# Soil Analysis And Crop Selection Using IoT

**K. Spandana, T. Manoj Kumar, Suresh Pabboju**

**Abstract:** In Indian economy, agriculture plays major role. Irrigation is essential factor in farming, as unpredictable monsoon rainfalls. Different type of crops needs different type of soils and amount of water. The amount of water required by plant is also dependent on the climate where it is being grown. By selecting the right crop for the given soil and climate conditions, one can optimize his yields and save water requirements for irrigation. Internet of Things (IoT) will rebuild the agriculture to enable farmers with wide range of methods for sustainable development. This paper presents how to analyze the crop field and provide results to the farm owner and help him get connected to the farm with the help of Sensor technology.

**Index Terms:** Internet of Things (IoT), Sensor Technology, Smart Agriculture, Soil Quality, Water Quality, KNN.

## 1 INTRODUCTION

In India farming is done using the routine ways. The fact is that the majority of our farmers need proper knowledge to make it perfect even if it is more unpredictable. A large fraction of farming and agricultural behavior is based on the presages. Farmers have to tolerate huge losses if they follow traditional methods. Since we know the advantages of appropriate soil moisture and its quality, air quality and irrigation, in the enlargement of crops, these parameters shouldn't be ignored.

There are several IoT applications in farming such as data collection on temperature, precipitation, humidity, wind speed, pest invasion, and soil moisture content. The collected data is used to automate farming methods. Farmer has to follow decisions given by the IoT system to improve quality and quantity, diminish risk and waste of water, and reduce effort required to administer crops. This work will help to the farmers to get connected to their farm anywhere and anytime. To monitor and automate the farm process we can use wireless sensor networks and IoT devices. Farmer can use smart phone to know updated farm conditions made by the IoT system through mobile app. The main objective that will be focused on in this work is to select suitable crop for the particular field. There are several tools have been developed for collecting data on temperature, precipitation, humidity, wind speed, and soil moisture content. Collected data can be used to choose the crop suitable for the field.

## 2 LITERATURE SURVEY

"IoT is an intelligent technology which includes identification, sensing and intelligence". Intelligence of life itself can also be considered as part of IoT technology. This technology is used in pattern recognition field like computing, measurement, communication, collecting information, and processing[2] . IoT not definition changes if the cloud computing includes. It is defined as "IoT=cloud computing + ubiquitous network + intelligent sensing network". Brain of the cloud computing is "Cloud computing management platform".

It involves organizing of cloud computing customization application by consumers of this IoT, computing and processing what is involved in customization service; managing and coordinating nodes in the data center [8]. While World is looking for smart agriculture, it is important While world agriculture is undergoing industrialization, it is important to build up agricultural information at the same time. Agricultural information has become the tendency of expansion for world agriculture. As far as China's agricultural development, "agricultural information is a most important force promoting agricultural development and transformation and a corner stone for maintaining sound and 5 sustaining economic development". In recent years, they have been focusing on agricultural information service and infrastructure development. After years of hard efforts, notable consequences have been seen in agricultural infrastructure development, like "Every Village" project of Ministry of Industry and Information, "Golden Agriculture project" and "Three Dian Project" of Ministry of Agriculture. However, in China's agricultural information problems are still exist. For example, we put more prominence on hardware than software and cannot offer high quality information to meet production needs of farmers. Moreover, information is not adequately used by farmers [3].

## 3 METHODOLOGY

Over the decades, people tried various methodologies in the field of agriculture. In this era of technology, modern agricultural methods are evolving rapidly. It has become a necessity to adopt newer techniques to cater to the needs of the growing population. The Proposed System extends the existing system by augmenting new techniques to the previously available plan of work. The hardware consists of NodeMCU, soil moisture sensor, temperature and humidity sensor, pH sensor, current amplifier and Mail. The sensors are plugged at different locations in the field for data acquisition.


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They check the different parameters like moisture content, temperature, humidity and alkalinity of the soil. The data collected from the sensors are stored in the data base later they send to the web app and the crop is predicted using KNN algorithm , predicted crop i.e,. the result is sent to the farmer through the mail.

