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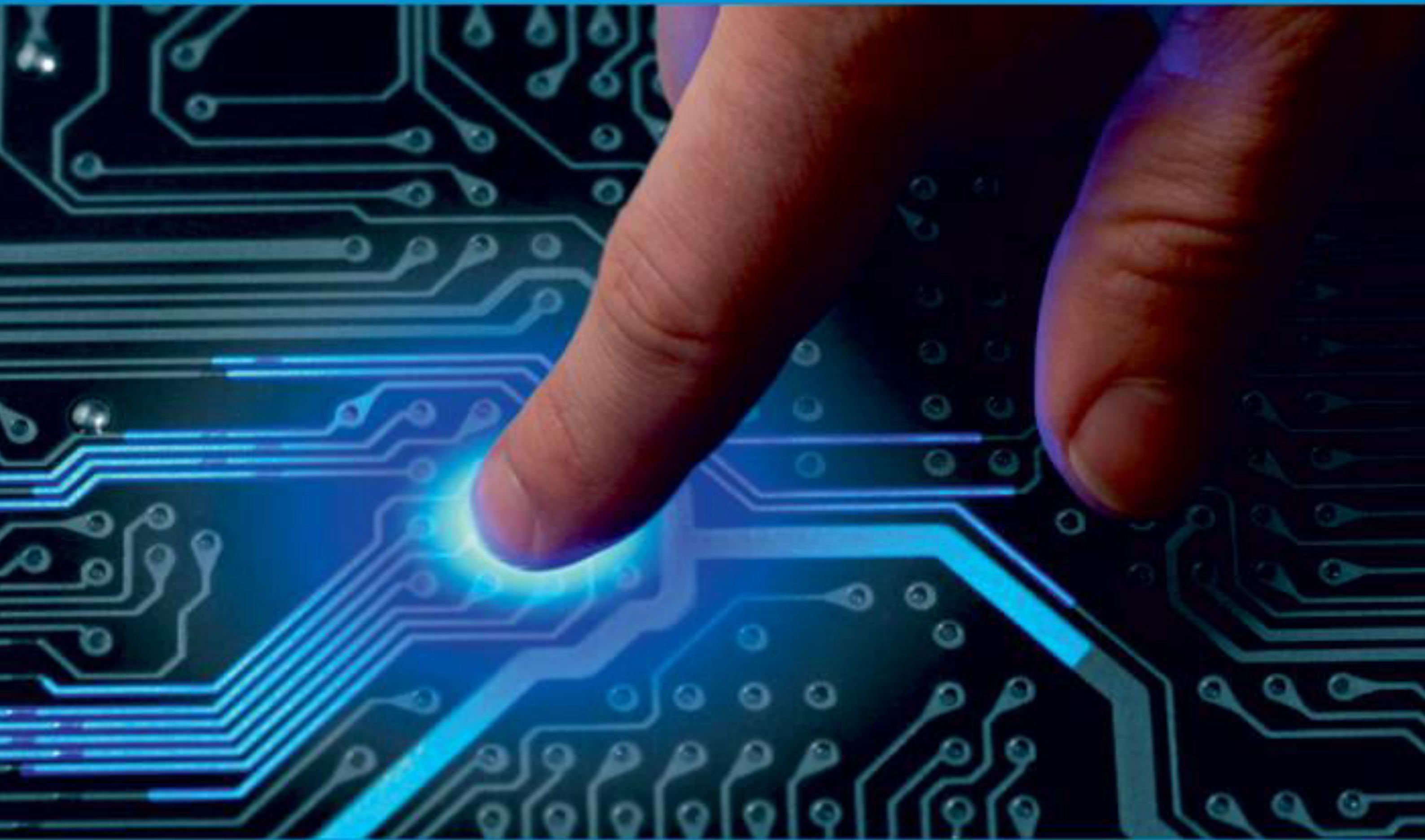

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Soil Fertility Detection and Crop prediction using ML and IOT

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ABSTRACT: This transformative project is dedicated to advancing agricultural methodologies through the strategic application of technology. By focusing on precise location parameters such as state, district, and season, the project endeavours to predict crop outcomes with unprecedented accuracy. Leveraging state-of-the-art image recognition technology, the system is designed to predict and diagnose crop diseases swiftly and effectively. Additionally, the project incorporates advanced algorithms to forecast rainfall patterns based on region and month, enabling farmers to make informed decisions regarding irrigation and crop management. The comprehensive crop recommendation system considers a myriad of factors including nitrogen, phosphorus, potassium, temperature, humidity, pH, and rainfall, providing tailored suggestions to optimize crop growth. Furthermore, the fertilizer recommendation component utilizes a holistic approach, considering nitrogen, phosphorus, potassium, temperature, humidity, soil moisture, soil type, and crop variety to offer precise guidance. The integration of a chatbot feature ensures real-time support and seamless access to weather forecasts and National Weather Service data feeds. Through the amalgamation of data analytics, image recognition technologies, and machine learning algorithms, this project aims to equip farmers with invaluable insights and recommendations to elevate crop yield and sustainability practices in the agricultural sector.

