



CROP RECOMMENDATION SYSTEM USING MACHINE LEARNING

¹Omkar Gosavi, ²Ekta Bhowad, ³Shweta Bachute, ⁴Kedar Sawant, ⁵Ragini Bhojar

^{1,2,3&4}B. E. Electronic and Telecommunication Engineering, MCT Rajiv Gandhi Institute of Technology, Mumbai, India

⁵Professor in Electronic and Telecommunication Engineering, MCT Rajiv Gandhi Institute of Technology, Mumbai, India

Abstract: The requirement for sustainable practices to guarantee effective crop cultivation is posing an increasing challenge to the agriculture sector. To address this, this study presents a novel project aimed at putting into practice a cutting-edge crop recommendation system. Using real-time data on important environmental parameters like as temperature, moisture content of soil, weather, and contextual subtleties, the system utilizes machine learning models that have been trained beforehand to examine complex inputs. To ensure precision and accuracy, the training process makes use of modern technologies such as support vector machines (SVM), random forests, decision trees, and others. With the use of data-driven insights, the robust model that is produced offers farmers customized and optimal crop suggestions that will increase agricultural output and promote sustainable farming methods. This approach is a major step toward a new era of agricultural growth and wealth since it emphasizes the resilience and efficiency of the agricultural sector.

Index Terms - Data Collection, Feature Engineering, Algorithm Selection, Model Training, Validation, Recommendation Generation, User Interface.

INTRODUCTION:

In the context of agricultural sustainability, knowing how important environmental variables like temperature and soil moisture interact dynamically is essential to crop cultivation's success. Our innovative response centers on the application of a state-of-the-art crop recommendation system. This method leverages real-time data on soil moisture content, outside temperature, meteorological conditions, and the month-specific contextual details. Through the utilisation of pretrained machine learning models, our system aims to thoroughly examine these diverse inputs and provide customized suggestions for the best crops to grow in each soil type. Crop cultivation performance in the context of agricultural sustainability depends on an understanding of the dynamic interactions between key environmental variables, such as temperature and soil moisture. Our creative solution focuses on using a cutting-edge crop recommendation algorithm. This approach makes use of current information on soil moisture content, ambient temperature, weather, and month-specific contextual information. Our approach uses pretrained machine learning models to analyse these many inputs in detail and generate tailored recommendations for which crops might do well in a particular type of soil.

Our program aims to provide farmers with timely, accurate, and data-driven information so they may make well-informed decisions to increase agricultural output by promoting a data driven strategy. Our system's primary goal is to increase overall crop productivity and promote sustainable farming methods. By strengthening the agricultural sector's resilience, it hopes to usher in a new era of agricultural wealth and advancement.

PROBLEM STATEMENT:

Agriculture is crucial to meeting the needs of a growing population and preserving the world's food supply. However, because of variable weather patterns, different types of soil, and ever-changing environmental factors, farmers have significant challenges when choosing the finest crops. To address this issue, a precise and effective machine learning-based crop recommendation system that considers important parameters including soil moisture, pH level, temperature, and the month of the year is needed.

OBJECTIVE:

This project's main goal is to create a reliable, data-driven crop recommendation system that makes use of both historical and current data to make recommendations for appropriate crops depending on agricultural criteria. We will be able to obtain soil-related data, including pH value, by using soil sensors. These values will then be utilized to train a prediction-focused machine learning model. By encouraging crop diversity and resource-efficient cultivation methods, the crop recommendation system's success will not only improve agricultural output but also advance sustainable farming practices.

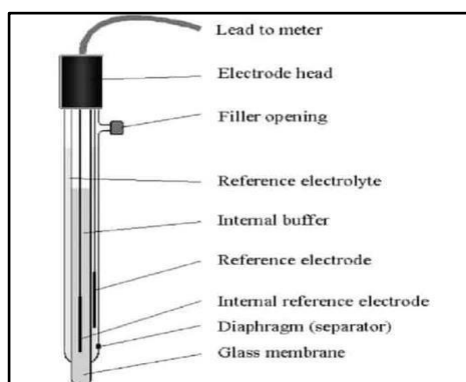
SOLUTION:

We intend to address the given problem statement by combining the technologies of microcontroller and machine learning. Sensors such as the Dht11 and soil pH sensor are connected to the NodeMCU-Esp32, allowing us to measure the temperature, humidity, and pH of the soil. The measured values are then fed into a pre-trained machine learning model that was trained through supervised learning. The algorithm recommends the best plant for a given soil type based on the variables provided. Because it is composed of a metallic conductor, the reference electrode is unaffected by the solution's pH. This conductor is immersed in an electrolyte solution, usually potassium chloride, which interacts with the test solution through a porous ceramic membrane.

