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Machine Learning based Drought Prediction System using Cloud and IOT

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ABSTRACT

Drought is arguably one among the most important threats of temperature change. It impacts the world resulting in lack of food and water. Therefore, there's a requirement for technological intervention to observe basic data concerning the weather and soil condition accurately, so as to spot, predict and manage drought conditions. A mix of intelligent sensors ,ESP32 together with cloud technology and machine learning algorithm would build knowledge on wetness and salinity of the soil, temperature and humidity on the surface that are accessible to end users. In this paper, the method proposed is soil moisture sensor and DHT 11 sensor connected to the ESP32-S module which will publish the data such as current temperature, humidity and soil moisture. The ESP32 –S module uses a HHTP GET request to update server. The cloud and the Flask micro web framework are used to Receive input from the HTTP GET request and store the data .This data is provided to a machine learning algorithm to determine if there will be a drought. Android apps and web apps are developed to get the results that can be viewed by the client therefore providing a mobile client with information to monitor the drought conditions thereby indicating promptly when it is required to take corrective measures.

Keywords: *Android app, DHT11 ,ESP32-S, Flask, GET Request, HTTP Request, Soil moisture sensor, Web app.*

I. INTRODUCTION

A drought is described as a period of low or below average precipitation in a given region which results in prolonged shortages in the water supply, which may be atmospheric, surface water or ground water. It also causes damage to crops. The history of droughts has been marked by periods of social and public health problems and tragedies. Droughts have even caused deaths due to starvation. Food products will have to be imported to reduce the adversities of a drought sometimes. All the nations of the world are trying out many ways to fight droughts, but there is no permanent solution yet. The prevention of droughts is the best solution so far.

A technological intervention is needed for the identification and prediction of droughts. The proposed method in this paper is a drought monitoring system that is capable of real-time monitoring remotely for long duration of time to identify and predict a drought early.DHT 11 sensors are used along with a ESP32-S module to monitor the field conditions .ESP32 is a chip microcontroller with a series of low cost and power system on it with dual mode bluetooth and integrated Wi-Fi is used for uploading data such as current temperature ,humidity and soil moisture for analysis.The flask micro web framework is used to receive the input and store the data in global variables. Flask is a micro web framework that is written in python and does not need any particular libraries or tools.It does not have a layer for database abstraction and also no form validation. Machine learning algorithm of linear or simple regression which is a linear approach to modeling the relationship between a scalar response and dependent and independent variables is used for the identification and determination of a drought condition which is notified to the user by android application by obtaining results from hardware for taking corrective measures.

SOFTWARE

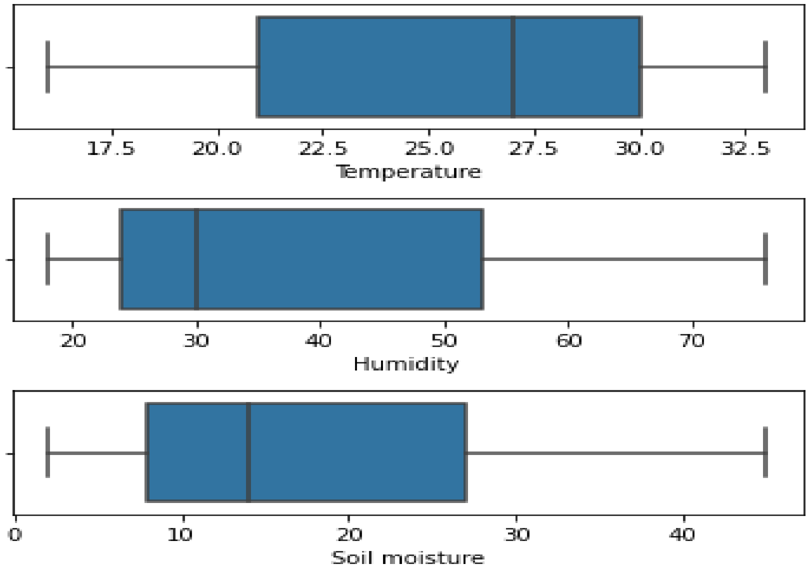
Data set:

