SMART WATER IRRIGATION SYSTEM MODEL
MINOR PROJECT 2
(15B19CI691)

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DECLARATION

We hereby declare that this submission is our own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

We would like to express our special thanks of gratitude to our supervisor “Dr. Neeraj jain”, who gave us a golden opportunity to do this wonderful project of building a Water Irrigation Systems using components of IoT, Who also devoted his precious time in helping us to complete our project within time frame. We came to know about so many new things, We are really thankful to him.

Signature:

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Summary

Proper irrigation management is crucial for prime yields and to avoid stress from excess or inadequacy of water. Determinative once to irrigate isn't a straightforward task. Sometimes this call is predicated on past experiences, weather outlook data (crop evapotranspiration data) or soil-related measurements. Past experiences are probabilistic and are typically not adjusted for annual changes in weather. Irrigation programming supported crop evapo-transpiration are often tough. This will build programming victimization weather based mostly data unsure. Attributable to the shortcomings of those strategies, soil-based irrigation programming is that the most well-liked technique. In soil-based measurements, most typically the soil wet content is monitored. We have studied several work done in this field and aimed our time to perform extensive analysis of those models built earlier, and hence drawn out our conclusions. This is an on-going project. Some preliminary results have been reported here. The purpose of this project is to build a basic model system of water irrigation and integrate this into an advanced model which can be produced and successfully be implemented into a real world.

CHAPTER 1 : INTRODUCTION

1.1 General Introduction:

In recent times, there has been vast developments in the field of agriculture. Considering the importance of this sector which supports nearly 70% of people in India let alone it becomes essential to come up with new advance techniques. In the past, irrigation systems used to be dependent on the mills to irrigate the fields by conventional methods without really knowing the real requirement of the crops. These can cause major problems as the conventional methods can lead to damaging the crops due the lack of adequate amount of water provided. However with recent technological developments, there have been new ways to irrigate the field without the interference of the farmer and also keep the situation in his constant monitoring.

In India, agriculture sector is the largest sector to its economy, but when it comes to technology we find that it is still very deficient. This is because of the high cost it takes then the presently used conventional methods. Now a day's there is huge enhancement in technology which plays a vital impact on various fields like healthcare, education, etc. The problem with Agriculture is that most farmers are unable to afford these technology from big brands due to their large price marks. This result into a devastating fact that most of the irrigation systems are operated manually. This is a risky method as it may give rise to problems of wasting water, over watering, lack of watering. The available techniques that are used for irrigation are drip irrigation and sprinkler irrigation etc. These techniques are to be combined with IoT so that we can eliminate human error and analyze the soil through various sensors and conclude if there is a requirement for watering.

In this project, we have attempted to built a smart irrigation systems using IoT and achieve the desired objectives of this system. The project is facilitated to simplify the irrigation systems by installing the system, and increase crop performance by reducing overwatering from saturated soil. The idea is to eliminate human error by assigning an engine to realize the need of watering and thus preserving water from wasting.

1.2 Problem Statement

Our work basically is focused on eradicating the problems faced by the farmers due to irrigation of the fields. The very job of irrigating the fields faces many problems like lack of rain, over watering which is harmful for the crop, and how to schedule the process of irrigation. To deal with this problem we came across solutions which are unaffordable or very complex for the farmers.

Our main aim was to focus on minimizing the workload and maximizing the crop productivity by building a smart irrigation system which senses data from the surroundings such as soil moisture, humidity and rainfall and decide for itself if the field required to be irrigated or not. With the data collected by the sensors we tried to predict the data using the AR Model, and thus comparing how the surrounding are varied from that predicted.

1.3 Significance of the Problem

Today we hear so many news of farmers committing succeeds due to inefficient help provided by the country. The fact is that their major problems is that they feel that there hard-work is undervalued as they are unable to earn as much as the effort they have put in. Lack of rainfall and water scarcity only contributes more to their problems.

