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Department of Electronics & Telecommunication Engineering

Minor-Project (18TE64) Phase-II presentation on,

“INTELLIGENT IRRIGATION SYSTEM USING ML”

Presented By,

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INTRODUCTION

Agriculture in India plays a crucial role in the GDP and employment, with 60-70% of the population dependent on it. However, the scarcity of water resources poses a significant challenge for efficient irrigation. To address this, an intelligent irrigation system leveraging IoT technology is proposed. This system utilizes sensors to monitor soil moisture, temperature, and humidity, enabling automated control of water pumps to prevent underwatering or overwatering. The collected data is sent to the cloud for continuous monitoring and decision-making.

INTRODUCTION

Additionally, a crop recommendation system based on machine learning is proposed to assist farmers in making informed decisions. By considering factors such as temperature, rainfall, soil nutrients, and pH, this system predicts suitable crops for cultivation. Integration of these systems can enhance water management, optimize crop selection, and ultimately improve agricultural productivity and farmer income.

LITERATURE REVIEW

Sl.no	TITLE	Author	KEY Observations
1	Crop Recommendation System Using Machine Learning Algorithms	Jadhav, Atharva; Riswadkar, Nihar; Jadhav, Pranay & Gogawale International Research Journal of Engineering and Technology (IRJET)- 2022	● Implemented and tested various machine learning algorithms (Random Forest, ANN, SVM, MLR, KNN) for yield prediction accuracy. ● The mobile application offers multiple features for crop selection, including an inbuilt yield predictor system. ● Utilized datasets from Maharashtra and Karnataka states for testing the machine learning algorithms.

LITERATURE REVIEW

Sl.no	TITLE	Author	KEY Observations
2	Study on Smart Irrigation System Using IoT for Surveillance of Crop- Field.	Ashwini B V International Journal of Engineering & Technology (IJET) - 2021	• The system enables remote monitoring of temperature, humidity, and soil moisture levels through an Android application. • The Naive Bayes algorithm helps make intelligent decisions based on frequently occurring attribute values. • Historical sensor data can be stored and displayed on the user's phone, enabling better analysis and decision-making.

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LITERATURE REVIEW

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Sl.no	TITLE	Author	KEY Observations
3	Crop yield prediction using machine learning algorithm	Reddy, D. J., & Kumar, M. R. 5th International Conference on Intelligent Computing and Control Systems- 2021	• The gathered sensor values are transmitted to a third-party analytics service, ThingSpeak, for real-time graph plotting and data storage. ● If the soil moisture is low and the water level sensor detects dampness, Arduino sends a signal through Node MCU. ● Users can access the data and graphs from ThingSpeak remotely using an internet-connected device.

LITERATURE REVIEW

Sl.no	TITLE	Author	KEY Observations
4	Crop recommender system using machine learning approach	Pande S. M, Ramesh P. K, Anmol A., Aishwarya B. R, Rohilla K, & Shaurya K. 5th International Conference on Computing Methodologies and Communication- **2021**	● The system utilizes GPS to identify the user's location and incorporates input on the area and soil type. ● Random Forest algorithm demonstrated the highest accuracy of 95% in crop yield prediction. ● The system also provides recommendations on the optimal timing for fertilizer usage to enhance crop yield.

LITERATURE REVIEW

Sl.no	TITLE	Author	KEY Observations
5	Agricultural Crop Recommendations based on Productivity and Season	Vaishnavi, S; Shobana, M; Sabitha, R. & Karthik, S 7th International Conference on Advanced Computing & Communication Systems 2021.	• Focuses on Tamil Nadu in particular, as a coastal state it faces uncertainty and decreased agricultural production due to climatic factors. • Modern technological methods, such as machine learning and data analytics, can provide insights and predictions for agricultural factors and parameters. • Data analytics allows for valuable information extraction from agricultural databases, aiding in decision-making.

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LITERATURE REVIEW

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Sl.no	TITLE	Author	KEY Observations
6	Crop Recommendation System using Machine Learning	Gosai, Dhruvi, Raval, Chintan, Nayak, Rikin, Jayswal, Hardik Patel, Axat Inter- national Journal of Scientific Research in Computer Science Engineering and Information Technology 2021	• The proposed system combines IoT and ML for soil testing using sensors to measure and observe soil parameters. • The sensed data is stored on a microcontroller and analyzed using machine learning algorithms, such as random forest, to provide crop growth suggestions. • The convolution neural network(CNN) analyzes plant images to determine if the plant is at risk of a disease, allowing for timely intervention.

LITERATURE REVIEW

Sl.no	TITLE	Author	KEY Observations
7	Machine Learning Based Crop Recommendation System	Parikh, Dhruv; Jain, Jugal; Gupta, Tanishq & Dabhade, Rishit International Journal of Advanced Research in Science, Communication and Technology 2021	• The attributes taken into consideration are the ratio of nitrogen in soil, ratio of phosphorus in soil, ratio of potassium in soil, temperature, humidity, pH of soil and the amount of rainfall. • The model has then been incorporated with GUI using Tkinter

LITERATURE REVIEW

Sl.no	TITLE	Author	KEY Observations
8	Smart irrigation system using IoT	Karpagam, J., Merlin, I. I., Bavithra, P., & Kousalya, J 6th International Conference on Advanced Computing and Communication Systems 2020	● IoT-based solution for monitoring plant humidity and irrigating accordingly. ● An IoT tool has been developed that can be controlled through a mobile app for convenient management. ● The proposed application helps reduce water wastage by watering plants when needed based on humidity levels.

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LITERATURE REVIEW

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Sl.no	TITLE	Author	KEY Observations
9	Smart Irrigation system using Internet of Things	Anitha, A, Sampath, Nithya & Jerlin, Asha International Conference on Emerging Trends in Information Technology and Engineering 2020	• IoT-based smart irrigation system identifies soil dampness and automates crop watering. • Soil moisture sensors measure water content, and microcontrollers transmit data via GPRS modules to the internet. • Features include smart control, real-time field data analysis, and remote monitoring through WiFi or ThingSpeak modules.

LITERATURE REVIEW

Sl.no	TITLE	Author	KEY Observations
10	Automation Of Irrigation System Using IoT	Naik, Pavankumar; Katti, Kirthishree; Kumbi, Arun & Telkar, Nagraj International Journal of Engineering and Manufacturing Science 2019	● Based on the soil moisture value obtained from the sensors, the system automatically controls the irrigation process by turning the motor ON or OFF as needed. ● The status of the sensed parameters and the motor is displayed to the user through an Android application, providing real-time information. ● The project leverages Internet of Things (IoT) concepts, Arduino microcontroller, temperature sensors, soil moisture sensors, humidity sensors, and related technologies.

