IoT Based Soil Analysis and crop Recommendation system using Machine Learning

Mohan Raj[1]
[1]Associate Professor
Department Of Information Technology,
Velammal Engineering College,
Chennai, Tamil Nadu, India.

Manishma S[2], Rashmi P[2]
[2]Student, Velammal Engineering College, Chennai, Tamilnadu, India.

ABSTRACT

India is a country that has Agriculture as the backbone of the economy. More than 58% of the population has Agriculture as the primary source of income. There are almost 100-150 million farmers in the mother nation. Seeking the dark part of this sector is that many face losses due to climatic and soil conditions. Many crops die before harvest due to scarcity of water and soil nutrients. Here is a paper that guides the farmer on what crop to cultivate based on the forecast report of climate and the present soil conditions. The climatic condition is identified, moisture content present in the soil is detected and the Ph level of water is also considered for crop recommendation. The sensed data from the sensors are fed into the machine learning algorithm which suggests a suitable crop for cultivation. We also predict the crop yield that can be produced under given circumstances. The concept of this paper takes the uncertainty of weather and soil conditions and gives the farmer a clear picture of the crop field and the climate.

Keywords— Iot, LCD, KNN, SVM, IDE

I. INTRODUCTION

Agriculture is that the backbone of each economy. in an exceedingly country like India, which has ever increasing demand of food thanks to rising population, advances in agriculture sector are required to fulfill the wants. From ancient period, agriculture is taken into account because the main and therefore the foremost culture practiced in India. Ancient people cultivate the crops in their own land and then they need been accommodated to their needs. Therefore, the natural crops are cultivated and are employed by many creatures like kith and kin, animals and birds. The greenish goods produced within the land which are taken by the creature ends up in a healthy and welfare life. Since the invention of latest innovative technologies and techniques the agriculture field is slowly degrading. thanks to these, abundant invention people are been targeting cultivating artificial products that's hybrid products where there results in an unhealthy life. Nowadays, modern people don't have awareness about the cultivation of the crops in an exceedingly right time and at a right place. due to these cultivating techniques the seasonal atmospheric condition also are being changed against the basic assets like soil, water and air which cause in security of food. Many crops die before harvest thanks to scarcity of water and soil nutrients. Here may be a paper that guides the farmer on what crop to cultivate supported the forecast report of climate and therefore the present soil conditions. The climatic condition is identified, moisture content present in 2 the soil is detected and Ph level of water is additionally considered for crop recommendation. The sensed data from the sensors are fed into the machine learning algorithm which suggests an acceptable crop for cultivation. We also predict the crop yield which will be produced under given circumstances. This paper takes the uncertainty of weather and soil conditions and provides the farmer a transparent picture of the crop field and therefore the climate.

The most aim of this paper is to recommend the appropriate crop and predict the yield predication of the sector, within the different kind of soil and weather. The system aims to recommend the foremost accurate crop supported weather, moisture content present within the soil and ph level of the water led for irrigation. The soil parameters are precisely analyzed and led into machine learning model to recommend crop. the identical parameters also are led into other machine learning model to predict the possible yield percentage of the sector.

II. LITERATURE SURVEY

Sonika R,"Automatic Soil Nutrients and crop Detection Management using IOT", IJIRST,2021. In this paper the soil parameters are analyzed using respective sensors and the suitable crop is recommended based on the cloud database and the present soil condition.

Rahul BV,"Monitoring the soil Parameters using Iot and Android Based Application for Smart Agriculture", IEEE, 2021. This paper states that Precision farming is used to maintain the productivity of crops and increase the yield rate of production. The data collected from the field area is fed into a prediction framework for obtaining suggestion. The existing prediction and monitoring methods for crop selection and changing climatic conditions can be addressed. The proposed system helps in overcoming the drawbacks found in the existing system by increasing the yield of crops, real-time analysis of crops using IOT, selecting efficient parameters, making smarter decisions and getting better yield.

Ramya S,"IOT Framework for Smart Farming using Machine Learning Technique",IJRMST, 2020. In this paper, to increase crop yields, IoT based soil monitoring systems are used, which provide the necessary information to the farmers remotely. The system uses sensors to monitor soil parameters and provides useful inference about the recommendation of crops, fertilizer, and so on in the field.