It is sad that even though they contribute nearly 70% to our country's economy we have not provided them with effective equipments to help them. The major reason is that in India IoT is still a very new concept and thus is hard to implement at ground level. In recent years, with a decrease in the cost of internet, there is a hope of light to provide the farmers with a fairly low-cost but an effective system to help them irrigate their fields as per requirements through automatic engine and thus decreasing cost of watering and manpower. By solving this problems we might also be able to change this cycle of wasting water and help prevent water scarcity.

1.4 Comparison of existing approach to the problem framed

In an existing automated water management system we cannot take decision at that instance by taking different attribute of agriculture soil. Current automated irrigation system only works on one parameter at one time. Soil have different attribute like soil moisture and temperature, humidity etc. Soil moisture is below threshold value then water valve is open for water supply and after proper water supply if it goes above threshold value water valve is get close. Existing system does not concern about available water in reservoir and requirement of water to particular crop. So system does not have decision power. It only works on one condition at one time. In the system send the information about the growth of paddy plant and sugarcane in the field.

The data are send details about the every stage in the plant growth in the field. The proposed system consists of three sensors – rain, soil-moisture, and temperature, humidity sensors. All the sensors along with the pump and the relay are connected with the micro-controller. After the sensor read the data from the environment, the microcontroller decides if the pump needs to be set ON/OFF. The data collected are also trained and tested using AR and ARIMA model, which give us an idea of how much the experimental value differ from the value.

CHAPTER 2 :Background Study

Different irrigation systems exist that are used to reduce the dependency on rain and mostly the existing irrigation systems are driven by electrical power and manually ON/OFF scheduling controlled. Farmers usually control the electric motors observing the soil, crop and weather conditions by visiting the sites. These manually controlled irrigation systems cannot ensure a proper level of water in the site. Due to the lack of electricity and mismanagement in the manually controlling systems, sometimes their fields become dry and sometimes flooded with excess water. These unplanned and manually controlled irrigation systems also cause a significant amount of water waste.

Recent technological advances have paved the way for developing and offering advanced services for the stakeholders in the agricultural sector. A paradigm shift is underway from proprietary and monolithic tools to Internet-based, cloud hosted, open systems that will enable more effective collaboration between stakeholders. This new paradigm includes the technological support of application developers to create specialized services that will seamlessly interoperate, thus creating a sophisticated and customizable working environment.

Automatic irrigation system is usually designed for ensuring the proper level of water for growing up the plants all through the season. Even when the farmers are away, these automatic irrigation systems would ensure the proper level of water in the sites. In addition, it provides maximum water usage efficiency by monitoring soil moistures at optimum level. The smart irrigation control technology considers all the aspects of plants related to water irrigation.

CHAPTER 3 : REQUIREMENT ANALYSIS AND SOLUTION APPROACH

3.1 Hardware Tools

3.1.1 Soil Sensor :

The soil moisture sensor is a simple device for measuring the moisture level in soil and similar materials. The soil moisture sensor is straight forward to use. The two large exposed pads function as probes for the sensor, together acting as a variable resistor. The more water that is in the soil or any other material means the better the conductivity between the pads will be and will result in a lower resistance, and a higher SIG out. To get the soil moisture sensor functioning we need to connect the VCC and GND pins to your Arduino-based device and you will receive SIG out which will depend on the amount of water in the soil [1].

3.1.2 DHT-11 Sensor :

The DHT11 is a commonly used Temperature and humidity sensor. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers. The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and ±1%. So if you are looking to measure in this range then this sensor might be the right choice for you. The sensor will come as a 4-pin package out of which only three pins will be used whereas the module will come with three pins [2].

3.1.3 Rain Sensor :

The rain sensor module is an easy tool for rain detection. It can be used as a switch when raindrop falls through the raining board and also for measuring rainfall intensity. The module features, a rain board and the control board that is separate for more convenience, power indicator LED and an adjustable sensitivity though a potentiometer. The analog output is used in detection of drops in the amount of rainfall. Connected to 5V power supply, the LED will turn on when induction board has no rain drop, and DO output is high. When dropping a little amount water, DO output is low, the switch indicator will turn on. Brush off the water droplets, and when restored to the initial state, outputs high level [3].