### 3.1 DESIGN OF THE PROPOSED SYSTEM

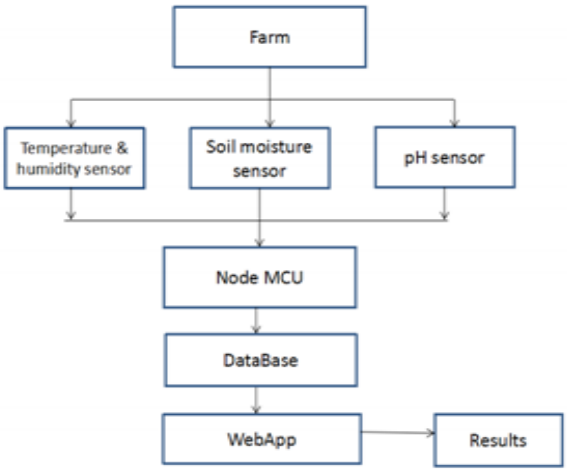


***Fig 3.1**: Block Diagram*

The above block diagram gives brief description about the work. All the sensors which are connected to the node MCU(ESP8266) will be inserted in the farm. The sensors that are used in the project are soil moisture sensor, temperature and humidity sensor (DHT11) and pH sensor. Node MCU(ESP8266) retrieves data from the sensors and sends to database using Arduino IDE. Later live values will be retrieved from the 10 database through web application and performs KNN classification. Once the crop is predicted, the result is sent to the farmer through java mail API.

### 3.2 ALGORITHM

The training patterns are vectors in a multidimensional characteristic space, each with a class label. The algorithm consists of storing feature vectors and class labels of the samples in training phase. " k is user defined constant" and "an unlabeled vector is classified by assigning the label which is most frequent among the k training samples nearest to that query point" in classification phase. Euclidean distance is commonly used distance metric. Hamming distance is used for discrete variables. KNN has also been employed with "correlation coefficients such as Pearson and Spearman" . Often, "the classification accuracy of KNN can be improved significantly if the distance metric is learned with specialized algorithms such as large margin nearest neighbor". Let m be the number of training data samples. Let p be an unknown point.

1. In an array of data points arr[] store the training samples. Means every element of this array represents a tuple (x, y).
2. For i=0 to m: Calculate Euclidean distance d(arr[i],p)
3. Make set S of K smallest distances obtained. Each of these distances corresponds to an already classified data point.
4. Return the majority label among S.

## 4 EXPERIMENTAL RESULTS

### 4.1 ADMIN PAGE

Here, the admin will login with the unique user name and password and monitor the readings of the crop and send the predicted crop to the farmer using respected mail id's. Once we click on the login button it will redirect to other web page which includes view dataset, live values, Home etc.

### VIEW DATASET

This section provides the admin to view the dataset that is predefined or the dataset that accurately gives the results of the parameter values for the crops, that helps to compare with our live values using KNN algorithm.