We went through all official website to collect dataset for our project but we were not successful to collect data. So we studied on climatic conditions on normal and drought field in India .We got to know that temperature in normal field will be 16 to 26 Celsius and in drought area temperature is nearly 27 to 33 Celsius .The humidity level in normal field is 30% to 76% and in drought area nearly 18% to 30% and soil moisture in normal filed is 10 to 45% but in drought area soil moisture 5 to 15% based on this study we created our own dataset using a simple python program to generate csv files

In below figure the status will indicate the state of area like normal or drought area so the zero (0) will indicate the area is normal and the one (1) will indicate the area is drought.

	A	B	C	D
1	Temperature	Humidity	Soil moisture	status
2	22	53	38	0
3	17	31	37	0
4	20	52	16	0
5	20	41	42	0
6	21	52	40	0
7	18	67	26	0
8	24	47	41	0
9	26	51	37	0
10	22	53	31	0
11	17	55	26	0
12	22	67	18	0
13	20	67	32	0
14	16	32	22	0
15	20	61	24	0

This figure will indicate the level of temperature, humidity and soil moisture took in our dataset.



Linear regression:

Linear regression is a simple or linear model. It is a model in which a linear relationship between the input variables x and the single output variable y is assumed , which means that y can be determined or calculated by using a linear combination of the input variables x.

If we consider a single input variable x, then this method is called as simple linear regression. If there is more than one input variable then it is called as multiple linear regressions.

Linear regression is represented by a linear equation .This equation will combine a set of input values x that is specific and the predicted output for that set of input values which is y is the solution. The input values x and the output value y are usually numeric values.

The linear equation will have the value of one scale factor for every input value .This is called a coefficient and it is given by the capital Greek letter Beta (B). One additional coefficient is also added to give the line a certain additional degree of freedom such as to move up and down a 2-D plot. It is called the intercept or bias coefficient.

For example, in a simple regression problem with a single x and y, the form of the model is given by,

$y = B0 + B1*x$

If we consider a higher dimension when we have more than one input x then the line is called a plane or a hyper-plane. This is represented in the form of the equation and the specific values used for the coefficients such as B0 and B1 in the example given above.

The complexity of a regression model like linear regression refers to the number of coefficients used in the model. When a coefficient becomes zero, it will remove the affect that the input variable has on the model .Therefore it will also remove the influence on the prediction made using the model i.e., x*0=0. This can be seen in regularization methods that change the learning algorithm so that it can reduce the complexity of the regression models. This is done by adding pressure on the absolute size of the coefficients which will drive some of them to zero.

$$minimize \frac{1}{n}\sum_{i=1}^{n}(pred_i - y_i)^2 \quad J = \frac{1}{n}\sum_{i=1}^{n}(pred_i - y_i)^2$$

In our paper we have given x inputs =Temperature, Humidity and soil moisture and we are predicting the state of area as y output. The accuracy of the model is 86.46014513997086 %.

We are implementing recursive linear regression to improve the model accuracy

II. HARDWARE

Soil Sensor

- Soil sensor measures the wetness material of the soil.
- Soil moisture sensors determine the water content by using other property of the soil, as a proxy for the moisture content.
- The measured property and soil moisture varies based on environmental factors such as soil type, temperature, or electric conductivity.

Temperature sensor

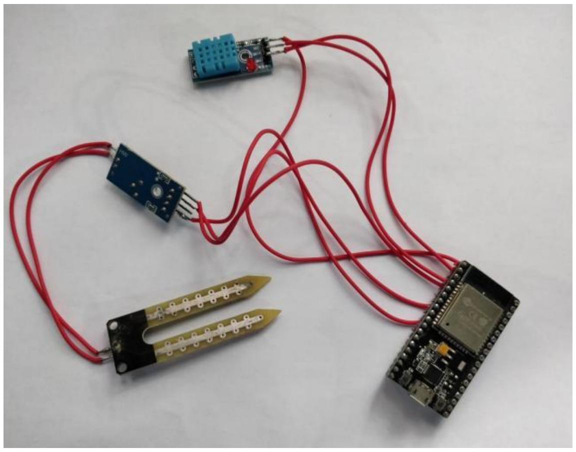
It is used to figure temperature for an electrical yield (in °C). It might quantify temperature additionalfaultlessly.