3.1.4 Arduino :

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. (Figure 4)

3.1.5 Relay Module :

A relay is an electrically operated switch that can be turned on or off, letting the current go through or not, and can be controlled with low voltages, like the 5V provided by the Arduino pins. Controlling a relay module with the Arduino is as simple as controlling any other output as we'll see later on. (Figure 5)

3.1.6 Wifi Module :

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor [4].

3.1.7 LCD Display :

An LCD is an electronic display module which uses liquid crystal to produce a visible image. The 16×2 LCD display is a very basic module commonly used in DIYs and circuits. The 16×2 translates o a display 16 characters per line in 2 such lines. In this LCD each character is displayed in a 5×7 pixel matrix [5].

3.1.8 Electric Motor :

An electric motor is an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and electric current in a wire winding to generate force in the form of rotation of a shaft. Electric motors can be powered by direct current (DC) sources, such as from batteries, motor vehicles or rectifiers, or by alternating current (AC) sources, such as a power grid, inverters or electrical generators.

3.2 Solution Approach :

In the proposed irrigation system Arduino UNO plays a major role. The purpose of the IoT in this system is, it has to share the data to the users. Thus the IoT server is connected with the Wi-Fi module. The information of the soil is transmitted to the Wi-Fi network through the signal conditioning circuit of the various sensors. The Arduino is the open source IoT server through which the signal is shared to the user. The physical information of the soil such as soil moisture, humidity, temperature are send to the Wi-Fi, then it is shared to the user using

IoT. The height of the crops and information of the plant is also shared to the user personal computer with internet connection or smart phone. This prototype monitors the amount of soil moisture and temperature. A predefined range of soil moisture and temperature is set, and can be varied with soil type or crop type. In case the moisture or temperature of the soil deviates from the specified range, the watering system is turned on/off. In case of dry soil and high soil temperature, it will activate the irrigation system, pumping water for watering the plants. It consists of a microcontroller which is the brain of the system. Both the moisture and temperature sensors are connected to the input pins of the controller. The water pump and the servo motor are coupled with the output pins. If the sensors depart from the predefined range, the controller turns on the pump. The servo motor is used to control the angular position of the pipe, which ensures equal distribution of water to the soil. An LED indicator indicates the status of the pump. This system can be implemented on a large scale for farming purposes, which can further prove to be more advantageous. Owing to prevailing conditions and water shortages, the optimum irrigation schedules should be determined especially in farms to conserve water.