R Madhumathi,"Soil NPK and Moisture analysis using Wireless Sensor Networks", IEEE, 2020. In this paper a Suitable crop for particular land is predicted by considering parameters such as Nature of soil, Humidity, light, Soil moisture and market demand. End User can select one of the crops and gives his input via SMS.

Niizar Ali Alhaj Abdellah,"Real Time Application of Iot for the Agriculture in the Field along with Machine Learning Algorithm", IEEE, 2020. This research paper proposes a sensor-driven AI-based agriculture recommendation model for assessing land suitability. The model is trained using sensors and neural networks and uses Multi-Layer Perceptron to classify land in four decision classes.

Smita Pawar,"Design of an IoT enabled Automated Hydroponics System using NodeMCV and Blynk",IEEE, 2019. In this paper a soil health monitoring system is proposed in which farmer can monitor soil moisture, soil temperature and soil pH in his android smart-phone and get recommendations of lime and Sulphur based on the pH of the soil.

Dr. R Kezia Rani,"A Novel IOT Based Solution for Agriculture Field Monitoring and Crop Prediction Using Machine Learning", IJIRST, 2019. This paper explains that Farmers in India still use primitive and old ways to grow their crops, especially paddy. To increase their paddy yield, they need to utilize modern technology that will not only reduce their dependency on weather conditions and manual labor but also increase their yield.

Setia Gumilar,"Real-Time Monitoring System for Measurement of soil Fertility Parameters, Susanto Nugarha", IEEE, 2019. In this paper they have used IOT technology using which the farmers can monitor weather, moisture, temperature and fertility of soil, detect weed, level of water, pest detection, animal intrusion in to the field, and control and automate farm processes.

Suhas Athani,"Soil Moisture monitoring using IoT enabled arduino sensors with neural networks for improving soil management for farmers and predict seasonal rainfall for planning future harvest in North Karnataka-India",IEEE, 2017. In today's world, IoT allows objects to be sensed or remotely controlled through other existing networks. This paper proposes a demand based crop recommender system for farmers can help farmers produce suitable crops and improve their lifestyles.

M.K.Gayathri, J.Jayasakthi, Dr.G.S.Anandhamala, "Providing Smart Agriculture Solutions to Farmers for Better Yield using IOT",IEEE, 2015. This paper presents a system for soil monitoring and irrigation that helps farmers to increase their agricultural production by analyzing past data patterns. The system sends the soil values to the field manager, who can then suggest the appropriate crop to grow.

II. METHODOLOGY

The Figure below explains the system architecture diagram of the proposed work. The soil parameters are analyzed first to recommend a suitable crop. The soil moisture sensor senses the moisture content present in the soil. Ph sensor senses the Ph level of the water that irrigates the field. Temperature and Humidity sensor together gives the temperature. The Arduino UNO fetches the data from the sensors and displays it to the user. The sensor data (Soil Moisture, Water Ph level and temperature) is given into the machine learning model (Rain forest). The machine learning predicts the suitable crop based on the given parameters. The same sensors data are given into another machine learning model (Rain forest) for crop yield prediction by that field under given circumstances.

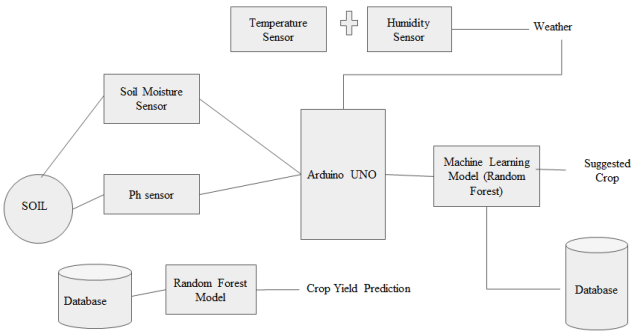

Fig 1 System Architecture

There are 5 modules in the system.

1. Weather Module

Dht11 sensor is employed here to observe the humidity variation of the environment where the crops are cultivated. This digital sensor measures the humidity value during a percentage format.