Humidity sensor

Humidity sensor is used to measure the nearness of water in arrive. It can be utilized as a part of events like: clinics, workshop, material industry and so on.

ESP 32

- It is a module which is used in music streaming, and MP3 decoding.
- At the core of this is the ESP32S chip, which is designed to be scalable and adaptive. There are 2 cores of CPU that can be controlled or powered.
- Using Bluetooth, users can connect to their phone or broadcast low energy for its detection. The Wi-Fi usage enables a large physical range, and a direct connection to the internet via a Wi-Fi router.



III. APPLICATIONS

Virtual assistants

They collect the data from the environment which is used to select the right crops that can grow and sustain under specific climatic conditions.

Remote sensing application

- It can be used to monitor drought- related variables.
- They utilize sensors for gathering data which is transmitted to analytical tool for analysis.

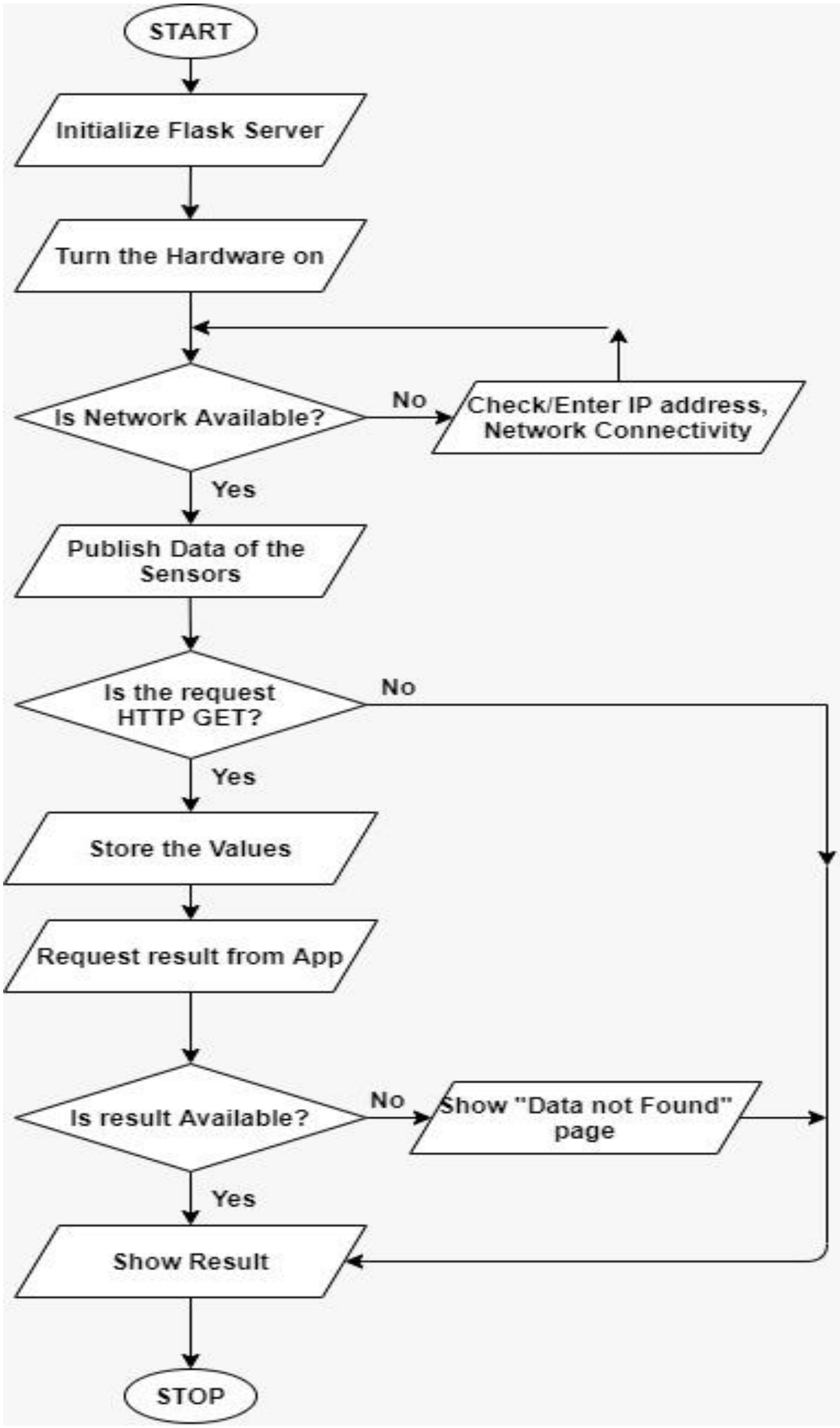
Famine detection

If there is drought then crops can't be grown which causes famine. Using our project we can detect famine.

Precision farming

- It is based on ultra-modern agronomic solutions.
- The aim of precision farming is to analyze the data, generated via sensors, to react accordingly.

IV. FLOWCHART



V. METHODOLOGY

The system provides the state of the art technology in developing futuristic solutions of predicting drought in the particular area. The system is divided into hardware and software. The hardware is integrated with the Internet of things. The chosen IOT