3.3 Gantt chart:

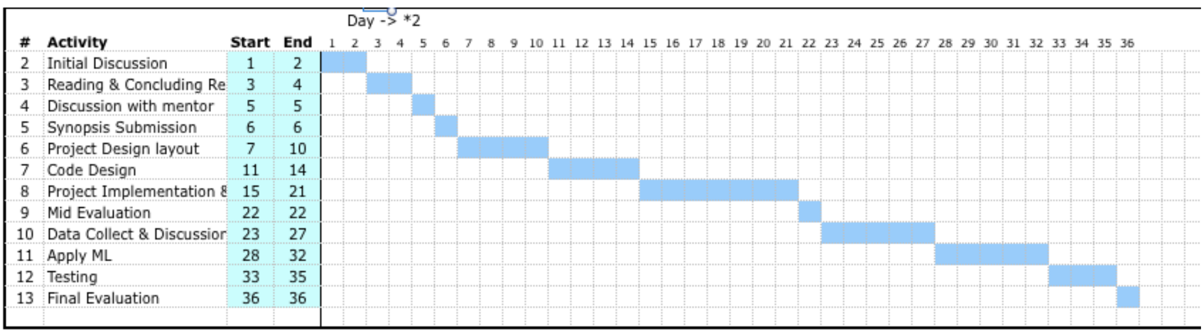


Figure 1: Gantt Chart

3.4 Flow Chart Diagram:

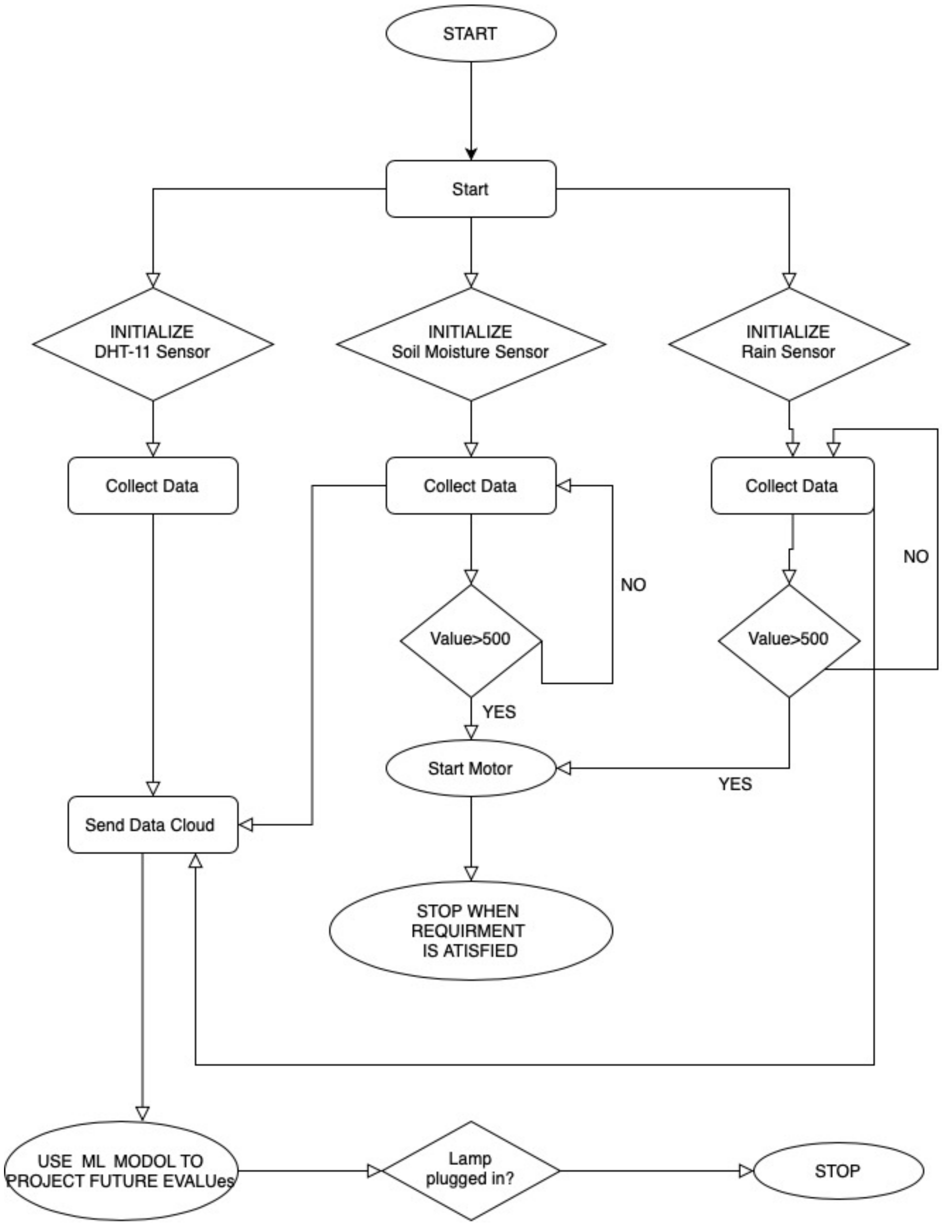


Figure 2: Flow Chart

3.5 Block Diagram:

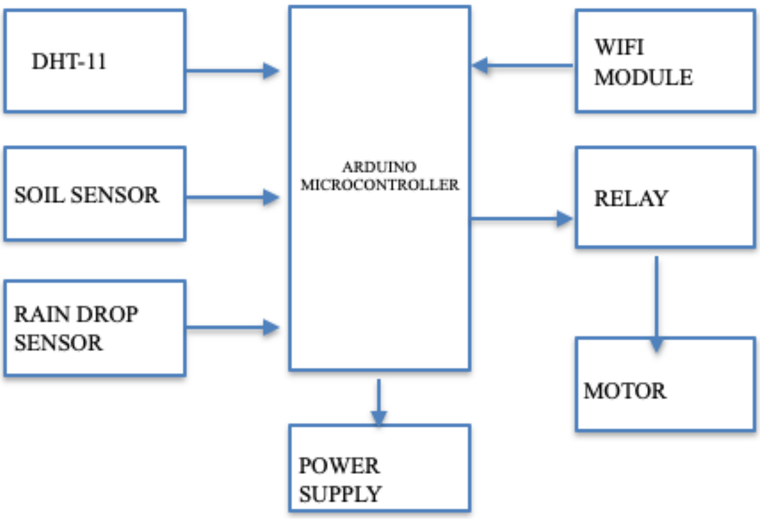


Figure 3: Block Diagram of System

3.6 ThinkSpeak Data Graph (Cloud Data):

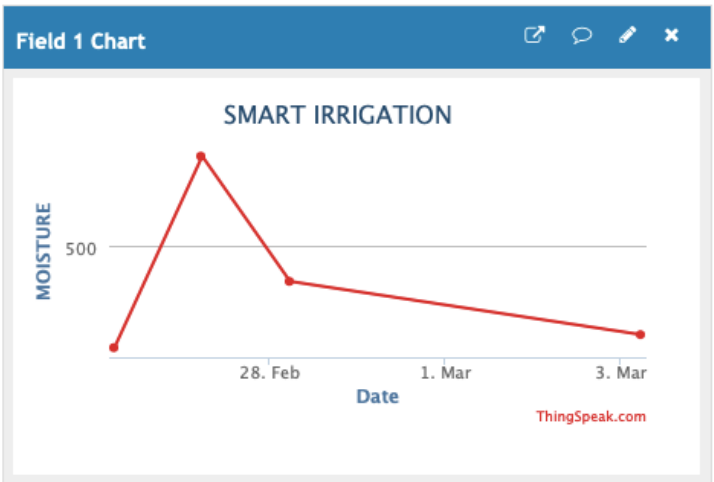


Figure 4.1: Moisture

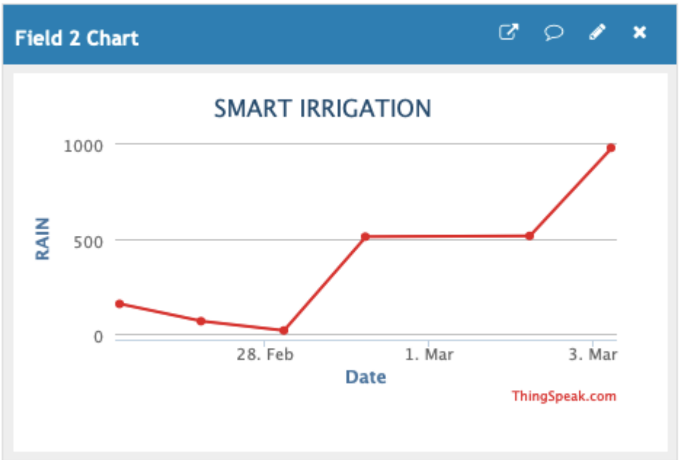


Figure 4.2: Rain

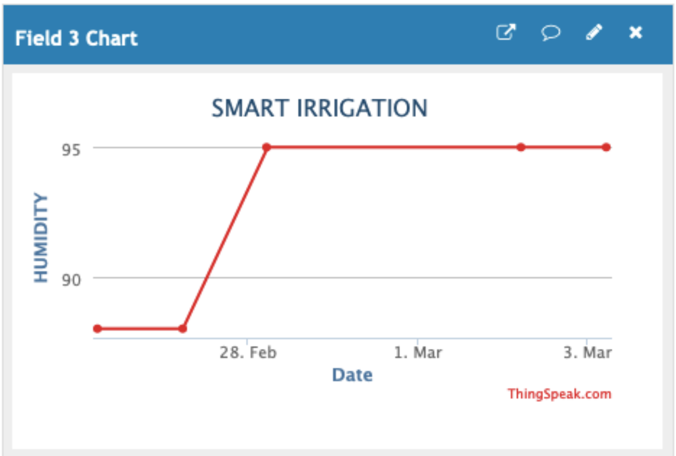


Figure 4.3: Humidity

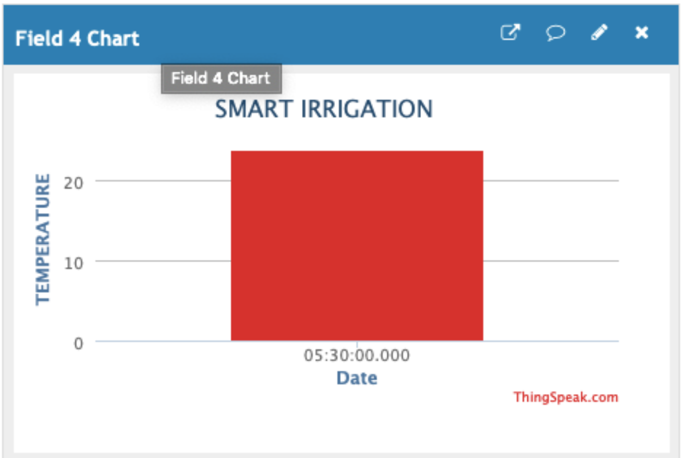


Figure 4: Temperature

3.7 Water Irrigation System Model:

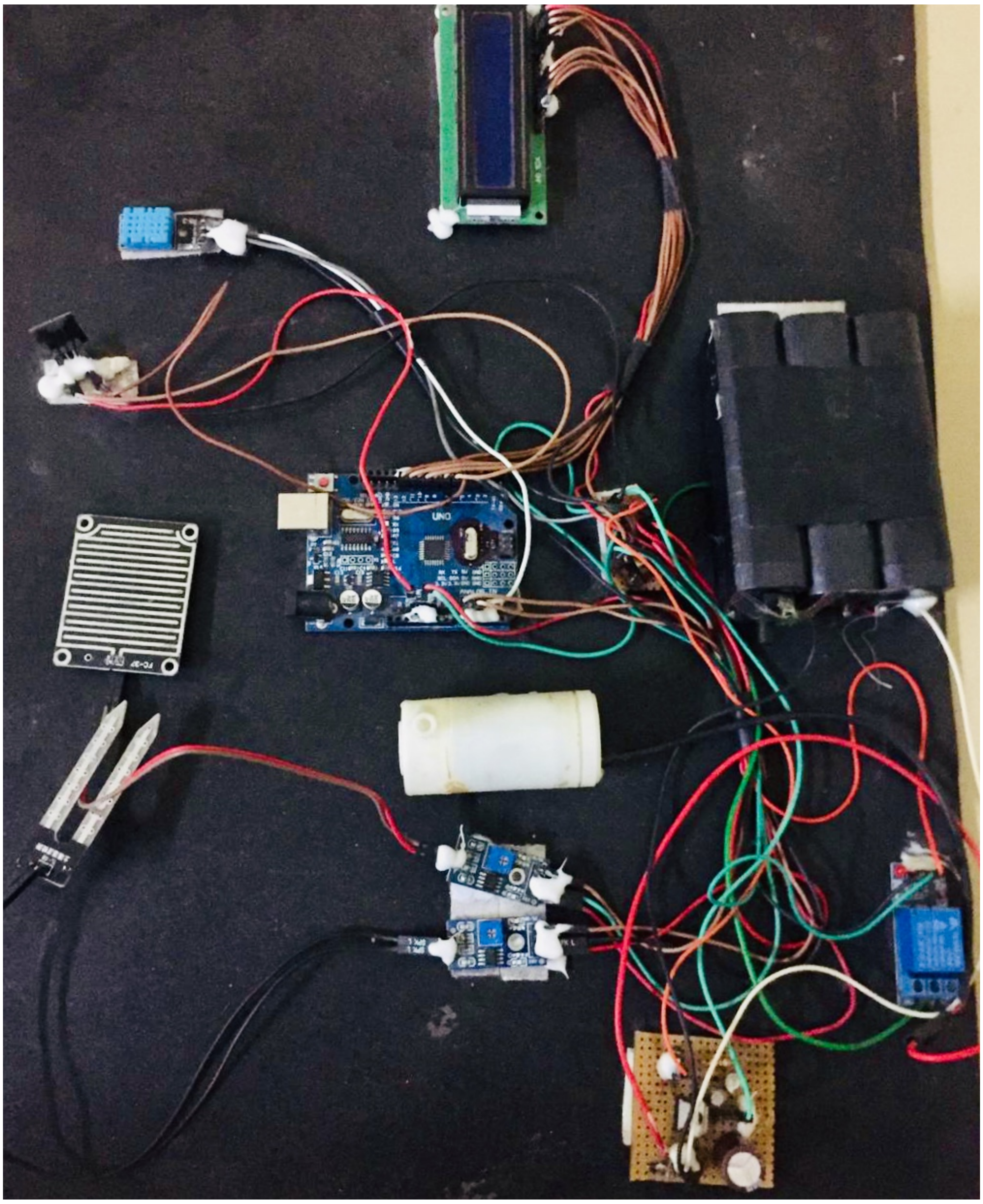


Figure 5: Water Irrigation Model

CHAPTER 4: APPLYING MACHINE LEARNING TECHNIQUE

We use Machine Learning to build a future soil Moisture prediction Model. These ML technique are the best recognition method of learning model.

4.1 Reason to choose KNN, SVM & Logistic regression with LLE for Smart Water Irrigation System Model:

