific use cases.to get the maximum productivity of crops soil and the environment need to be monitored for humidity and temperature. It is important not only to monitor not only absolute humidity and temperature but the change over a shorter and longer period of time. This data can be correlated with ideal profile for the crop. This monitoring also helps to identify when and how much pesticides and fertilizer need to be used to minimize their usage.

CHAPTER 2

LITERATURE SURVEY

1. **Abdelmadjid Saad at all proposed for "Water Management in Agriculture: Current Challenges and Technological Solutions"**

   Methodology:
   Here they used cyber physical systems in agriculture, where sensors were deployed in agricultural fields with actuators to analyse the required water for crops.
   The sensors recorded the temperature, humidity around the crops and using these data the sprinklers let water to the crops, until it reached certain threshold values.
   Accuracy:
   The system they used here did not have anything related to Wifi, Bluetooth or cloud system which reduced the system to small fields and reduced efficiency as it did not involve much analysing.

2. **Jinyu Chen at all proposed for "Intelligent Agriculture and Its Key Technologies Based on Internet of Things Architecture"**

   Methodology:
   Here four main technologies are designed: sensor technology, RFID technology, Quick Response Code and embedded system technology. RFID technology is a comprehensive technology which combines radio frequency with embedded technology. Quick response code (QR code) is a recognition technology, and the information is displayed in the form of Quick Response. Embedded system technology refers to an operating system applied to small devices, which is a collection of computers, sensors, integrated circuits and so on. Because the embedded system only aims at a specific technology, designers can optimize it to reduce its size and cost.
   Accuracy:
   The system used resources efficiently and produced better results but the system used varied technologies which was difficult for farmers or new beginners to understand make use of it.

3. **Carlos Daniel López at all proposed for "Optimization of Energy and water Consumption on crop Irrigation using UAVs via Path Design"**

   Methodology:

Crop water stress index (CWSI)-based irrigation management. For this, attaining crop canopy at different periods and air temperature are needed for the calculation of CWSI. A wireless sensors based monitoring system where all the field sensors are connected to collect the mentioned measurements, further transmit to processing centre where corresponding intelligent software applications are used to analyse the farm data. Weather data and satellite imaging is applied to CWSI models for water need assessment, and finally specific irrigation. Appropriate example is VRI (Variable Rate Irrigation) optimization by Crop Metrics, which works according to topography or soil variability, ultimately improves the water use efficiency.

Accuracy:

This advanced system produced better results compared to other irrigation systems, but the whole system was considered a bit costly.

4. **Norashikin M. Thamrin at all proposed "IoT implementation for indoor vertical farming watering system"**

Methodology:

VF in the form of urban agriculture offers an opportunity to stack the plants in a more controlled environment resulting in, most importantly, significant reduction in resource consumption. By following this method, we can increase the production multiple times, as only a fraction of ground surface is required as compared to traditional agriculture practices. Human hands are not required to touch the crops at any stage when following the IoT-connected vertical farm.

Accuracy:

Not only for ground surface, this system is highly efficient in terms of other resources, as well. and most importantly, consuming 40% less energy and up to 99% reduced water consumption compared to outdoor fields. Under this farming method, many parameters are important, but CO2 measurements are most critical; hence, non-dispersive infrared (NDIR) CO2 sensors play a critical role to track and control the conditions in vertical farms.

5. **Sheetal Vatari at all proposed "Green House by using IOT and cloud computing"**

Methodology:

Greenhouse farming is considered the oldest method of smart farming. Crops grown indoors are very less affected by environment; most importantly, they are not limited to receiving light only during the daytime. As a result, the success and production of various crops under such controlled environment depend on many factors, like accuracy of monitoring parameters, structure of shed, covering material to control wind effects, ventilation system, decision support system, etc. Precise monitoring of environment parameters is the most critical task in modern greenhouses, where several measurement points of various parameters are required to control and ensure the local climate. In an IoT-based prototype is proposed to monitor the greenhouses where nodes are used to measure the inside parameters like humidity, temperature, light, and pressure.

Accuracy:

The crops that traditionally could only be grown under suitable conditions or in certain parts of the world are now being growing anytime and anywhere. And this has been possible because this method being widely accepted.

CHAPTER 3

SYSTEM REQUIREMENTS SPECIFICATION

In IOT we see that we require more hardware components for placing the sensors for real time data in the environment.