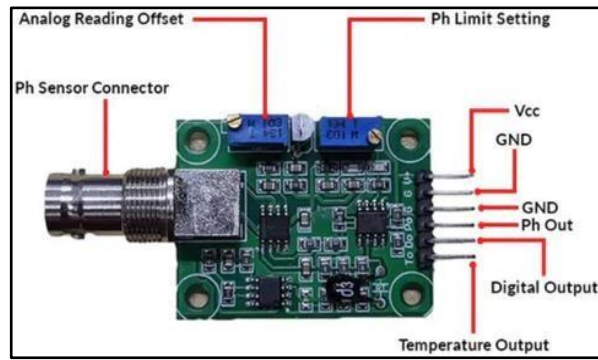


NodeMCU: ESP-32

The NodeMCU ESP32 module, a microcontroller that runs on the ESP32 chip, boasting a diminutive form and pocket-friendly price. This little device enables developers to forge connections with the cyberspace and govern their projects from afar. It cooperates with the Arduino Integrated Development Environment, and allows for scripting in the Lua language or the Arduino programming language. It is a staple in lot ventures, with potential to construct gadgets for domiciles, remote manipulation, and more.

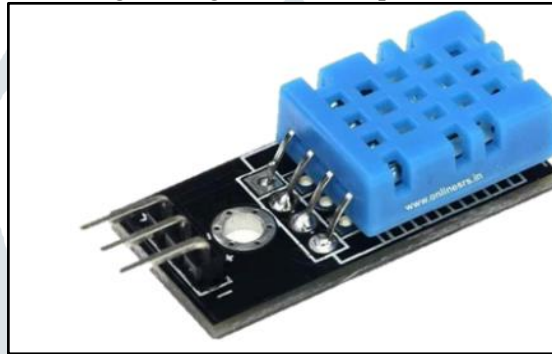


Soil pH Sensor Probe



Transducer

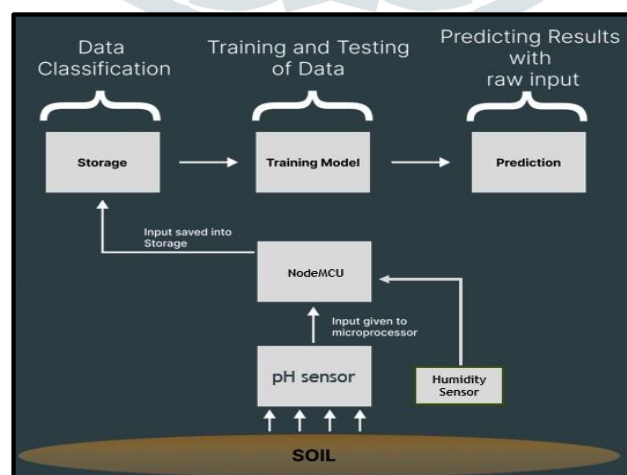
The transducer known as the transmitter, also known as the signal conversion board, is attached to this pH sensor. This board has six IO pins, a PH limit setting, an analog reading offset, and a pH sensor connector that is attached to the sensor probe.



DHT11 Sensor

The DHT11 sensor stands out for its affordability and simplicity in measuring temperature and humidity digitally. It communicates through a single-wire digital interface, making integration straightforward. Its temperature accuracy is within $\pm 2^{\circ}\text{C}$, and humidity accuracy is within $\pm 5\%$. With an operating voltage range of 3.3V to 5V, it is compatible with a variety of microcontrollers and development boards. Although it's widely used for basic environmental monitoring projects due to its cost-effectiveness and ease of implementation, its lower accuracy compared to other sensors should be noted for applications requiring precise measurements.

BLOCK DIAGRAM:



Working of Project

WORKING:**Step 1: Gathering data:**

By connecting soil moisture sensors with NodeMCU we will collect soil pH levels, Temperature and Humidity.

Step 2: Data Preprocessing:

We will use different soil sample and their data to make one dataset. Ensure that the collected data is in a consistent format and free from errors or missing values.