- These models are capable of producing accurate and robust classification results, even when input data are non-monotone and non-linearly separable. So they can help to evaluate more relevant information in a convenient way.
- By properly setting the value of C-regularisation parameter one can easily suppress the outliers and hence they are robust to noise.
- A key feature of SVM is that it automatically identifies and incorporates support vectors during the training process and prevents the influence of the non-support vectors over the model. This causes the model to cope well with noisy conditions.
- With some key actual training vectors embedded in the models as support vectors, the SVM has the potential to trace back historical events so that future predictions can be improved with the lessons learnt from the past.
- Input vectors of SVM are quite flexible; hence various other influential factors (such as temperature, relative humidity, and wind speed) can be easily incorporated into the model.

4.2 Data Preprocessing:

- Missing Data.
  Data contains rows in which one or more column data is missing so we can do is we can take the average of all the values in that column and find mean and put it at missing place & removing the surd data int the data set.
- Categorical data
  Columns can be divided into categories like Rain, Humidity, Temperature and Moisture data can be categorised acc to value This will help to filter data and categorisation.

- Feature Scaling.
  we see that in our dataset some columns may have higher values and some lower. since Machine Learning models are based on Euclidean distances. So we need to do feature scaling so that all values in the dataset come to the same scale.

	Rain	Soli Moisture	Air Humidity	Temp
0	1023	1017	86	25
1	1023	1017	86	25
2	1023	1017	86	25
3	1023	1017	86	25
4	1023	1017	85	25
...	...	...	...	...
526	667	1021	94	28
527	667	1021	94	28
528	672	1021	94	28
529	1015	1021	94	28
530	1019	1021	94	28

Figure 6: Importing Data Set

4.3. Machine learning technique:

a. K Nearest Neighbour (KNN) :

- We are developing an intelligent IoT based automated irrigation system where the temperature and moisture sensors deployed in field communicates.
- Machine learning algorithm called KNN (K Nearest Neighbors) classificatio which takes the soil moisture and temperature into consideration.
- The KNN (K-Nearest Neighbors) algorithm is the most fundamental and simples classification technique where little or prior knowledge about the distribution of data is needed.
- Machine learning algorithm called KNN (K Nearest Neighbors) classification which takes the soil moisture and temperature into consideration.
- The current accuracy rate of the implemented algorithm o the dataset is 67% (approx).