3.1 HARDWARE

- ARDUINO UNO
- HC-05 Bluetooth module
- Temperature sensor
- Humidity sensor
- Moisture sensor
- Relay
- Motor pump
- Battery
- Bread board

3.2 SOFTWARE

- C++ / C language
- Python language
- Processor 2.50 GHz
- Installed RAM 8GB
- System type : 64-bit operating system
- OS - Windows 10

3.2 TESTING TOOLS

- Arduino IDE
- Tera Term

CHAPTER 4

SYSTEM ANALYSIS AND DESIGN

The overall design and architecture of the system is described in the below diagram fig.1.

4.1 System Block Diagram

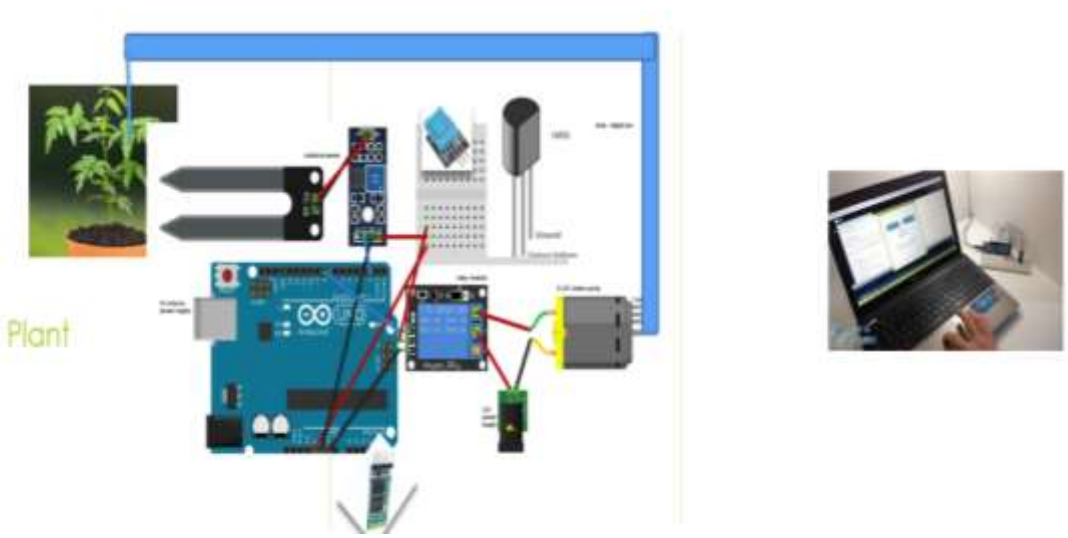

Fig -4.1 Architecture of System Analysis & Design

Initially, the sensors data which we get is taken by the Bluetooth module. The temperature sensor , moisture sensor , humidity sensor values are sent to the system on to console of Arduino . Using Tera Term software we can save the sensor collected data directly into csv file. When the value which is calculated for particular interval is less/more than the threshold values set for a particular kind of plant, the arduino micro controller triggers the motor to pump water through a pipe to the plant. After some interval when the values from the sensor coming is satisfied with the threshold values , the arduino micro controller switches off the motor by the relay automatically.

As we see, the system contains 3 sensors, the temperature sensor, humidity sensor and moisture sensor. The moisture sensor as we see is kept in the soil and the value which we convert the following sensor data is into percentage form. Now according to the plant we fix the minimum percentage of moisture required . The temperature sensor is connected on bread board. The readings from the temperature sensor is compared with the threshold. If the temperature is much more than expected , then arduino micro controller triggers the pump to water the plant. At last we have humidity sensor. We convert the value in to percentages and according to the threshold of it, we then check to see if we can trigger the motor through arduino code or not.

The connections must be appropriately connected so that no component gets burnt or spoilt and provide us the error data. Bluetooth LE HC-05 module must be connected to 3.3 V instead of 5 V as there were scenarios before that the module gets overloaded with voltage. The temperature sensor must be connected properly to ground and VCC to its pins respectfully. If not the sensor gets heated very quickly and might not give proper sensor values, which is not at all favourable for automatic gardening as well. Humidity sensor must be connected similarly as temperature sensor, connecting with the VCC , ground to its pins respectfully.