hardware is ESP32-S module. This electronic part is essential to connect to the server and behave as a client or to establish a server locally. The device has an inbuilt ADC which is capable of converting analog data to digital data. The digital data varies between 0 - 4096 steps.

The soil moisture sensor is connected to an amplifier module which amplifies the signal and provides its analog output to the ESP32-S module. ESP32-S converts analog data to digital data.

DHT 11 sensor works based on OneWire protocol. The DHT11 sensor provides the temperature, humidity, heat index and other parameters based on the outer weather conditions. These parameters are received by the ESP32-S module.

The ESP32-S module publishes the following data such as current temperature, humidity and soil moisture. The ESP32-S uses HTTP GET request protocol to update the server with its parameters.

The software part is subdivided into two parts, server and client. The server which is configured on the cloud, performs the operations as per the backend application deployed on to the server.

The backend application is developed using Flask. Flask is a framework written in Python. It is classified as a micro framework because it requires no particular tools or libraries. There is no abstraction layer of database , form validation, or other components where pre-existing third-party libraries provide common functions.

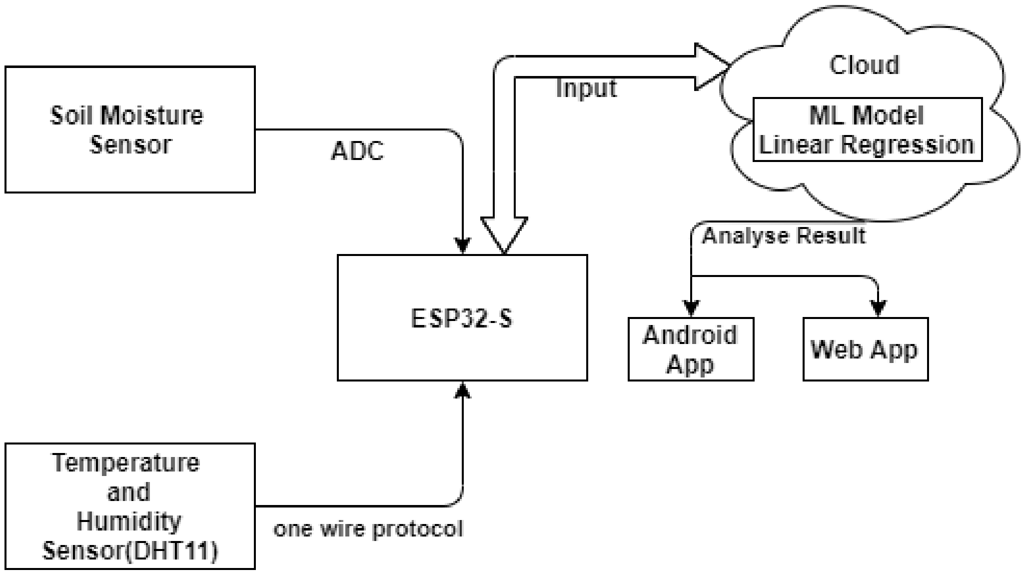
The flask app receives the input from the HTTP GET request. The data is stored in global variables (data is not saved permanently in a database).