• The KNN (K-Nearest Neighbors) algorithm is the most fundamental and simplest classification technique where little or prior knowledge about the distribution ofdata is needed.

```
>Predicted= '25', actual= '25'
>Predicted= '25', actual= '25'
>Predicted= '25', actual= '25'
>Predicted= '25', actual= '25'
>Predicted= '25', actual= '28'
>Predicted= '25', actual= '25'
>Predicted= '25', actual= '25'
>Predicted= '25', actual= '25'
>Predicted= '25', actual= '25'
>Predicted= '25', actual= '25'
>Predicted= '25', actual= '25'
>Predicted= '25', actual= '25'
>Predicted= '25', actual= '25'
>Predicted= '25', actual= '25'
>Predicted= '25', actual= '25'
>Predicted= '25', actual= '25'
>Predicted= '25', actual= '25'
>Predicted= '25', actual= '25'
Accuracy: 66.66666666666666%
```

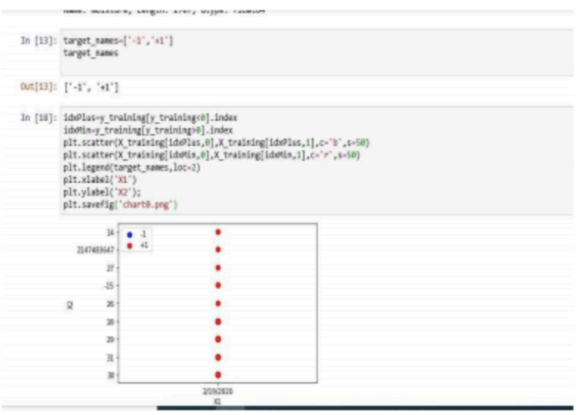
Figure 7: Result & accuracy rate of implemented algorithm

b. <u>Support Vector Machine (SVM) :</u>

• Irrigation is one of the most important agricultural work, since the amount of water needed for irrigation depends on many different factors like humidity, temperature, soil moisture etc.

• We propose a Support Vector Machine (SVM) based irrigation prediction control system.

• The goal of our system is enabling suitable irrigation automatically using SVM based model.



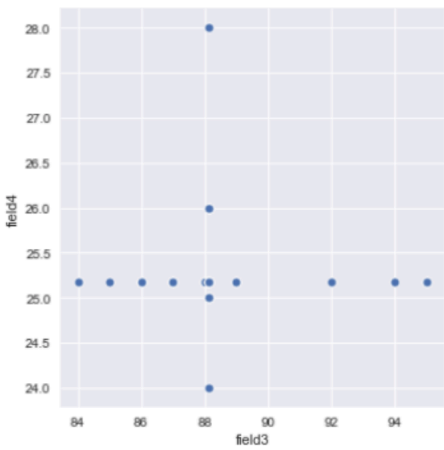


Figure 9: Result of SVM image(1)

Figure 8 :Result of SVM img(2)

c. Logistic regression with LLE:

- Logistic regression is a supervised classification algorithm.
- In a classification problem, we propose Logistic regression based irrigation prediction control system..
- Logistic Regression is used when the dependent variable (target) is categorical.

```
[ ]  y_pred

array([[25.21186304],
       [25.17577434],
       [25.17577434],
       [25.59045594],
       [26.52822675],
       [26.559078  ],
       [25.88740457],
       [25.88740457],
       [26.59507932],
       [26.58684904],
       [26.59582753],
       [26.49033029],
       [26.59433111],
       [26.45366814],
       [25.99440545],
       [26.57936697],
       [26.59208649],
       [26.58610083],
       [26.46115021],
```

Figure 10: Result Logistic Regression

Table 1: Accuracy

Machine Learning Technique	Logistic Regression	K Nearest neighbour (KNN)	Support Vector Machine (SVM)
Accuracy	76.46%	66.66%	78.88%

CHAPTER 5 : CONCLUSION

5.1 Conclusion:

The automated irrigation system has been designed and implemented in this paper. The system developed is beneficial and works in cost effective manner. It reduces the water consumption to a greater extent. It needs minimal maintenance .The power consumption has been reduced very much. The system can be used in green houses. The System is very useful in areas where water scarcity is major problem .The crop productivity increases and the wastage of crops is very much reduced using this irrigation system. The developed system is more helpful and gives more feasible results.

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