CHAPTER 5

IMPLEMENTATION

The first part is to connect the circuit to the system and install the Tera Term which is an open-source, free, software run, terminal emulator program. It emulates different types of computer terminals, from DEC VT100 to DEC VT382. It also supports telnet, SSH 1 & 2 and serial port connections.

5.1 METHODOLOGY

First we must get the sensor's data from the Bluetooth LE HC-05 module to the serial monitor in the system. So, select the same hardware interface as that of the Arduino UNO and Bluetooth LE HC-05 module. In my case , COM 5 is supported by my BLE.

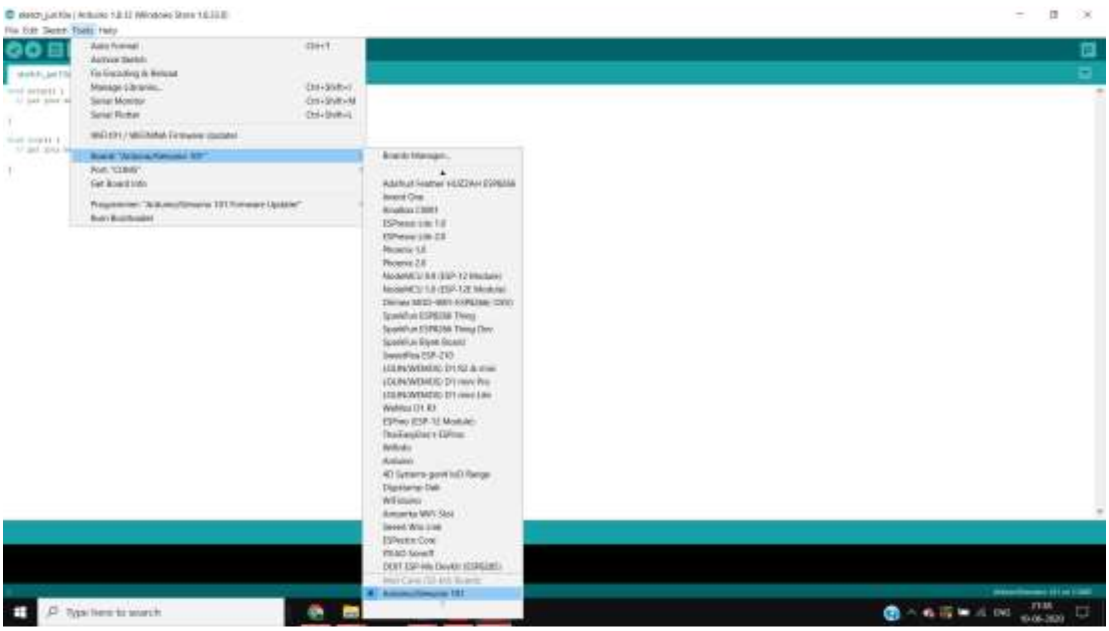

Fig 5.1 : Arduino/Genuino

Download the Arduino/Genuino from the Board Manager and select the "Arduino/Genuino 101" board from Tools.