The android app developed provides the following options, to obtain the results from the hardware. The android app also has the option to test the machine learning model by providing manual inputs and fetching the result.

When either of the options are chosen, data is provided to the machine learning algorithm. The chosen algorithm for this use case is Linear Regression. The model is given the input features such as temperature, humidity and soil moisture and its respective outputs (Drought/ Normal). The model provides the result as drought or normal.

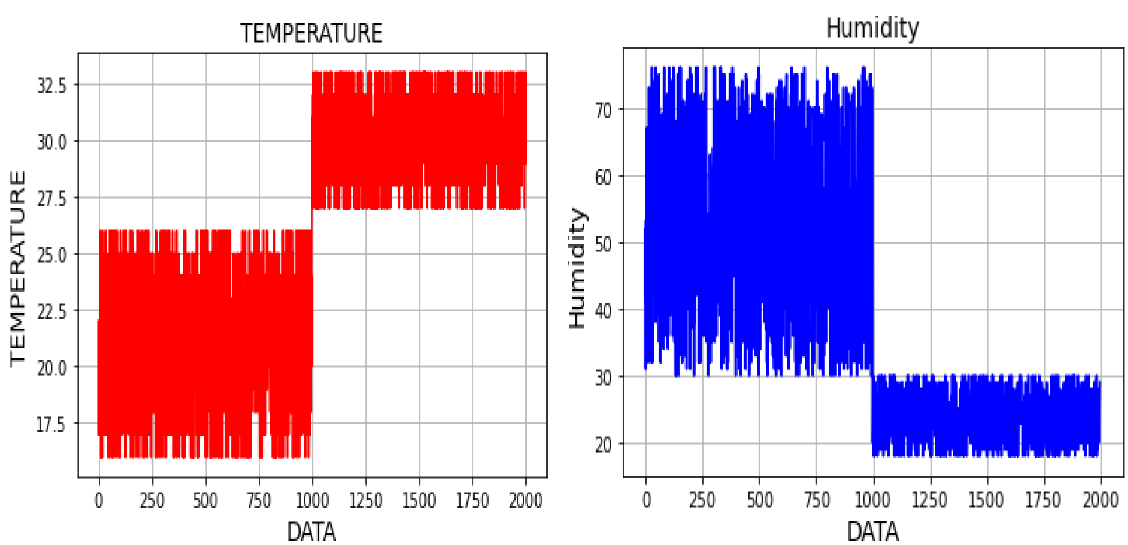
The response is sent back to the client as a response along with rendering the result html page. This page will be visible on the android app.

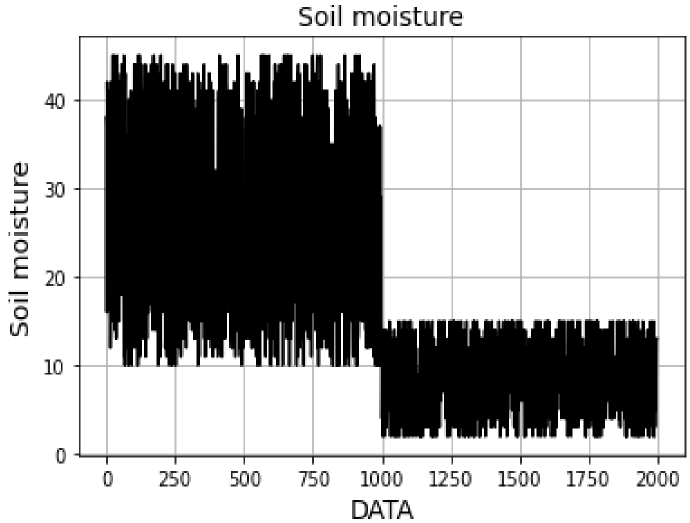
Thus, one can predict the drought/normal conditions in a particular area. The accuracy of the model is approximately 84%.