KEYWORDS: Crop Prediction, Rainfall Prediction, Crop Diseases Prediction, Crop Recommendation, Fertilizer Recommendation, Weather Forecast, Chatbot Support, IOT, Machine Learning.

I. INTRODUCTION

The global economy greatly depends on the agricultural sector. With an increasing global population, the agriculture sector will face greater challenges. Data is used in two new scientific fields: agri-technology and precision farming, also known as "digital agriculture" by some. A key function for agriculture plays in the world economy. To address concerns about food security and lessen the effects of climate change, it is more crucial than ever to comprehend global agricultural productivity. One of the main problems in agriculture is projecting crop yields. A number of weather-related factors, including temperature variations, pesticide use, and heavy rainfall, have a big influence on agricultural productivity.

One major factor influencing agricultural productivity is the weather forecast. As a result, planting decisions are made in accordance with the weather forecast, which is predicted. Weather forecasting is the application of science and technology to predict future atmospheric conditions for a certain area and period. Informal weather forecasting has been practiced for thousands of years, especially since the nineteenth century. Weather forecasts are created by gathering information about the atmosphere's current condition at a certain area and then utilizing the weather to forecast future changes to the atmosphere. Finding the finest predictive model for forecasting still requires individual involvement.

Improved weather forecasting for agriculture has clear advantages, and farms are one of the main clients of private weather forecasting companies. The weather determines when crops are best planted, fertilized, watered, and harvested. Farm productivity can be increased by farmers with access to accurate meteorological data for every area of the farm. Crops can be grown and exported more quickly when weather forecasts are used. Around the world, there are a lot of dirt rural roads. Farmers need to know whether it's safe to use them. In order to help farmers choose the right crops and irrigation techniques in response to shifting weather conditions, we employ data from a particular place to forecast future weather.

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II. RELATED WORK

"Smart Agro Farm Solar Powered Soil and Weather Monitoring System for Farmers" Devi Devapal (2020) Proceedings 24 (2020) 1843–1854, DIRECT SCIENCE A low-cost solar-powered soil and weather monitoring system that analyzes the various soil qualities and climates to create a high-tech smart farm for farmers might be referred to as a smart agro farm. The three primary modules of this approach are the web application module, machine learning module, and Internet of Things module. The IoT module has circuit connections and a range of soil sensors for characterizing moisture or wetness in the soil. It also automatically or self-sufficiently uses alternative energy to operate, making it very affordable for farmers. due to the possibility that the vector division methodology used as the input for the K-means cluster originated from.

Renuka and Sujata Terdal, "Evaluation of Machine Learning Algorithms for Crop Prediction," Volume 177, October 2020, SCIENCE DIRECT, 105709, The expansion of the national economy is significantly influenced by agriculture. It depends on various environmental factors and the weather. Many of the elements that make agriculture possible are soil, temperature, precipitation, flooding, fertilizers, crops, pesticides, and herbs. Because it depends on many variables, the crop output is difficult to forecast. In this work, we often use various machine learning approaches to conduct descriptive studies on agricultural data in order to gain an understanding of crop production status. Crop yield estimates include the estimation of crop yields based on historical crop yields, soil data, and readily available precipitation information.

J. C. Augusto, M. Quinde, J. G. Giménez Manuel, S. M. M. Ali, C. L. Oguego, and C. James Reynolds, "The SEArch Smart Environments Architecture," in the 15th International Conference on Intelligent Environments (IE), Rabat, Morocco, 2019. One important catalyst for innovation in ICT, computing, and technology with social impact is now sensing technology [1, 2]. Recently, the company and world have created a wide range of systems that support the concept of "smart technologies," implying the possibility to gather exact conversational information through sensing and supporting more useful decision-making. several of those advancements

III. METHODOLOGY

The Internet of Things, or IoT, is nothing more than cutting-edge technology that allows devices to be controlled and monitored in real time from anywhere in the globe. Our goal is to create a technology that can assist with an automated watering system by determining the ground's moisture content. The technique of predicting crops involves combining historical and current data from multiple IoT-connected sensors. One way to automate a given model is to analyse data using machine learning. Crop forecast within the historical data was computed by an analysis of farmers' experience with climate conditions. Lastly, a web application is created to give farmers the necessary knowledge and direction on growing preferred crops. Thus, our technology is the ideal fusion of machine learning and IoT.