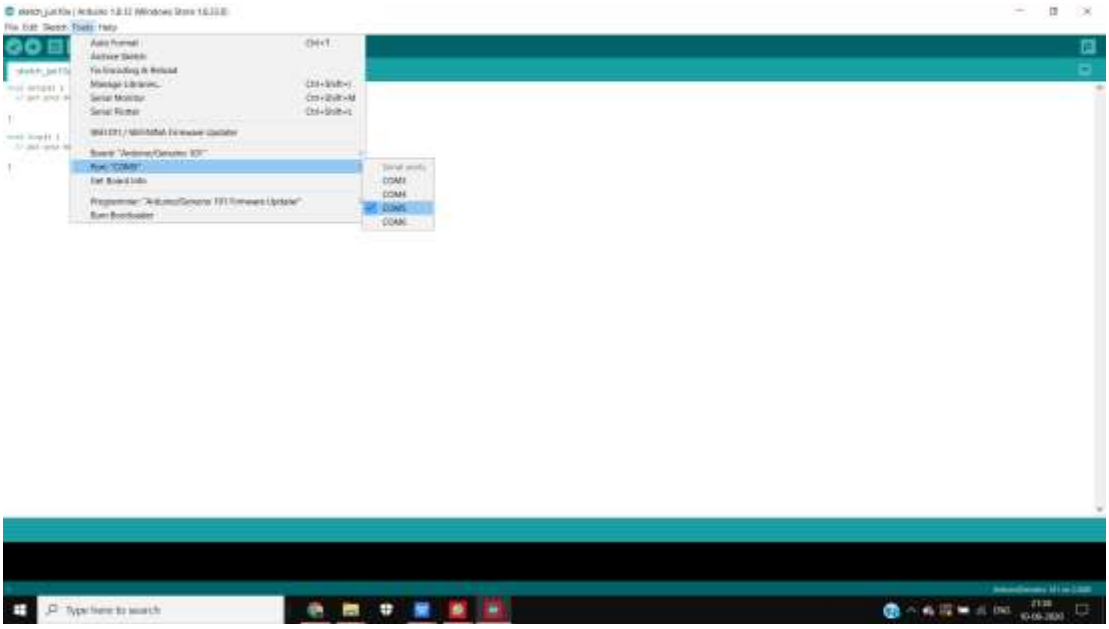

Fig 5.2 Port COM5

Select the COM5 from Tools of Port.

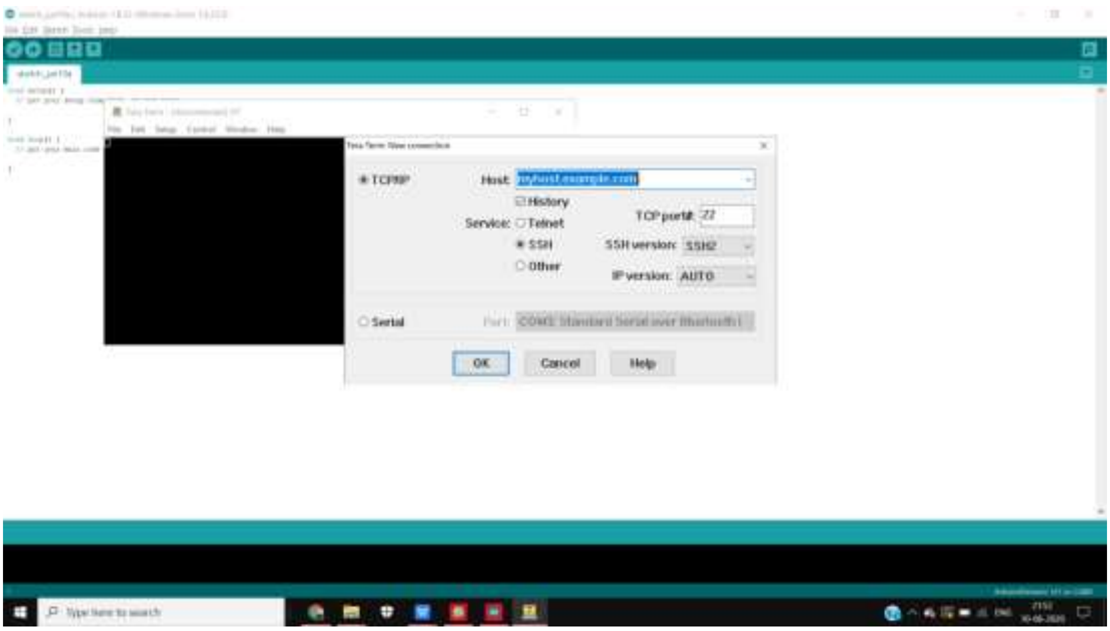

Fig 5.3 Install TeraTerm

Select the COM5 and select the port ID.