LITERATURE REVIEW

Sl.no	TITLE	Author	KEY Observations
11	Automated Irrigation System-IoT Based Approach	Mishra, Dweepayan, Arzeena Khan; Rajeev Tiwari,Shuchi Upadhyay 3rd International Conference On Internet of Things: Smart Innovation and Usages 2019	● The system utilizes an Arduino kit along with a moisture sensor and a Wi-Fi module. ● The experimental setup is connected to a cloud framework, allowing data acquisition and analysis. ● Cloud services analyze the acquired data to provide appropriate recommendations.

LITERATURE REVIEW

Sl.no	TITLE	Author	KEY Observations
12	Agro- Consultant: Intelligent Crop Recommendation System Using Machine Learning Algorithms	Doshi, Zeel; Agarwal, Rashi; Nadkarni, Subhash & Shah, Neepa Fourth International Conference on Computing Communication Control and Automation 2019	• The paper employs techniques like Ridge Regression and Classifier to improve accuracy in crop prediction. • The proposed system predicts the most suitable crop based on parameters such as district, rainfall, temperature, and area. • The system helps farmers forecast the crop yield before deciding which crop to cultivate.

LITERATURE GAP

- The individual studies focus on specific aspects such as sensor-based data collection, machine learning algorithms for crop recommendation, and automated irrigation control, there is a lack of holistic approaches that combine these elements into a seamless and fully integrated system.

- Bridging this literature gap would involve the design and implementation of a unified framework that effectively combines data collection, machine learning-based crop recommendation, and automated irrigation control, while considering practical constraints

- Such an integrated approach could provide a more effective and user-friendly solution for sustainable and efficient agricultural practices.

MOTIVATION

A smart irrigation system powered by machine learning seeks to revolutionize traditional agricultural practices by harnessing advanced data analytics and predictive algorithms. By seamlessly integrating weather forecasts, soil moisture levels, and crop-specific requirements, this innovative technology empowers farmers to optimize water usage, minimize wastage, and enhance crop yields. With the potential to mitigate water scarcity, increase sustainability, and alleviate the burden on farmers, the smart irrigation system driven by ML is a beacon of transformative progress, ushering in a new era of efficient and environmentally conscious agriculture.

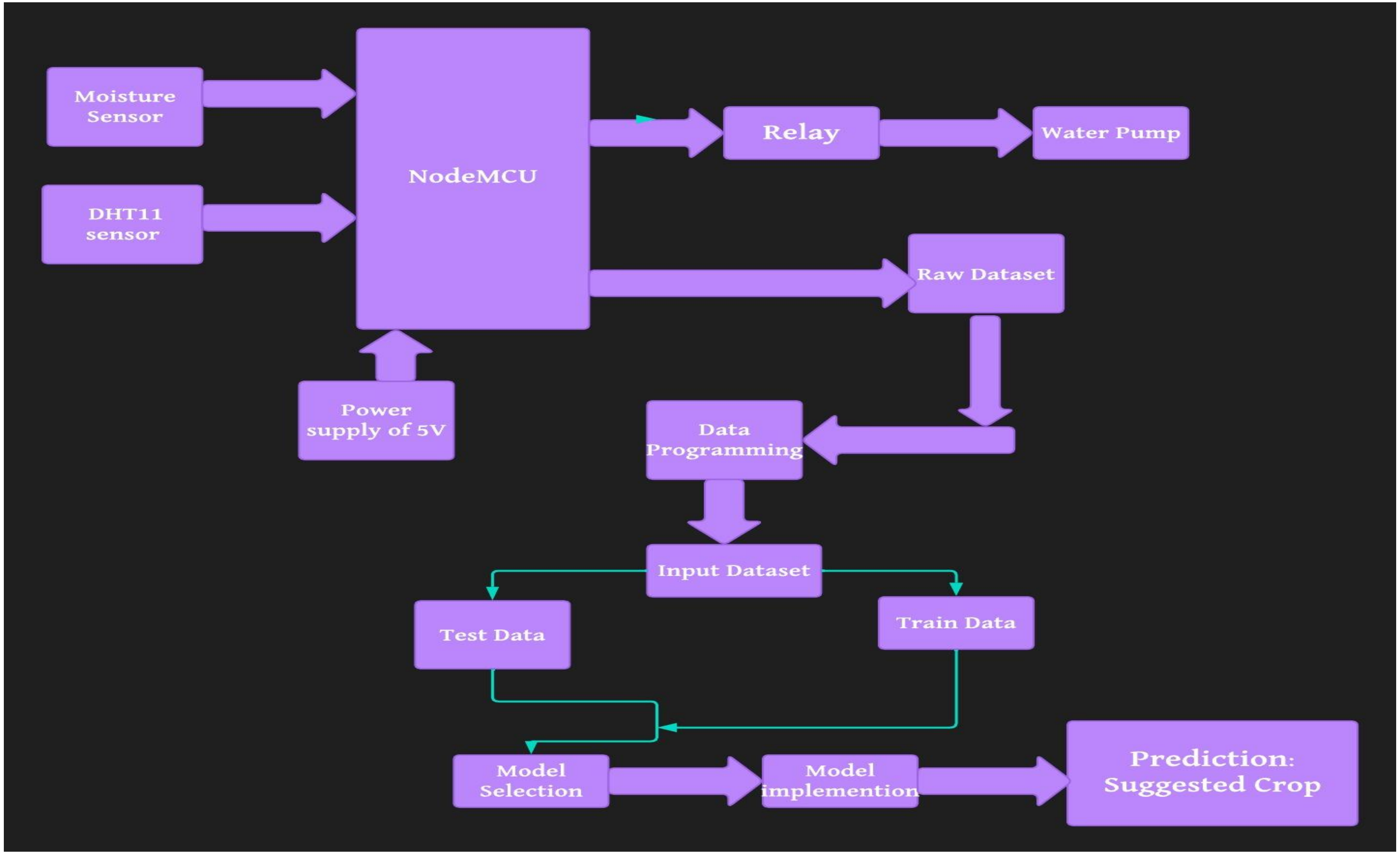
PROBLEM DEFINITION

- Design of an Automated Irrigation System for measuring soil moisture , temperature and humidity using sensors and then using ML to identify the most suitable that can be grown.