Block Diagram:

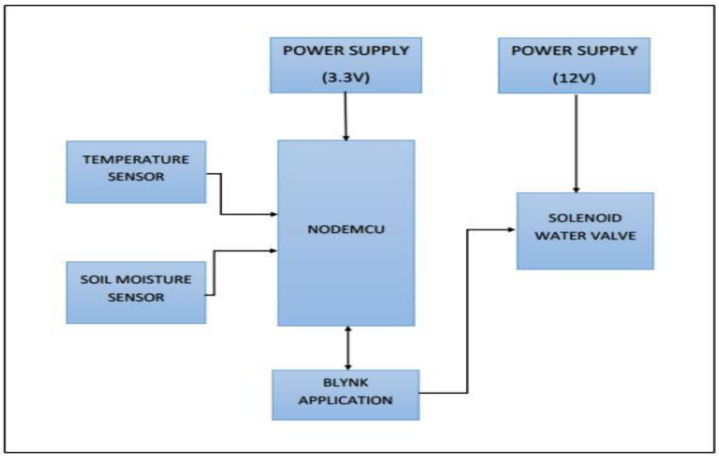

Fig 1 Block Diagram of Proposed System

The planned system is NODE MCU primarily based automation for optimizing utilization of water resources and reducing labour value in agricultural applications. System consists of NODE MCU platform and useful elements like

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moisture device & motor load and proposed block diagram shown in the figure. NODE MCU could be a single board elements hardware and IDE code interface for playing automation operations. moisture device detects the humidness level of soil. Soil moisture and temperature planned vary is about significantly for specific plants demand, and in keeping with that system is being operated. Motor load includes water pumps and concerned accessories for provision water to plants. Atmega328 Microcontroller automates water cycle supported data collected from humidness and temperature device. If soil moisture level is a smaller amount than minimum outlined threshold price, microcontroller acts to automatically trigger pump to work until device meets most threshold.

A threshold value is about at the start of the procedure. The steps before fixing the threshold price are as follows: The soil moisture device is buried within the soil and the flow of water is opened a minimum of one inch of water is allowed to face on the soil. The soil is left beneath the sun for twenty-four hours. If it rains during this interval the procedure needs to be started from the start. The moisture reading is noted at the tip of twenty-four hours and with fifth deviation from the wetness reading, the threshold values are set.

The data is gathered and compared to the threshold reading. after the comparison, If the wetness content is higher than the threshold value then once a delay of a predefined time the value is scan once more and compared. If the wetness content is a smaller amount than the threshold reading, then the system bypasses one circle of reading the values. Signal is shipped to the pump to give notice a few phases change (From LOW to HIGH) Valve for the actual strip during which the wetness content is a smaller amount than the threshold reading is opened and water from the pump is allowed to flow.

IV. EXPERIMENTAL RESULTS

The soil moisture sensors are used and they are allowed to read the moisture content of the soil in every fixed interval of time. The data is gathered and compared to the threshold value. After the comparison, If the moisture content is more than the threshold value then after a delay of a fixed time the value is read again and compared. The monitored data compared with threshold value. After the comparison, if the moisture content is more than the threshold values then, the NODE MCU sends a signal to stop the motor. In another case if the moisture content is less than the threshold values then, the NODE MCU sends a signal to start the motor. The proposed system is also having a web application to monitor the agricultural environment and here we can see the various sensor output and weather conditions and these values are taken for crop prediction

RESNET-9

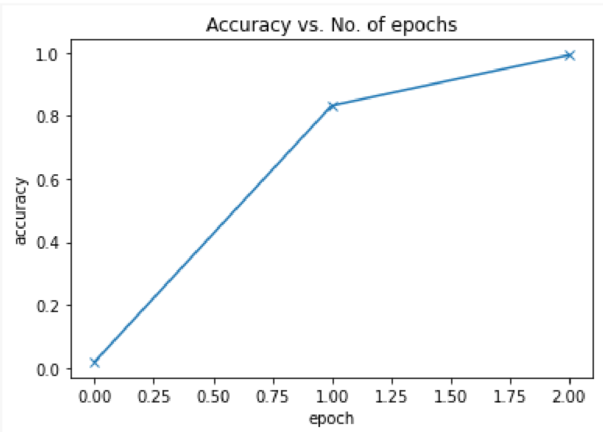

Fig. Validation Accuracy For Disease Prediction

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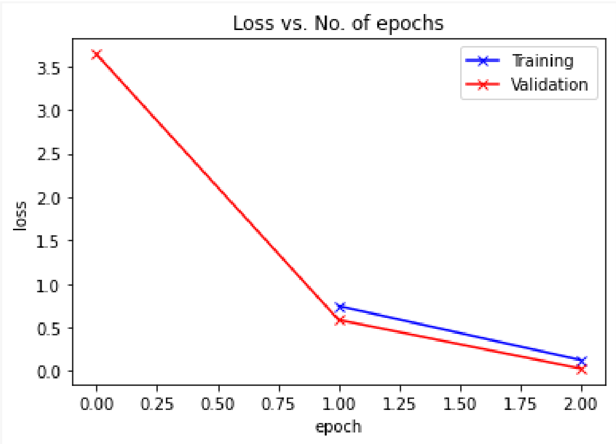