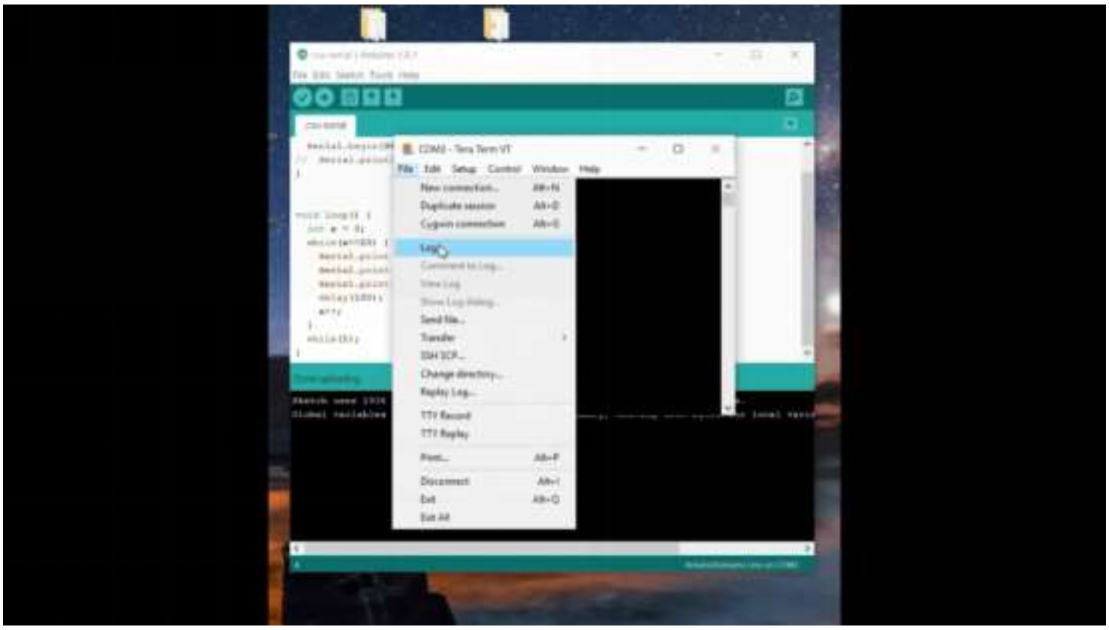

Fig 5.4 To save the logs.

We click on File and click on Logs to save the file with the log data.

Fig 5.5:- Saving the log file

Here since we read the data from the system for ML execution through csv file, we save the log file as csv file.

Now we will get the data in csv file for particular interval of time. This csv file is then used as data input for testing against the trained ML program.

So, we check the accuracy part each time and check the working if its pumping the water correctly or not.

5.2 ALGORITHM

It is an ensemble tree-based learning algorithm. The Random Forest Classifier is a set of decision trees from randomly selected subset of training set. It aggregates the votes from different decision trees to decide the final class of the test object.

Features and Advantages of Random Forest :

1. It is one of the most accurate learning algorithms available. For many data sets, it produces a highly accurate classifier.
2. It runs efficiently on large databases.
3. It can handle thousands of input variables without variable deletion.
4. It gives estimates of what variables that are important in the classification.
5. It generates an internal unbiased estimate of the generalization error as the forest building progresses.
6. It has an effective method for estimating missing data and maintains accuracy when a large proportion of the data are missing.

Disadvantages of Random Forest :

1. Random forests have been observed to overfit for some datasets with noisy classification/regression tasks.
2. For data including categorical variables with different number of levels, random forests are biased in favor of those attributes with more levels. Therefore, the variable importance scores from random forest are not reliable for this type of data.

CHAPTER 6

RESULTS AND DISCUSSION

The screen shots of the results are shown below

6.1 SCREENSHOTS AND EXPLANATION

Fig 6.1 Connecting the moisture sensor to the soil

We here insert the moisture sensor in the plant's soil.

Fig 6.2 Then we take out the moisture sensor and now we see that the value of moisture becomes much lesser than threshold.

Fig 6.3 After the moisture sensor is taken out from soil, the motor automatically starts to pump water.

Fig 6.4 The moisture sensor's sensitivity is decided by the screw , if we tight it more, the sensitivity is increased and if we loosen it, the sensitivity is decreased.

```
COM5
Send
Current humidity = 56.00%  temperature = 22.00C
Current humidity = 56.00%  temperature = 22.00C
Current humidity = 56.00%  temperature = 22.00C
Current humidity = 56.00%  temperature = 22.00C
Current humidity = 56.00%  temperature = 22.00C
Current humidity = 56.00%  temperature = 22.00C
Current humidity = 56.00%  temperature = 22.00C
Current humidity = 56.00%  temperature = 22.00C
Current humidity = 56.00%  temperature = 22.00C
Current humidity = 56.00%  temperature = 22.00C
Current humidity = 56.00%  temperature = 22.00C
Current humidity = 56.00%  temperature = 22.00C
Current humidity = 56.00%  temperature = 22.00C
Autoscroll                    No line ending    9600 baud
```