VI. CONCLUSION AND RESULTS

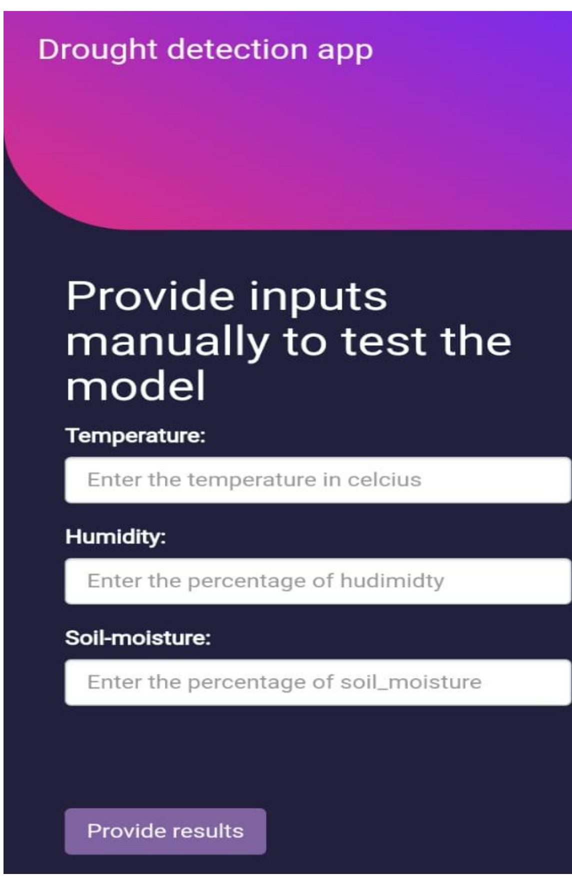
Drought has a great impact on agriculture, economy Not only in India but across the whole world. In this Paper we have proposed a method for drought Prediction after analysis of dataset. This system describes the drought prediction scheme using the machine learning algorithm. The soil moisture can be predicted based on the temperature, humidity and other parameters. Using Machine learning an intelligent irrigation system can be built without being completely dependent on the sensors. Developing applications using this can correlate and predict natural calamities ranging from earthquakes to hurricanes that are normally occurring but may have cross correlation to observable physical parametric variations which is of great advantage.

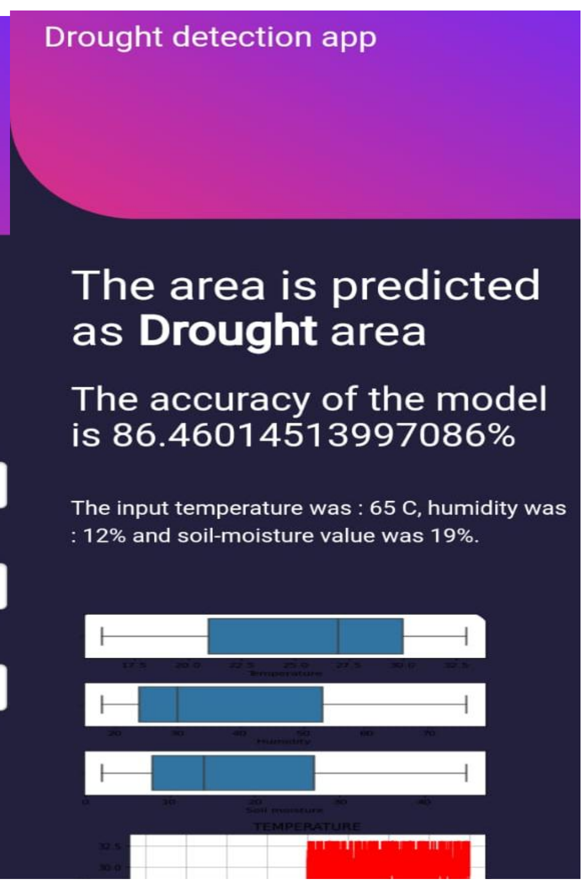




In above figure we plotted graph of our dataset. So from zero to thousand indicate normal area and from thousand to two thousand indicate drought area.

App results output:





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