Fig. Validation Loss For Disease Prediction

IOT Model Results:

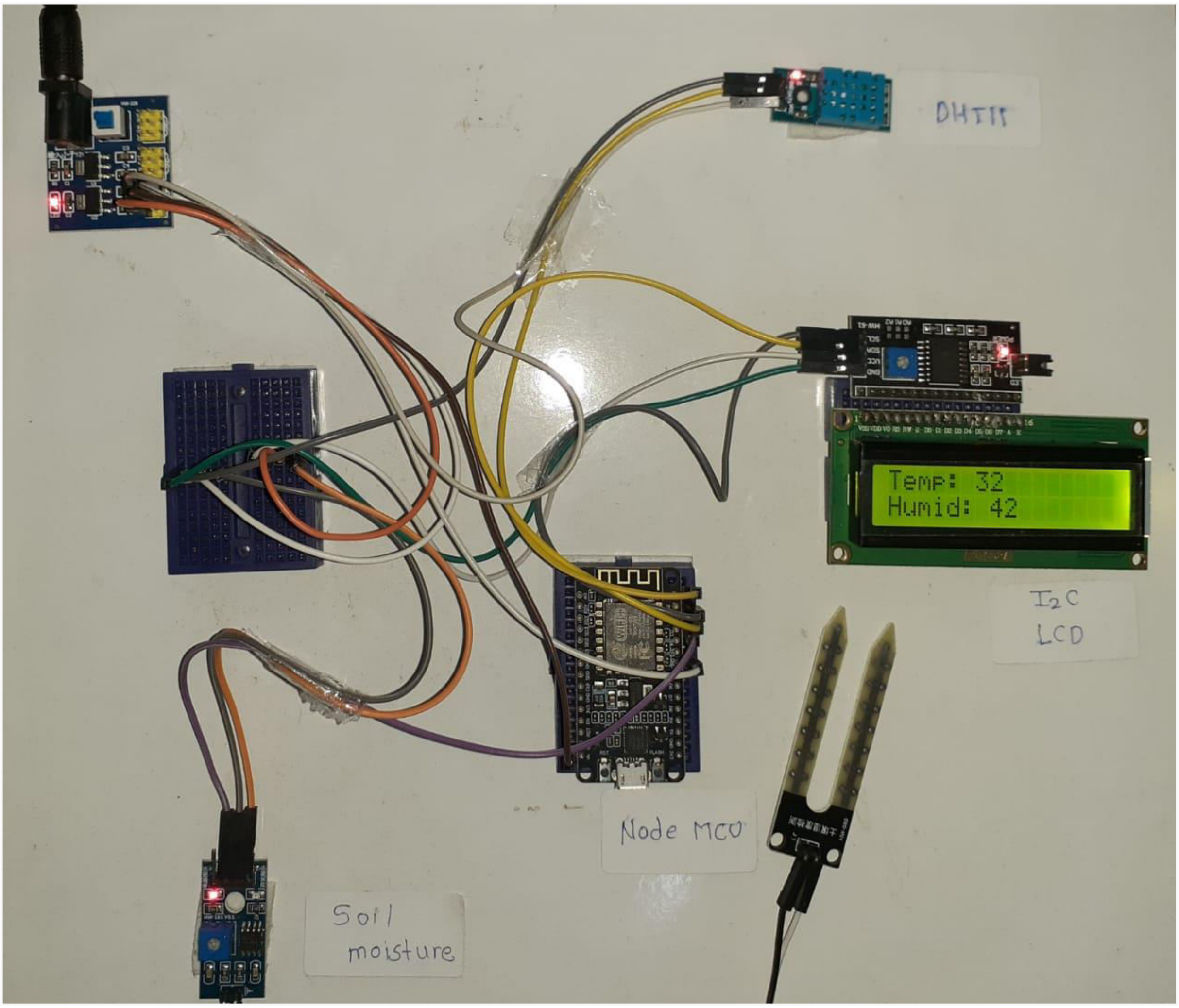

Fig. Real time Parameters by IOT model