OBJECTIVES

- To Understand the working of IoT and machine learning(random forest algorithm) in agricultural contexts.
- To develop a prototype for determining and maintaining the optimum moisture content in the soil.
- To suggest the most suitable crop to be grown on the tested soil.
- To Create a user-friendly interface for web application.
- To Minimize water wastage and promote efficient resource usage.

METHODOLOGY



METHODOLOGY

The integrated system operates by utilizing NodeMCU to gather data from a soil moisture sensor and DHT11 sensor, facilitating real-time monitoring of humidity, soil moisture, and temperature. Simultaneously, a machine learning model, trained on historical and current sensor data, recommends suitable crops based on the environmental conditions, optimizing crop selection for sustainable and efficient agriculture.

COMPONENTS

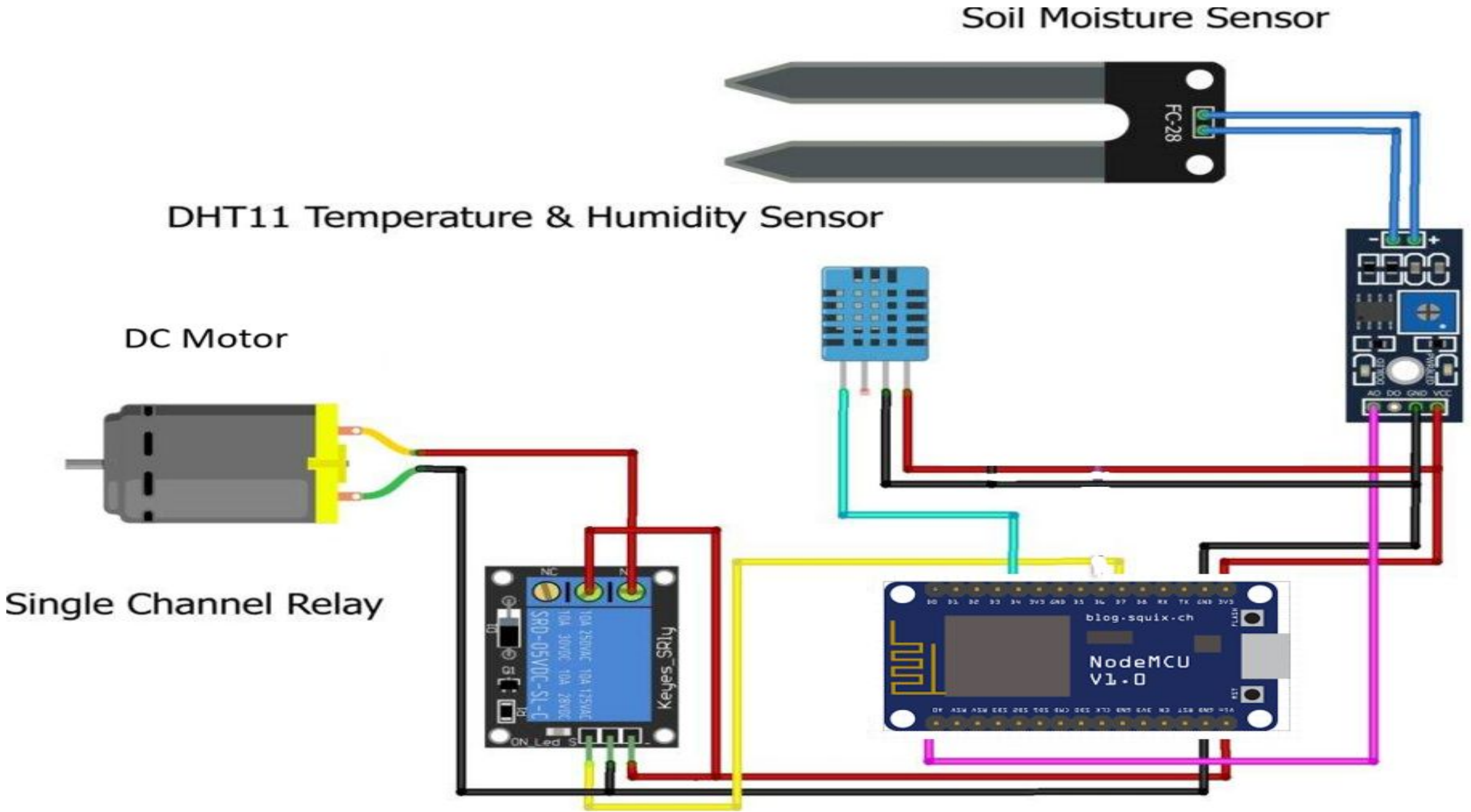
Hardware :

- NodeMCU microcontroller
- Soil Moisture Sensor Module
- Submersible DC motor
- DHT11 sensor
- Relay module

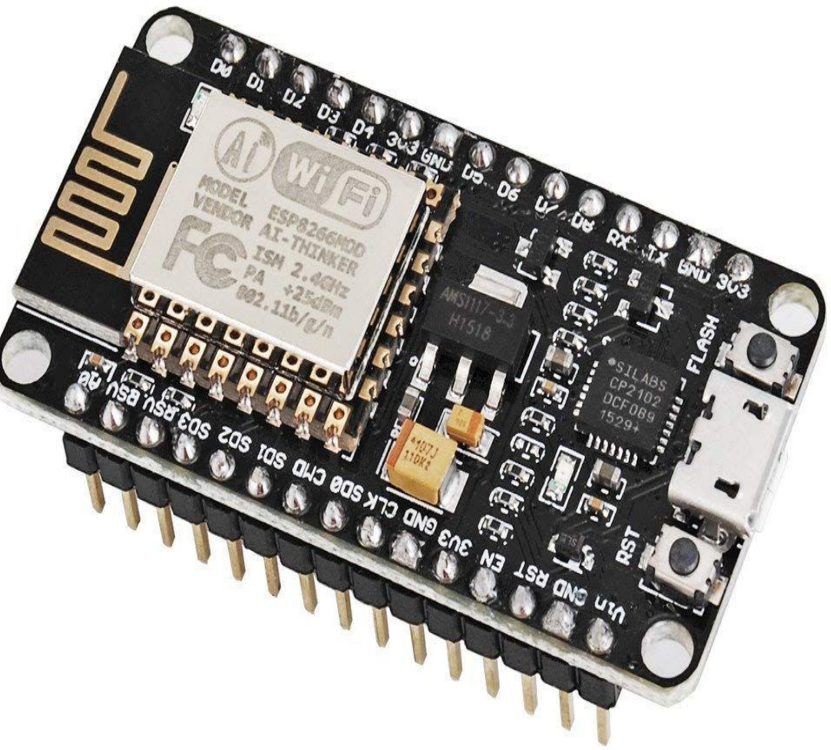
Software:

- Arduino IDE
- Google Collab
- Firebase

DESIGN

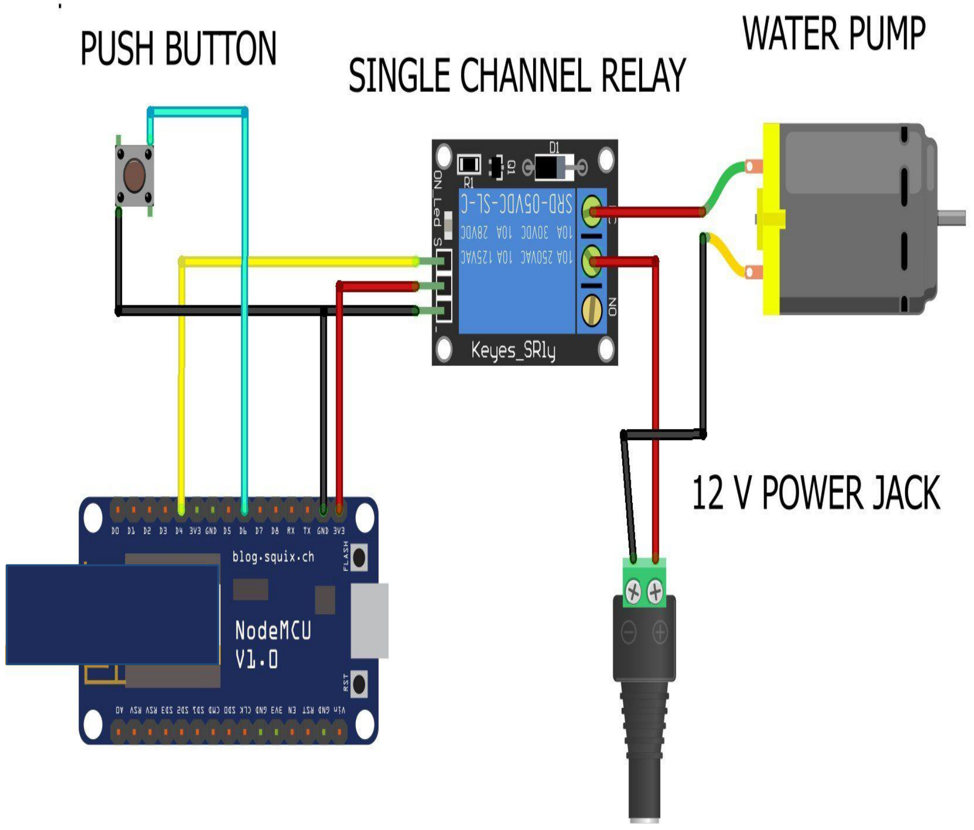

Soil Moisture Sensor
FC-28
DHT11 Temperature & Humidity Sensor
DC Motor
Single Channel Relay
SRD-05VDC-SL-C
Keyes_SRly
blog.squix.ch
NodeMCU
V1.0

DETAILS



NODEMCU ESP8266

Microcontroller	ESP-8266 32-bit
Clock Speed	80-160 MHz
USB Connector	Micro USB
Operating Voltage	3.3V
Input Voltage	upto 10V
Flash Memory/SRAM	4 MB / 128 KB
Digital I/O Pins	`9
Analog In Pins	1
WiFi	2.4Ghz



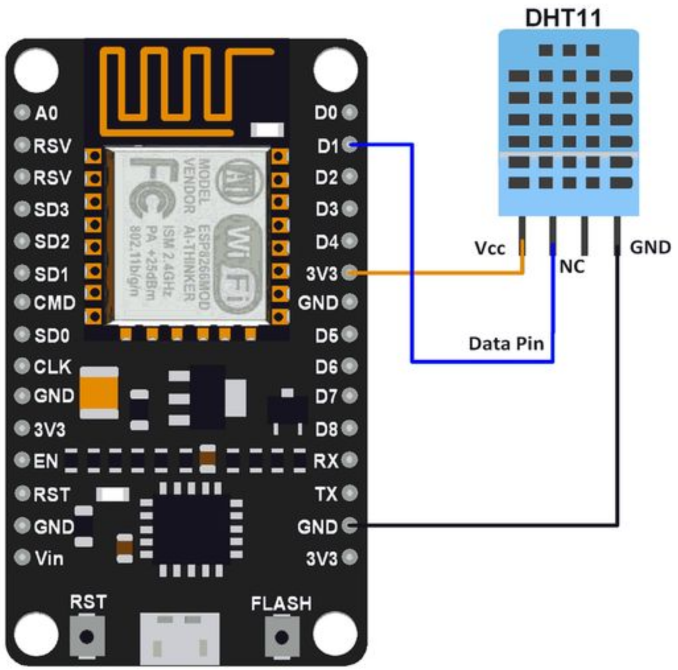
DC MOTOR/Water Pump

- DC Voltage: 2.5-6V.
- Maximum lift: 40-110cm / 15.75 "-43.4"
- Flow rate: 80-120L / H.
- Outside the water outlet diameter : 7.5mm /0.3 "
- internal diameter of water outlet: 4.7 mm / 0:18"
- Diameter: Ca. 24 mm / 0.95 "
- Length: Ca. 45 mm / 1.8"
- Height: Ca. 33 mm / 1.30 String "