Fig 2 DHT11 Sensor

2. Soil Moisture Prediction

The moisture sensor detects the wetness or dryness of the soil. supported the dryness value of the soil the controller controls the pump. The Moisture Sensor is employed to live the water content (moisture) of soil. When the soil features a water shortage, the module output is at a high level, else the output is at an occasional level.

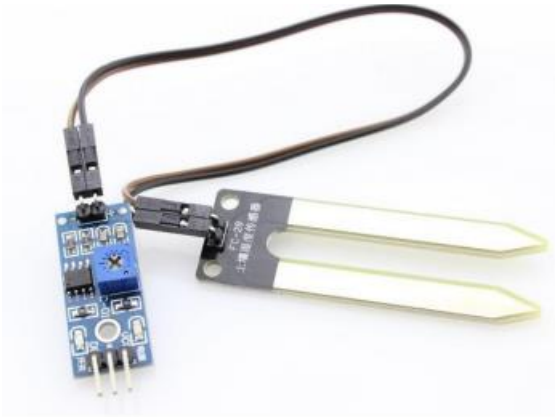

Figure 3 Soil Moisture Sensor

3. Water Ph prediction

The ph sensor predicts the worth of water ph starting from 0-7.

4. Crop recommendation system

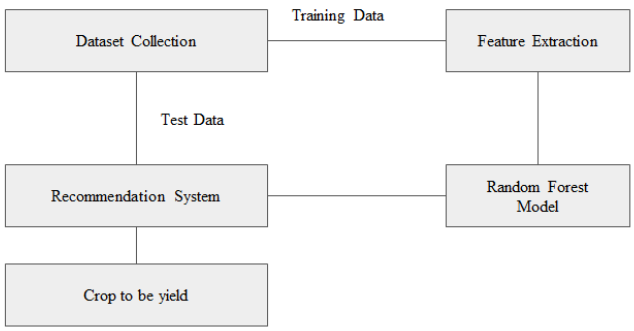

Fig 4 Block Diagram of Crop recommendation system

The dataset contains N, P, K, Temperature, Humidity, ph, Soil Moisture, and therefore the crop which will be sown. during this dataset N, P, K, temperature, humidity, ph, and Soil Moisture are considered as features. The label is taken into account the target or the output value. the full dataset is split into train data and test data within the ratio of 0.2. The training data is fed into various machine learning models like Decision Tree, Gaussian Naïve Bayes, Support Vector Machine Random Forest, and K-Nearest Neighbour Algorithm. A comparative study is undergone on the accuracy of the listed algorithms.

```
Decision Tree --> 0.9
Naive Bayes --> 0.990909090909091
SVM --> 0.9772727272727273
RF --> 0.9931818181818182
KNN --> 0.9659090909090909
```

Fig 5 Accuracy of various Machine learning models

The Accuracy Score of the Random Forest Model **seems** to be high.

5. Crop yield prediction

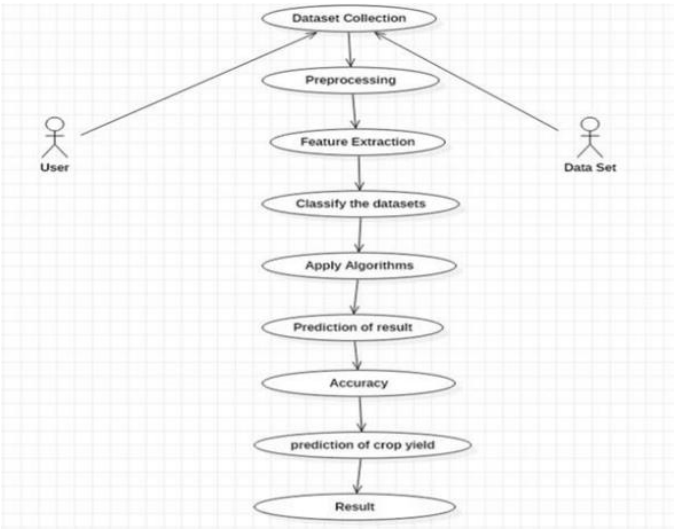

Fig 6 Crop yield prediction system

The dataset contains soil moisture, rainfall, and temperature. Supported the soil type and its parameters, the soil condition is categorized as Excellent, good, and poor. Supported some mathematical calculations and comparisons the ultimate yield is about and this value is stored within the output column final yield. the ultimate yield is taken into

account the target value and therefore the other columns are considered the input features. the ultimate dataset is split into test data and train data within the ratio of 0.3. The training data is passed into the Random Forest algorithm and therefore the final yield of test data is predicted. The model is made with an accuracy of 99.58%.