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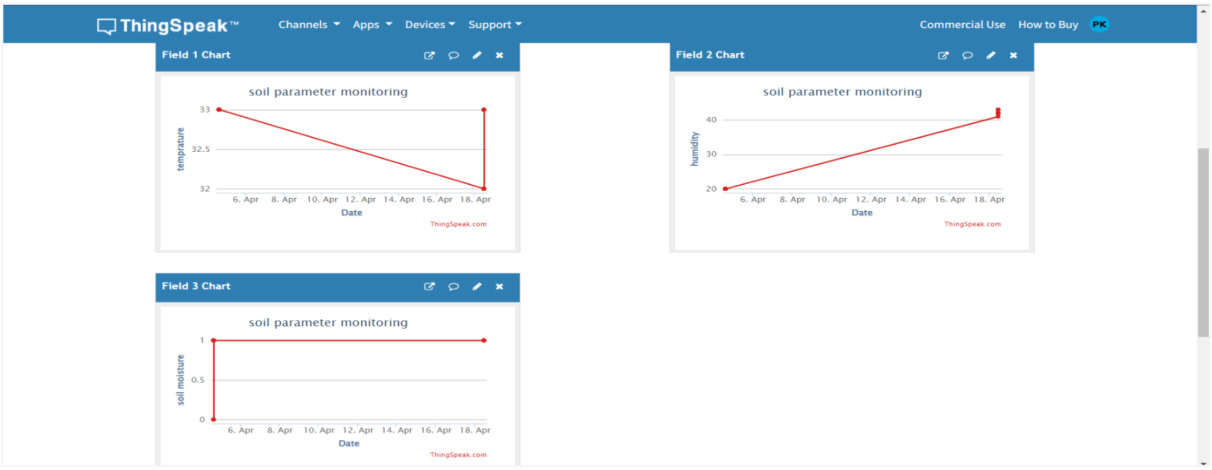
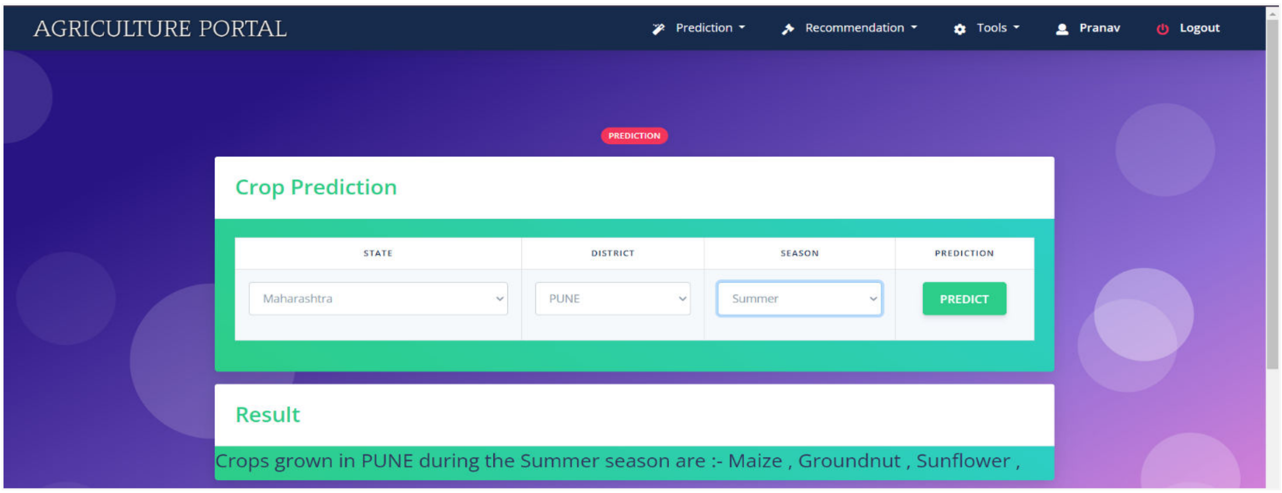
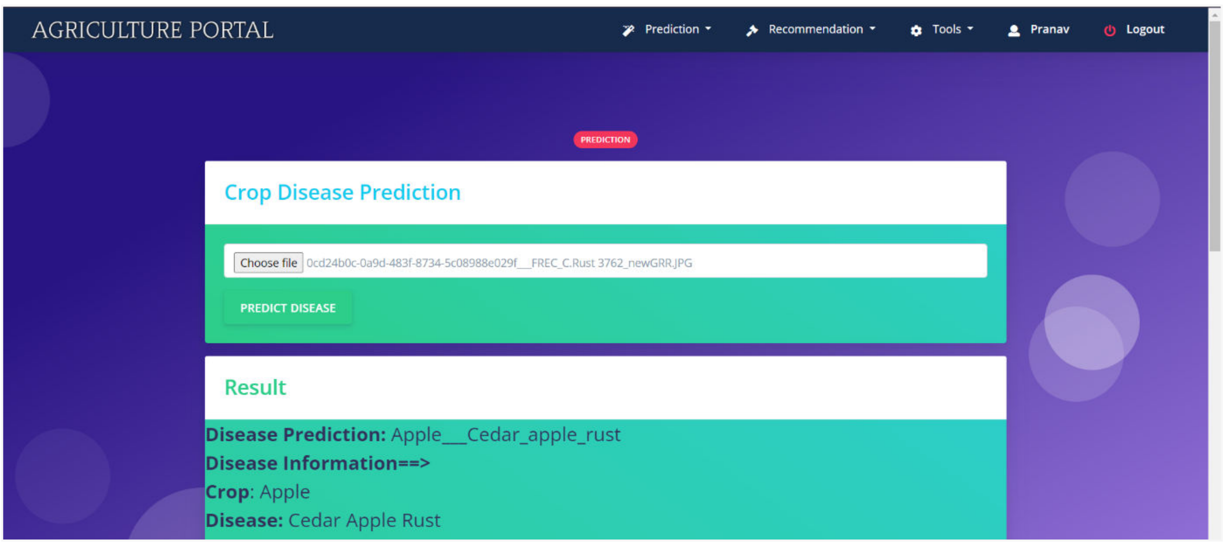