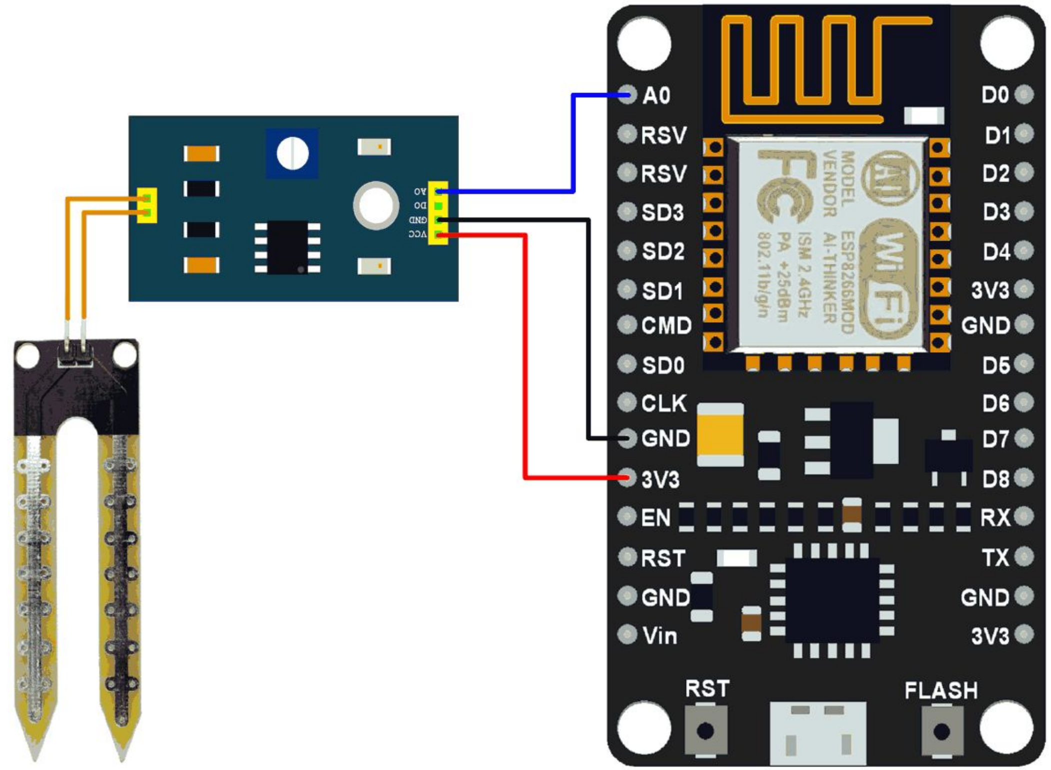
Single-Channel Relay Module

- Voltage supply ranges from 3.75V – 6V
- Quiescent current is 2mA
- Once the relay is active then the current is ~70mA
- The highest contact voltage of a relay is 250VAC/30VDC
- The maximum current is 10A

DHT11 Sensor



- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (standby)
- Output: Serial data
- Temperature Range: 0°C to 50°C
- Humidity Range: 20% to 90%
- Resolution: Temperature and Humidity both are 16-bit
- Accuracy: ±1°C and ±1%



Soil Moisture Sensor Module

SPECIFICATIONS:

- Operating Voltage: 3.3V to 5V DC
- Operating Current: 15mA
- Output Digital - 0V to 5V, Adjustable trigger level from preset
- Output Analog - 0V to 5V based on infrared radiation from fire flame falling on the sensor
- LEDs indicating output and power
- PCB Size: 3.2cm x 1.4cm

Arduino IDE

The Arduino IDE (Integrated Development Environment) is a software application used to program Arduino boards.
Supported Operating Systems: The Arduino IDE is compatible with major operating systems, including:

Windows (Windows 7 and later)
macOS (OS X 10.8 Mountain Lion and later)
Linux (32-bit and 64-bit distributions)

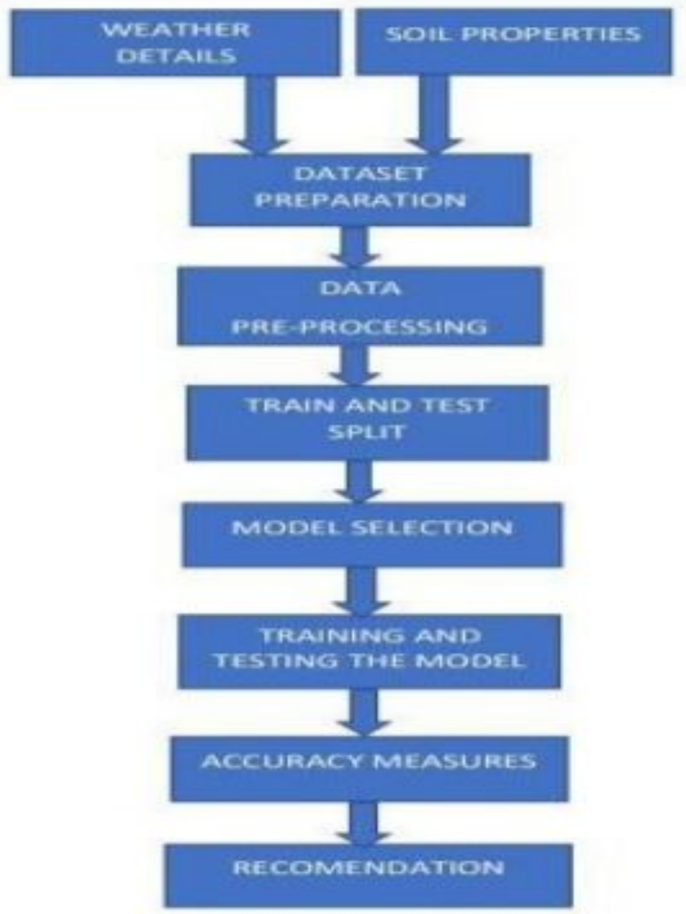
Firebase

Firebase is a comprehensive mobile and web development platform that offers a range of cloud-based services and tools for building and scaling applications. It provides functionalities such as real-time database, hosting, authentication, storage, and cloud functions, enabling developers to quickly develop, deploy, and manage applications without worrying about server infrastructure. Firebase's user-friendly interface and seamless integration with other Google Cloud services make it a popular choice for developers seeking a flexible and robust backend solution for their applications.

Co laboratory

Hardware and Runtime Configuration: Colab allows you to choose between different hardware accelerators, including GPUs and TPUs, based on your requirements. You can also configure the runtime environment, such as the Python version and additional dependencies.
This can runs on web browsers and is compatible with various operating systems, including Windows 11.

Machine Learning For Crop Recommendation



Block Diagram of Implementation

DATASET COLLECTION : We obtained a dataset from Kaggle that contains information on several factors (both soil and weather) including temperature, humidity, rainfall.
These factors will have a significant impact on the choice of produce.