Step 3: Classification of data:

Classify the crops into different categories based on their tolerance to soil pH levels, temperature, and Humidity.

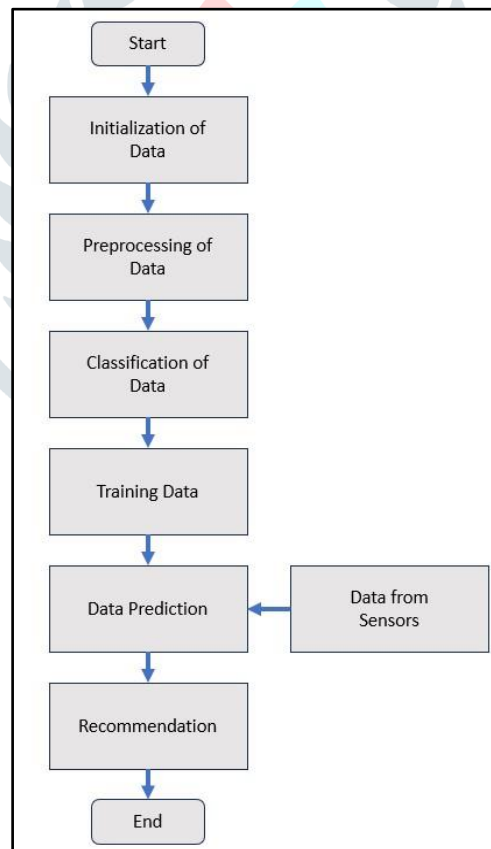
Step 4: Crop Selection Criteria:

Soil Moisture: Choose crops that match the measured soil moisture levels within their optimal range.

Soil pH: Select crops that prefer the soil pH value. **Temperature & Humidity:** Choose crops that thrive within the current temperature & Humidity range.

Step 5: Crop Recommendation Algorithm:

Develop an algorithm that takes the collected data as input and provides crop recommendations based on the predefined crop selection criteria. The algorithm should be able to prioritize the crops based on how well they match the environmental conditions.

FLOW CHART:

Flow Chart of Model Training and Prediction

OUTPUT:

```
Humidity: 59.20% Temperature: 30.70°C
Humidity: 59.10% Temperature: 30.60°C
Humidity: 59.00% Temperature: 30.60°C
Humidity: 59.00% Temperature: 30.60°C
Humidity: 59.00% Temperature: 30.60°C
```

DHT11 Output from NodeMCU

```
pH:9.47
pH:9.46
pH:9.45
pH:9.41
pH:9.39
pH:9.36
```

PH output from NodeMCU

```
#prediction for new values
new_temperature = 30
new_ph = 7
new_humidity = 59
```

Entering above values to pre-trained model

```
# Printing Predicted Result
print("Predicted Label for the given values:", new_prediction[0])

Predicted Label for the given values: blackgram
```

Recommendation from model

CONCLUSION:

Using supervised machine learning and a random forest classifier, we have successfully trained the machine learning model. We have also developed a prototype system that makes plant recommendations based on soil pH, temperature, and humidity levels. In the future, recommendations based on season can also be implemented to make this project more scalable.

REFERENCES:

- [1] IJITEE - International Journal of Engineering and advanced ..., https://www.ijeat.org/wpcontent/uploads/papers/v9i1s2/A10561291_S219.pdf (accessed Mar. 20, 2024).
- [2] Estimating soil moisture using remote sensing data: A machine ..., https://www.researchgate.net/publication/22076545_Estimating_Soil_Moisture_Using_Remote_Sensing_Data_A_Machine_Learning_Approach (accessed Mar. 20, 2024).
- [3] (PDF) Raspberry Pi based soil parameters monitoring device using ..., https://www.researchgate.net/publication/327823065_Raspberry_Pi_based_Soil_Parameters_Monitoring_Device_using_Sensors (accessed Mar. 20, 2024).

- [4] LM35 temperature sensor, <https://nskelectronics.in/LM35%20Temperature%20Sensor> (accessed Mar. 20, 2024).
- [5] “Dht11–temperature and humidity sensor,” Components101, <https://components101.com/sensors/dht11-temperature-sensor> (accessed Mar. 20, 2024).
- [6] “All about ph sensor - working, types, pinout, applications,” Robocraze, <https://robocraze.com/blogs/post/all-about-ph-sensor> (accessed Mar. 20, 2024).