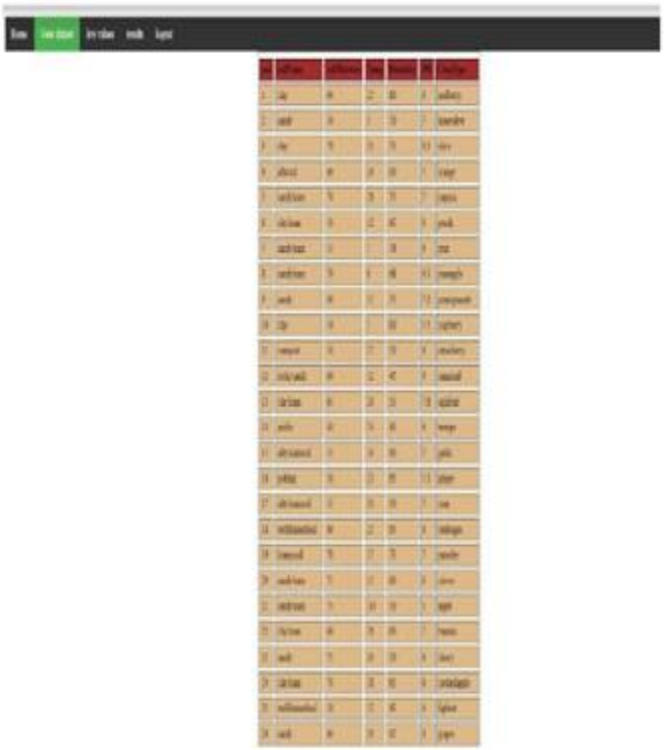

***Fig 4.1** : View Dataset*

### 4.2 LIVE VALUES

The values collected from the sensors are send to Node MCU through USB cable and the collected data is stored in the live values table which is shown below and from data base the data is sent to the web app for further processing of the data.

```
MariaDB [project]> select * from livevalues;
+----------+-------+----------+----+
| mositure | temp  | humidity | ph |
+----------+-------+----------+----+
| 102      | 34.40 | 31.00    | 8  |
| 102      | 34.30 | 31.00    | 8  |
| 100      | 34.00 | 33.00    | 0  |
| 0        | 34.00 | 33.00    | 8  |
| 100      | 34.00 | 33.00    | 8  |
| 0        | 34.30 | 33.00    | 8  |
| 0        | 34.40 | 33.00    | 8  |
| 0        | 34.10 | 33.00    | 8  |
| 99       | 34.10 | 33.00    | 8  |
| 16       | 34.10 | 33.00    | 8  |
| 16       | 34.10 | 33.00    | 8  |
| 17       | 34.10 | 33.00    | 8  |
| 16       | 34.10 | 33.00    | 8  |
| 16       | 34.10 | 33.00    | 8  |
| 30       | 34.10 | 33.00    | 8  |
| 26       | 33.90 | 33.00    | 8  |
| 27       | 34.30 | 34.00    | 8  |
| 6        | 34.30 | 33.00    | 8  |
| 7        | 34.20 | 33.00    | 8  |
| 17       | 34.10 | 33.00    | 8  |
| 23       | 34.00 | 33.00    | 8  |
| 20       | 34.30 | 34.00    | 8  |
| 20       | 34.50 | 33.00    | 8  |
| 20       | 34.40 | 33.00    | 8  |
| 20       | 34.20 | 33.00    | 8  |
| 14       | 34.30 | 34.00    | 8  |
```

***Figure 4.2*** *: Live values table in database*

The values which are retrieved from the sensors are transferred to Arduino IDE from there to the database and eventually on to the webapp. These results are now been displayed in this section. This field is used to demonstrate the project in a live environment once all the sensors are setup. Then we compare these values with the predefined dataset using KNN algorithm. Once admin click on the KNN button is able to see the predicted crop type.


***Figure 4.3*** *: Live values*

Finally, once we click the apply KNN button, the KNN algorithm gets evaluated on the values that were obtained from the sensors previously and the recommendation of the predicted crop is displayed. Then the predicted crop is sent to the farmer using mail id's. Once the data is analyzed and the crop is predicted the results are stored in the database which is shown below.


***Figure 4.4*** *: Results table in database*

Once the mail has been sent to the farmer admin will get an acknowledgment

```
MariaDB [project]> select * from results;
+----------+-------+----------+----+-----------+
| mositure | temp  | humidity | ph | ctype     |
+----------+-------+----------+----+-----------+
| 102      | 34.40 | 31.00    | 8  | greengram |
| 6        | 34.30 | 33.00    | 8  | mustard   |
| 30       | 34.10 | 33.00    | 8  | jowar     |
| 20       | 34.30 | 34.00    | 8  | jowar     |
| 99       | 36.40 | 17.00    | 8  | dates     |
+----------+-------+----------+----+-----------+
5 rows in set (0.14 sec)
```

***Figure 4.5*** *: Acknowledgment*

## 5 CONCLUSION

This project is developed using Node MCU and sensors and also using a comparison algorithm, K-Nearest Neighbor(KNN), which provides us easy measure to compare each set of data with the trained data using any kind of distance function and further classify in to one cluster. Cluster, here refers to same type of crop. As a part of our project work, we have gone through a lot of survey regarding the necessary climatic conditions that suits a crop and how the farmers suffer by initiating their agriculture production and later get suffered due to bad soil or climatic conditions. Hence, this project helps the farmers to pre estimate the type of crop that could grow in their land and buy those seeds instead of wasting money on any other type of crop. Also, the farmer could check the climatic conditions whether it is suitable for the crop to grow.

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