Fig 6.5 An example of how the temperature and humidity would be printed on the COM5 serial monitor

```python
from sklearn.metrics import accuracy_score
print(accuracy_score(y_test,y_pred))
```

```
0.937
```

```python
from sklearn.metrics import confusion_matrix
confusion_matrix(y_test,y_pred)
```

```
array([[887,  28],
       [ 35,  50]], dtype=int64)
```

```python
from sklearn.metrics import classification_report
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

         0.0       0.96      0.97      0.97       915
         1.0       0.64      0.59      0.61        85

   micro avg       0.94      0.94      0.94      1000
   macro avg       0.80      0.78      0.79      1000
weighted avg       0.93      0.94      0.94      1000
```

Fig 6.6 The precision, accuracy , recall and confusion matrix of the testing

The result of the metrics is shown above.

CHAPTER 7

TESTING

In the beginning we given the train data output column and test data output column to the couple of variables.

Second step is to import the accuracy score from sklearn.metrics

- To find the accuracy score
- Print the calculated accuracy score

Third step is to import the confusion matric from sklearn.metrics

- To find the confusion matrix
- To print the accuracy matrix

Fourth step is to import classification report from sklearn.metrics

- To find the classification report
- To print the report

By all these calculation on our data we got to know that ,

- Accuracy score is 93.7 percent
- Confusion matrix is
  array([[887, 28], [35, 50]], dtype=int64)
- Classification report is
  precision recall f1-score support 0.0 0.96 0.97 0.97 915 1.0 0.64 0.59 0.61 85 micro avg 0.94 0.94 0.94 1000 macro avg 0.80 0.78 0.79 1000 weighted avg 0.93 0.94 0.94 1000

```
import pandas as pd
import numpy as np
train_data = pd.read_excel(r"C:\Users\chands1\agri_dataset.xlsx")
test_data = pd.read_excel(r"C:\Users\chands1\agri_test.xlsx")


from sklearn.ensemble import RandomForestClassifier

y = train_data["condition"]

features = ['temp','moisture','humid']
x = pd.get_dummies(train_data[features])
x_test = pd.get_dummies(test_data[features])

model = RandomForestClassifier(n_estimators=100, max_depth=5, random_state=1)
model.fit(x,y)
predictions = model.predict(x_test)

output = pd.DataFrame({'crop': test_data.crop, 'condition': predictions})
output.to_csv('final_agri_data.csv', index=False)
print("Your submission was successfully saved")
```

```
Your submission was successfully saved
```

CHAPTER 8

CONCLUSION

This paper involves establishing a contemporary design technique of monitoring and controlling the moisture level of soil, temperature and humidity using their respective sensors. Providing comprehensive tools that need to build any measurement or control application in dramatically less time. The system is feasible and cost effective for optimizing water resources and power consumption in any small scale agricultural sectors. By implementing Android interface apps in mobile, a user can control the irrigation system remotely. Therefore, the intervention of human is much reduced using this smart irrigation system. With consideration of modern water management and monitoring techniques relying on advanced technologies such as the Internet of Things (IoT), Wireless Sensor Network (WSN) and cloud computing. Advanced energy harvesting technologies, and power-saving techniques should be leveraged for decreasing the sensors energy consumption. Finally, reliable wireless communication modules with low energy consumption must deserve attention. No longer only are farmers able to generally use much less water to grow a crop, they're able to increase growth yields and the satisfactory of the crops by using better management systems which plays vital part in plant growth.

REFERENCES

1. "Green House by using IOT and cloud computing" Sheetal Vatari , Aarti Bakshi , Tanvi Thakur
2. "IoT implementation for indoor vertical farming watering system, Muhammad Ikhwan Hanif bin Ismail , Norashikin M. Thamrin
3. "Optimization of Energy and water Consumption on crop Irrigation using UAVs via Path Design, Carlos Daniel López ,Luis Felipe Giraldo
4. "Intelligent Agriculture and Its Key Technologies Based on Internet of Things Architecture", Jinyu Chen, Ao Yang
5. "Water Management in Agriculture: Current Challenges and Technological Solutions" Abdelmadjid Saad, Abou El Hassan Benyamina, Abdoulaye Gamati