The hardware module and also the software module are connected through the interface.

Follow the steps below to attach the software and hardware module.

• Open Arduino IDE with the module ASCII text file.

• Navigate into Tools and choose ports.

• Select the port during which you connected the hardware module. during this case, we've connected through the COM7 port.

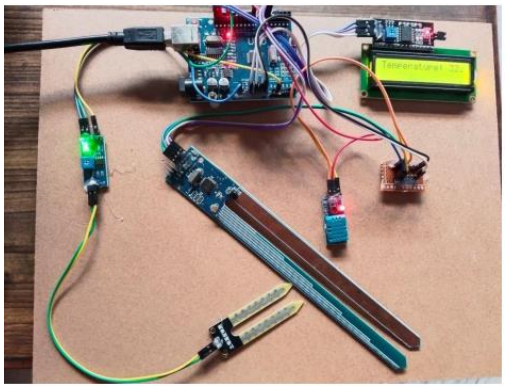

Fig 7 Connected hardware and software module

V. RESULT, CONCLUSION AND FUTURESCOPE

Immerse the soil moisture sensor in soil and ph sensor in water. The readings will be shown in the LCD display

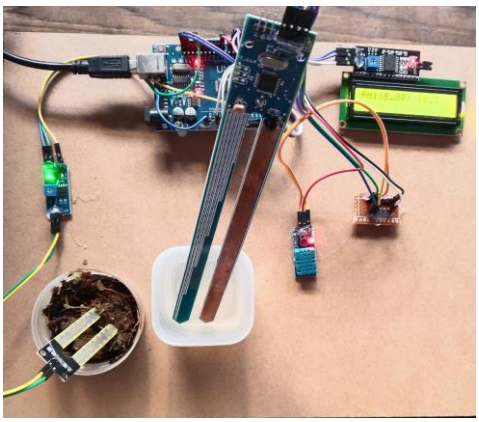

Fig 8 Placing sensors for capturing output

The Temperature sensor reading shown in LCD display for the given sample of soil.

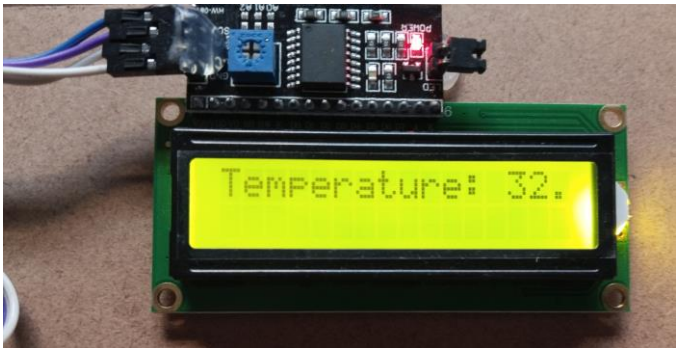

Fig 9 Temperature captured

The soil moisture sensor reading shown on LCD display for the given sample of soil.

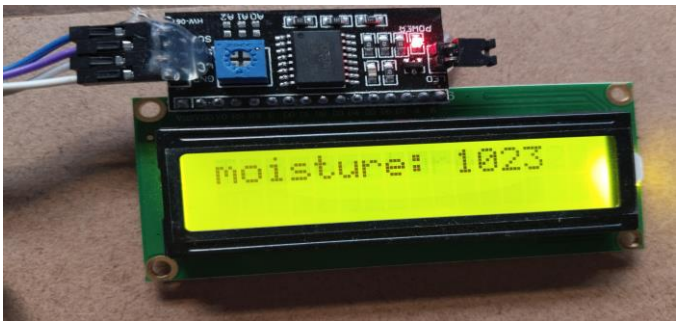

Fig 10 Moisture captured

The ph value shown in LCD display for the given sample of water.