DATA PREPROCESSING: In data preprocessing we are going to transform the gathered data such that we are capable to use that data for analysis. Data pre-processing includes handling missing data values, removing duplicates, handling outliers etc.

SPLITTING DATA INTO TRAIN AND TEST : we will separate the dataset in a 70:30 ratio. This indicates that we will use 70% of the data for training and the leftover 30% for testing.The model is more likely to perform well on fresh data if it does well on both the training and testing sets

Machine Learning For Crop Recommendation

CHOOSING MODEL FOR MACHINE LEARNING:

This is the process of selecting one final machine learning model from among a collection of candidate machine learning models for a training dataset. Before choosing a machine learning model, it is found which type of the dataset we are having. For our problem statement we are using Random Forest.

WHY RANDOM FOREST ?

1.Works well with high dimensional data .

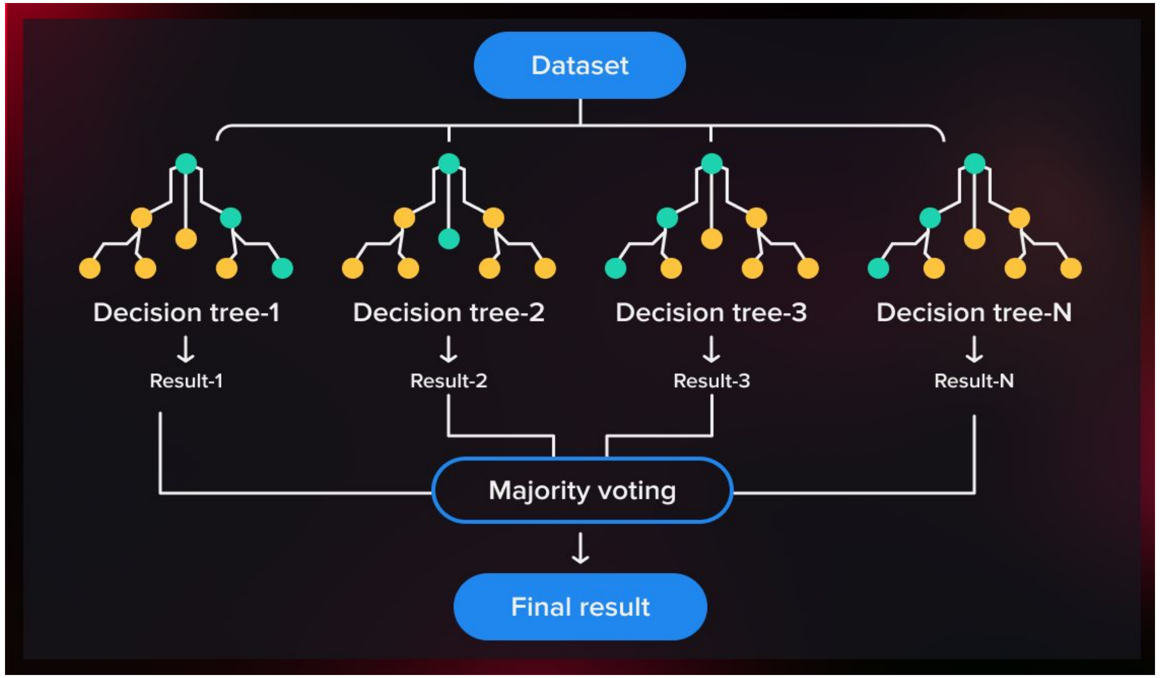
2. Gives high accuracy and robust in handling outliers.

3. Internally uses multiple decision trees .

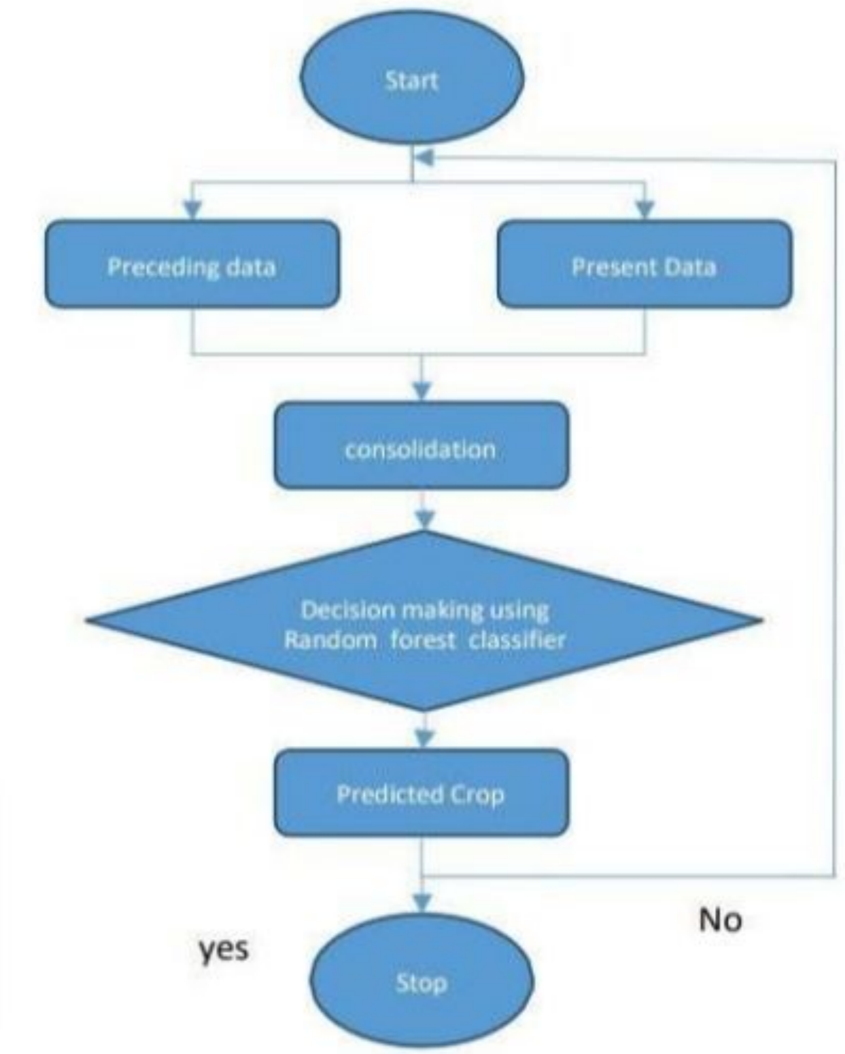
Machine Learning For Crop Recommendation

RANDOM FOREST ALGORITHM:

It is a supervised machine learning algorithm that is extremely popular and is used for Classification and Regression problems in Machine Learning. We know that a forest comprises numerous trees, and the more trees more it will be robust. Similarly, the greater the number of trees in a Random Forest Algorithm, the higher its accuracy and problem-solving ability.