Fig. Real Time Data Visualization with the help of ThingSpeak

Web Application Results:



Results for Pune, Maharashtra, in summer, suggest Maize, Groundnut, and Sunflower as suitable crops based on historical data and local conditions.



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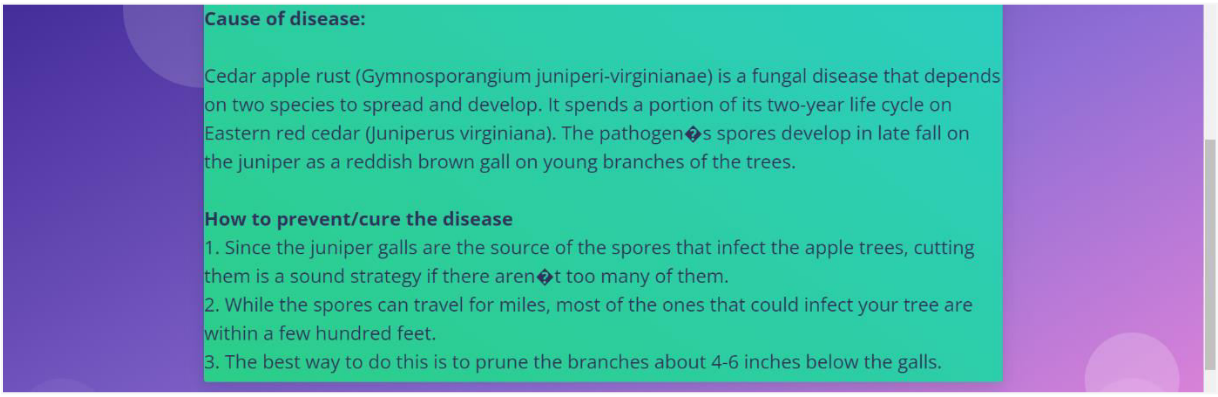
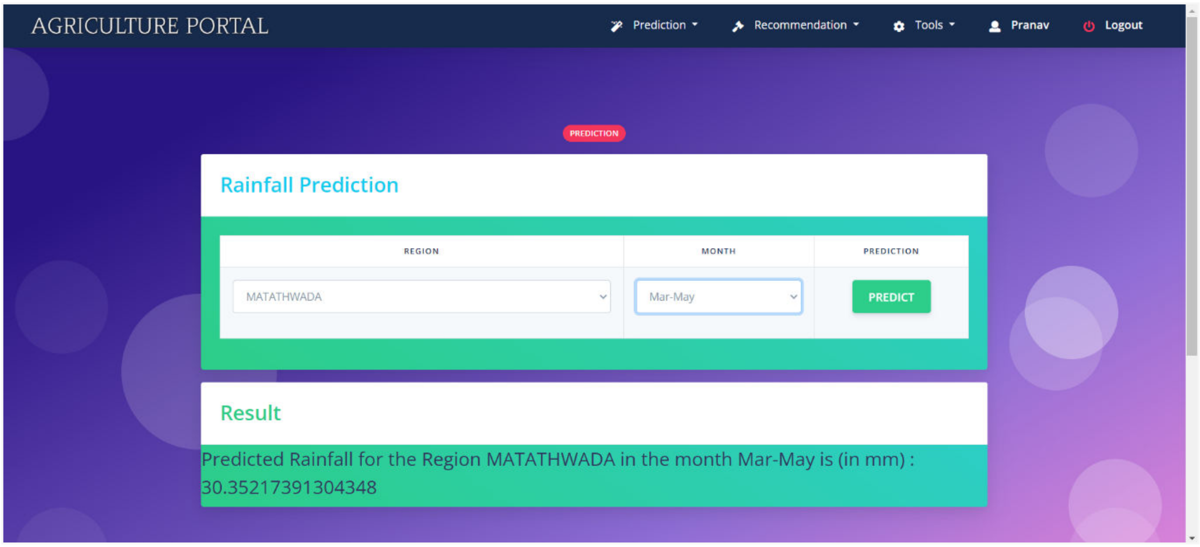
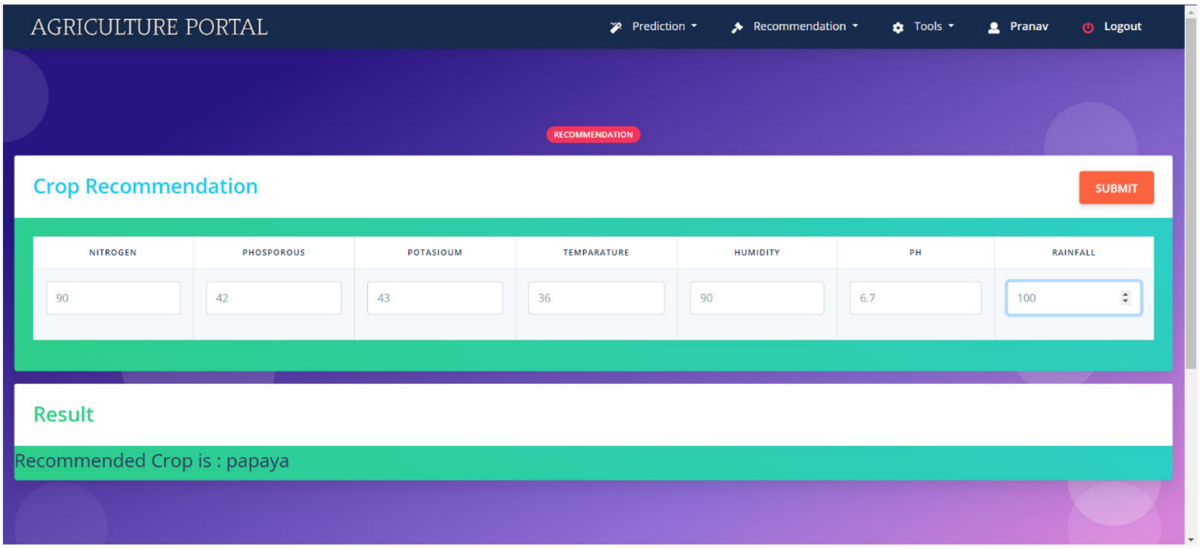


The above figure shows the crop Disease Prediction for the uploaded image of the plant. The disease prediction and also the causes and how can cure the disease in is given in the results.



The above figure shows the Rainfall Prediction based on the region and month. It indicates that rainfall in Maharashtra is predicted from March to May.



The above figure shows the Crop Recommendation result based on the given parameters (N, P, K, Temp, Hum, PH, Rainfall).