Fig 11 Ph value captured

The output from Soil Moisture Sensor, Ph Sensor and Temperature Humidity Sensor is passed to Arduino IDE and displayed.

```
Humidity61.0
moisture: 1023
PH: 7.90
Temperature: 32.00
```

Fig 12 Output Displayed in Arduino IDE

Recommended crop:

The temperature, humidity, pH and soil moisture is given as input by the user. (The values inputted are the values captured by the sensor). The NPK value is taken as average for this project. We can also do a manual testing to detect NPK using a NPK kit. We prefer NPK kit because NPK sensors are costly.

.

```
temp=float(input("Enter the temperature:"))
hum=float(input("Enter the humidity:"))
ph=float(input("Enter the ph value:"))
mois=float(input("Enter the Soil Moisture"))
```

```
Enter the temperature:32
Enter the humidity:61
Enter the ph value:7.90
Enter the Soil Moisture102.3
```

```
#['N', 'P', 'K', 'temperature', 'humidity', 'ph', 'soil moisture']
data = np.array([[57,49,42,temp,hum,ph,mois]])
prediction = RF.predict(data)
print(prediction)
```

```
['jute']
```

Fig 13 Crop recommended

Crop yield predicted :

```
test_vector = np.reshape(np.asarray([12.737998,0.026821,61,56,70,42,1.0,0.0,0.0,0.0,0.0,0.0]),(1,11))
p = int(rf.predict(test_vector)[0])
yield_list = ['20-30%','30-40%','50%','60-70%','80-100%']
print (yield_list[p])
```

```
80-100%
```

Fig 14 Crop yield predicted

The results show that we are able to attain an accurate crop that may be sown using the Rain forest algorithm. The yield that may be produced by the sector is additionally predicted using the Random Forest algorithm. The Random Forest algorithm achieves the simplest accuracy compared to other modules in recommending the simplest crop for the sector. The Random Forest algorithm achieves the biggest number of crop yield models with very cheap models. it's suitable for large crop yield prediction in agricultural planning. The soil parameters are analyzed using respective sensors and supported that the crop is usually recommended and crop yield is predicted. This makes the farmers take the correct decision for the correct crop specified the agricultural sector are developed with innovative ideas.

During this paper, we've recommended a crop and the predicted yield of the sector supported soil parameters. Within the future, we are able to develop an internet site or app that the farmer can use to look at the soil parameters and crop recommended, the estimated yield of his field. we are able to train the models of the crop recommendation system and crop yield predicted system using more real-time sensor data.

VI. REFERENCES

[1] Sonika R,"Automatic Soil Nutrients and crop Detection Management using IOT", IJIRST,2021.

[2] Rahul BV,"Monitoring the soil Parameters using Iot and Android Based Application for Smart Agriculture", IEEE, 2021 .

[3] Ramya S,"IOT Framework for Smart Farming using Machine Learning Technique",IJRMST, 2020.

[4] R Madhumathi,"Soil NPK and Moisture analysis using Wireless Sensor Networks", IEEE, 2020.

[5] Niizar Ali Alhaj Abdellah,"Real Time Application ofIot forthe Agriculture in the Field along with Machine Learning Algorithm", IEEE, 2020.

[6] Smita Pawar,"Design of an IoT enabled Automated Hydroponics System using NodeMCV and Blynk",IEEE, 2019.

[7] Dr. R Kezia Rani,"A Novel IOT Based Solution for Agriculture Field Monitoring and Crop Prediction Using Machine Learning", IJIRST, 2019.

[8] Setia Gumilar,"Real-Time Monitoring System for Measurement ofsoil Fertility Parameters, Susanto Nugarha", IEEE, 2019.

[9] Suhas Athani,"Soil Moisture monitoring using IoT enabled arduino sensors with neural networks for improving soil management forfarmers and predict seasonal rainfall for planning future harvest in North KarnatakaIndia",IEEE, 2017.

[10] M.K.Gayathri, J.Jayasakthi, Dr.G.S.Anandhamala, "Providing Smart Agriculture Solutions to Farmers forBetter Yield using IOT",IEEE, 2015.