Machine Learning For Crop Recommendation



TRAINING AND TESTING PHASE OF RANDOM FOREST :

After, importing we are going to allow the model to train upon the training dataset by using fit() method. The model will pick up patterns and connections between input features (x_train) and associated labelled or target outputs (y_train) throughout the training phases.

PREDICTION PHASE : Once the model was trained and tested on the data that was given. We can use that model for predicting class labels for new input data.Input parameters for the model will include values for humidity, ph level, rainfall, and temperature.. Finally, the model will give class label that is the most suitable crop for land according to given parameter values.

Machine Learning For Crop Recommendation

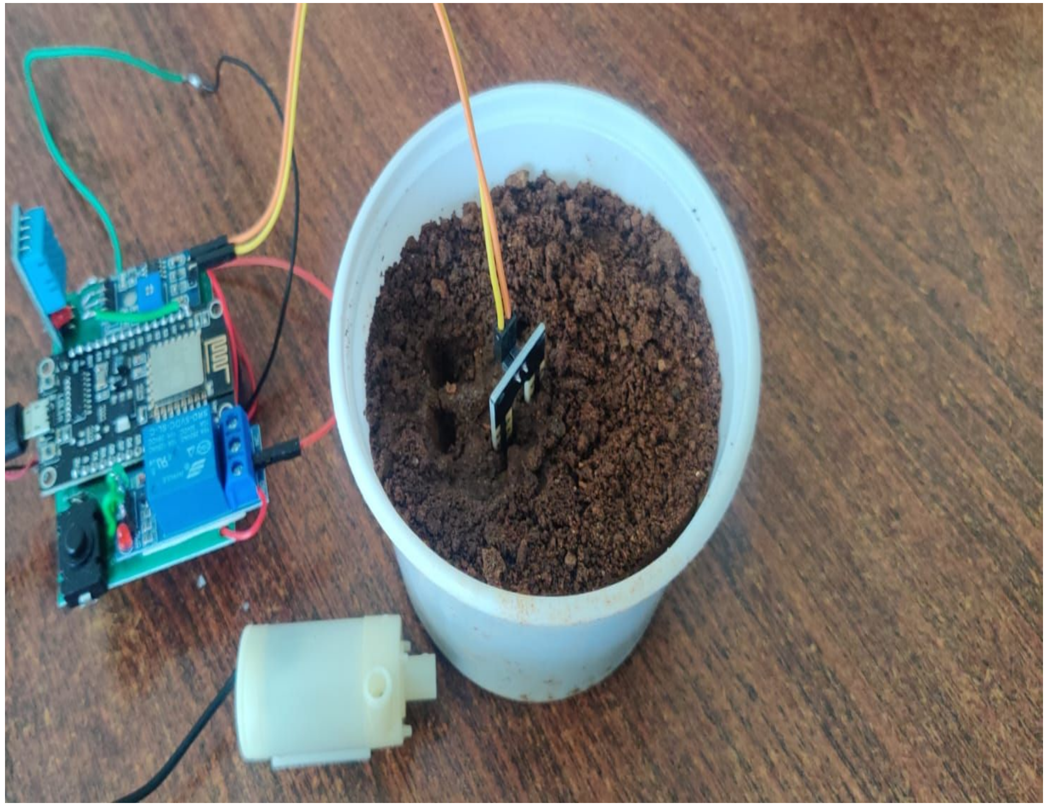
ACCURACY MEASURE: For measuring the performance, we use accuracy_score as our performance metrics. Along with this, we are going to visualize the predicted labels (y_pred) and actual labels (y_test) for given test data using scatter plot.

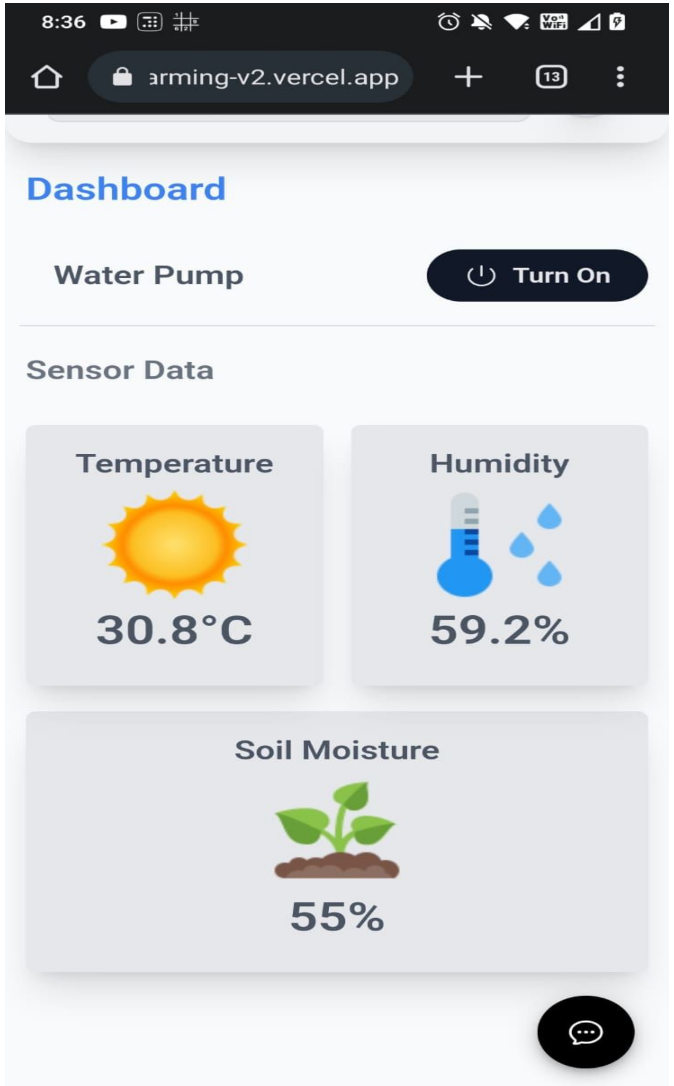
Accuracy measures of algorithms with our training data is 99%