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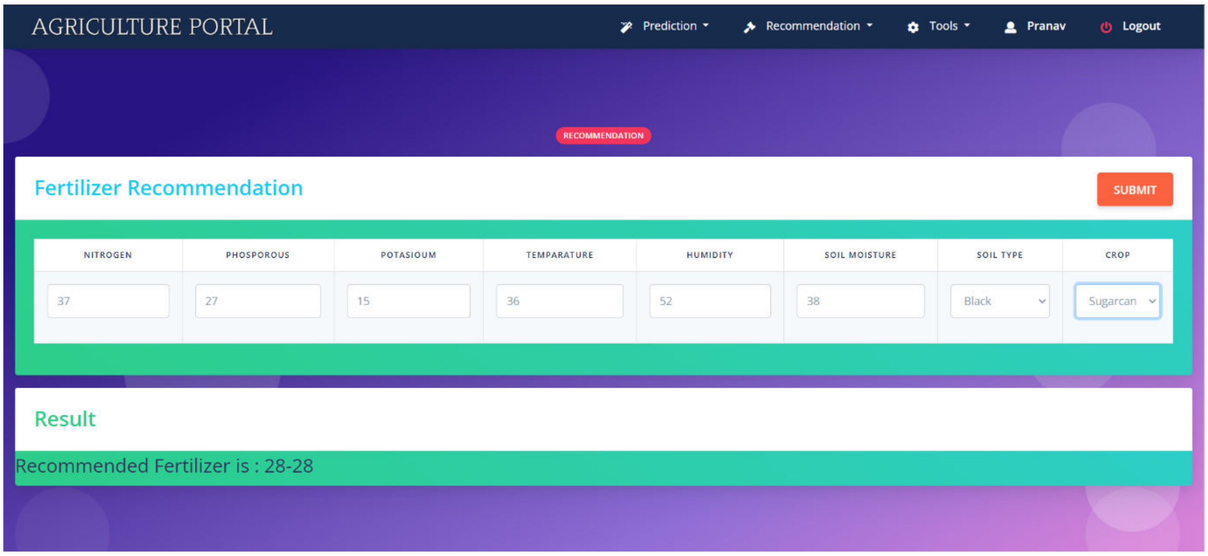
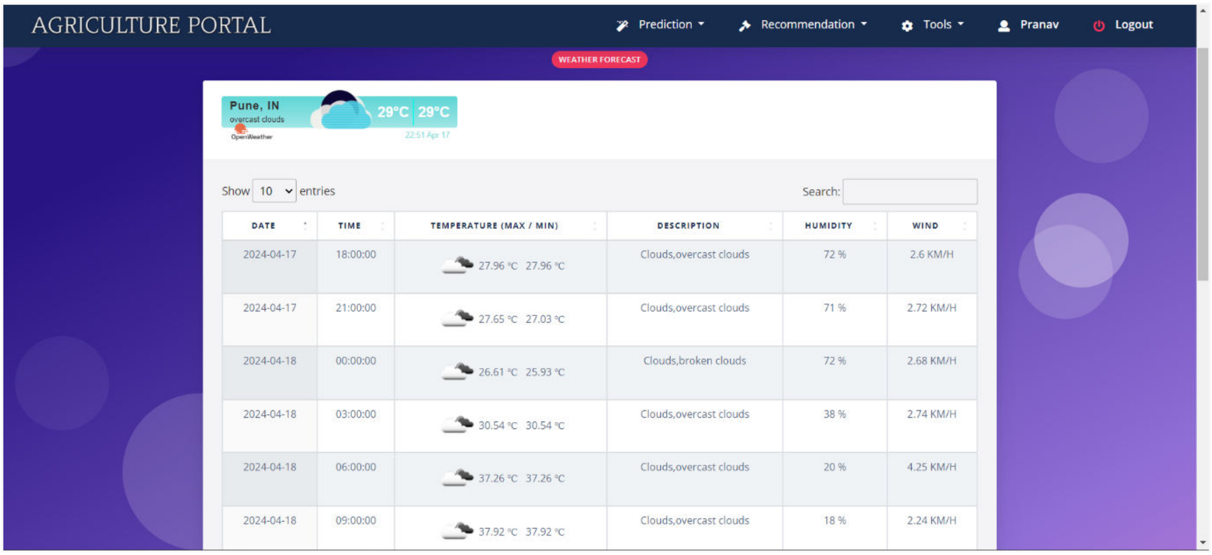


The above figure shows the Fertilizer Recommendation result based on the given parameters (N, P, K, Temp, Hum, Moister, Soil Type, Crop).



The above figure shows the Weather Forecast for up to 4 days using the Weather API. This will help Farmers to make decisions according to the weather conditions.

V. CONCLUSION AND FUTURE SCOPE

The precision agriculture project presents a comprehensive framework for enhancing agricultural practices through the integration of advanced technologies such as machine learning and the Internet of Things (IoT). By leveraging data-driven insights and real-time monitoring capabilities, the project aims to optimize crop yield, mitigate risks, and promote sustainability in farming operations. Through the development and deployment of innovative solutions for soil fertility detection, crop prediction, rainfall prediction, crop disease prediction, fertilizer recommendation, weather forecast, and news aggregation, farmers are empowered to make informed decisions that positively impact crop health, resource utilization, and overall productivity. The implementation of ResNet algorithms for image-based crop disease prediction, coupled with other machine learning techniques such as SVM, random forest, and gradient boosting, demonstrates the versatility and effectiveness of modern computational approaches in addressing complex agricultural

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challenges. Furthermore, the integration of IoT devices, including soil sensors, weather stations, and imaging devices, enables real-time data collection and analysis, facilitating proactive management of crop health and environmental factors. The utilization of edge computing devices and cloud servers ensures efficient processing and storage of large volumes of agricultural data, while user-friendly interfaces and chatbot support enhance accessibility and usability for farmers.

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