ALGORITHM	ACCURACY
Decision Tree	93%
KNN	90%
NAIVE BAYES	89.3%
SVM	76.6%
ANN	85%
RANDOM FOREST	99%

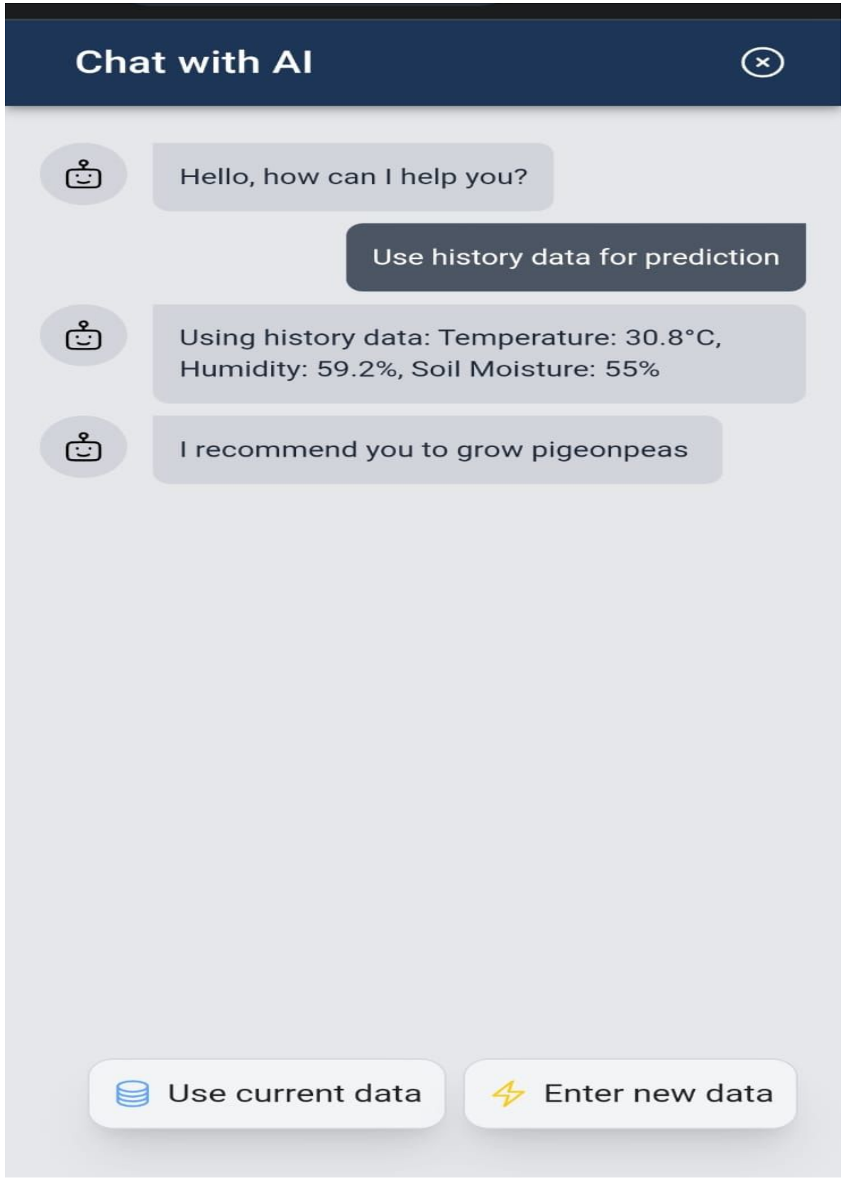
Accuracy for different algorithms are derived from reference paper [1] & [4]

RESULT




8:36
arming-v2.vercel.app
13
Dashboard
Water Pump
Turn On
Sensor Data
Temperature
30.8°C
Humidity
59.2%
Soil Moisture
55%

RESULT


Chat with AI
Hello, how can I help you?
Use history data for prediction
Using history data: Temperature: 30.8°C, Humidity: 59.2%, Soil Moisture: 55%
I recommend you to grow pigeonpeas
Use current data
Enter new data


Chat with AI
Hello, how can I help you?
Temperature: 20°C, Humidity: 30%, Soil Moisture: 25%
Thank you for your information!
I think you should grow maize|
Use current data
Enter new data

RESULT

Project demonstration video link

https://drive.google.com/drive/folders/1-b8US_WtWKk-pCH12l6bDU2dIaZvQME3?usp=sharing

CONCLUSION

The advent of a smart irrigation system fueled by machine learning holds tremendous promise for revolutionizing agriculture. By intelligently analyzing data through random forest algorithm which has 99% accuracy and predicting optimal irrigation schedules, this technology can significantly enhance water efficiency, boost crop yields, and contribute to sustainable farming practices. With its potential to address water scarcity challenges and alleviate the burden on farmers, the smart irrigation system stands as a beacon of innovation that has the capacity to reshape the future of agriculture and contribute to a more resilient and ecologically balanced world.

FUTURE SCOPE

The future scope for smart irrigation systems and crop recommendation using ML is very promising. ML algorithms are becoming more accurate and precise, and they are being used to develop new technologies that can improve the efficiency and effectiveness of these systems. This will lead to improved water efficiency and crop yields, which will be essential for meeting the growing demand for food in the coming years.

- ML algorithms can be used to predict the optimal time and amount of water to irrigate using data from satellite imagery, new sensors, and other technologies.
- ML can be used to develop crop recommendation systems that take into account a wider range of factors, such as the climate, soil conditions, and pests.
- Smart irrigation systems can be integrated with other technologies, such as drones and robots, to improve their efficiency and effectiveness.

LEARNING OUTCOME

- Understanding in utilizing and operating machine learning (ML) tools for analyzing soil and crop data, making recommendation, and assisting in decision-making processes.

- Familiarity with installing and integrating modules and packages relevant to the project, such as remote sensing software, data processing libraries, and ML frameworks.

- Ability to analyze and interpret data collected through sensors, using ML techniques to extract valuable insights for better soil and crop management.

- Integration skills for combining ML algorithms with data collected from hardware to process and analyze large-scale agricultural information effectively.

- Project planning and execution capabilities, including defining objectives, setting milestones, and achieving project deliverables in the context of soil and crop management.

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Thank You