SOIL INTERPRETATION AND CROP PREDICTION USING IOT AND MACHINE LEARNING

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Abstract: Efficient soil fertility monitoring and precise plant prediction are critical for optimising agricultural practises and increasing crop yields. People are pressed for time in today's hectic environment, yet technology is giving them more power than ever.The productivity of plants is directly impacted by traditional farming's different ambiguities in identifying some chemical qualities of soil.In modern agriculture and environmental management, soil analysis is crucial. Soil analysis has experienced a remarkable metamorphosis with the emergence of cutting-edge technologies like the Internet of Things (IoT) and machine learning, improving the accuracy, efficiency, and sustainability of agricultural practises. The IoT revolution has made it possible to put sensor-based equipment in agricultural fields, making it easier to collect vital soil parameter data in real-time. The soil conditions are continuously monitored by these IoT sensors, which are furnished with sensors for moisture, temperature, pH levels, nutrient content, and salinity.Machine learning algorithms have become effective resources for analysing soil data.Accurate forecasts of soil conditions and attributes are made possible by machine learning models that are trained to recognise patterns, correlations.The integration of IoT and machine learning approaches in soil analysis is discussed in this abstract, with special attention paid to recent developments, practical uses, and promising future directions.. By offering individualised recommendations for fertilisation, irrigation, and pest control based on current and past soil data, these systems optimise agricultural practises. Additionally, IoT-based soil analysis tools give farmers the ability to access real-time soil data and manage farming operations from any place via mobile applications or web interfaces.Precision agriculture is made possible by IoT and machine learning use in soil analysis. Using soil maps, farmers may locate spatial diversity within fields and apply site-specific agricultural techniques. This focused strategy maximises crop output while reducing environmental impact and maximising resource utilisation.

Keywords: Soil fertility detection ,crop prediction ,Internet of things ,Machine learning ,Iot sensors ,data analysis, decision-making, crop productivity, environmental sustainability.

I. INTRODUCTION

Soil fertility monitoring and crop prediction are crucial in modern agricultural for optimizing resource management and sustainability agricultural practices.Soil fertility refers to the ability of soil to offer vital nutrients and favourable circumstances for crop growth whereas crop prediction involves estimating crop performance based on environmental parameter such as soil conditions.Traditional techniques to soil fertility detection and crop prediction frequently rely on manual and time consuming processes that may not provide real time information or precise predictions.Understanding the health of the soil, its nutritional composition, its moisture content, and other critical factors that affect crop output is possible thanks to soil analysis. In order to improve the precision, effectiveness, and sustainability of soil analysis processes, the integration of Internet of Things (IoT) and machine learning has emerged as a disruptive strategy.An interconnected system of gadgets with sensors and actuators that can gather and share data online is known as the Internet of Things (IoT). To monitor different soil factors, including moisture content, temperature, pH levels, nutrient levels, and salinity, IoT devices with sensors are placed in agricultural areas. These sensors continuously gather current data, giving insightful information about the dynamic nature of the soil. ntrarily, machine learning is an area of artificial intelligence that focuses on creating models and algorithms that can automatically learn from data and make judgements or predictions. The gathered soil data can be examined to find patterns, correlations, and anomalies using machine learning techniques. On the basis of the input data, machine learning models can be trained to identify these patterns and produce predictions or classifications.There are many benefits to IoT and machine learning integration in soil analysis. A constant stream of information is provided through real-time data collecting using IoT devices, which eliminates the need for labor-intensive and laborious soil sample. This enormous volume of data can be processed by machine learning algorithms to uncover insightful information that was previously difficult to discover through traditional methods.

IoT and machine learning have a plethora of potential uses in soil analysis. The gathered information and insights can be used by farmers and agronomists to improve agricultural practises such pest control, fertiliser use, and irrigation timing. Personalised recommendations based on current soil data can be provided by decision support systems, supporting farmers in making educated choices.

Additionally, IoT-based soil analysis devices allow farmers to obtain real-time soil data from any location thanks to their remote monitoring and control capabilities. With less need for actual presence in the fields, farming activities may be managed more effectively.Another key result of incorporating IoT and machine learning in soil research is the rise of precision agriculture. Farmers can develop thorough soil maps, spot diversity within fields, and apply agricultural techniques unique to each site by analysing the data gathered. This focused strategy allows for the optimisation of resource use, reduces negative effects on the

environment, and increases agricultural productivity.
In conclusion, the application of machine learning and IoT to soil analysis has transformed the agricultural industry. Farmers and agronomists may make data-driven decisions, optimise agricultural practises, and adopt sustainable farming practises thanks to this integration's real-time data collecting, powerful analytics, and remote accessible features. A brighter and more fruitful future for agriculture is promised as a result of the great potential for additional innovation in soil analysis using IoT and machine learning.

II.PROPOSED SYSTEM

The system's goal is to assist farmers in making informed crop decisions. Along with live data, past temperature and humidity data from the government website is collected and kept to improve accuracy. In addition, historical rainfall data is gathered and maintained. To be certain and accurate in crop prediction, the project examines the temperature and humidity of the field – both live data collected using the DHT-22 sensor and historic data collected from the government website and/or Google Weather API the type of soil used by the farmer, and historic rainfall data. It is possible to achieve this using used by the farmer, and historic data. It is possible to achieve this using either an unsupervised or supervised machine learning technique. The dataset is trained using learning networks. The accuracy acquired by several machine learning approaches is compared in order to obtain the most accurate result.

Hardware Components:.

The DHT22sensor is advised for monitoring real-time temperature and humidity. It is a digital Temperature and humidity sensor.It has been demonstrated that this sensor is more accurate and precise.It uses
A capacitive humidity sensor and a thermistor to detect the ambient air ,and it delivers a digital signal on the data pin to the Nodemcu ESP8266 Uno port pin. DHT22 has a temperature range of -40 to 80 degrees Celsius and a humidity range of 0 to 100% RH.For measuring moisture when an LCD and Nodemcu ESP8266 are linked, a moisture sensor is advised. The soil contains the moisture sensor. All of the sensors are linked to the PCB distributor, as is the Nodemcu ESP8266.

Software Components:

The Thinkspeaker platform is utilised to gather data from the hardware component, and the Anaconda platform with Jupyter IDE is used to estimate the crop using machine learning.

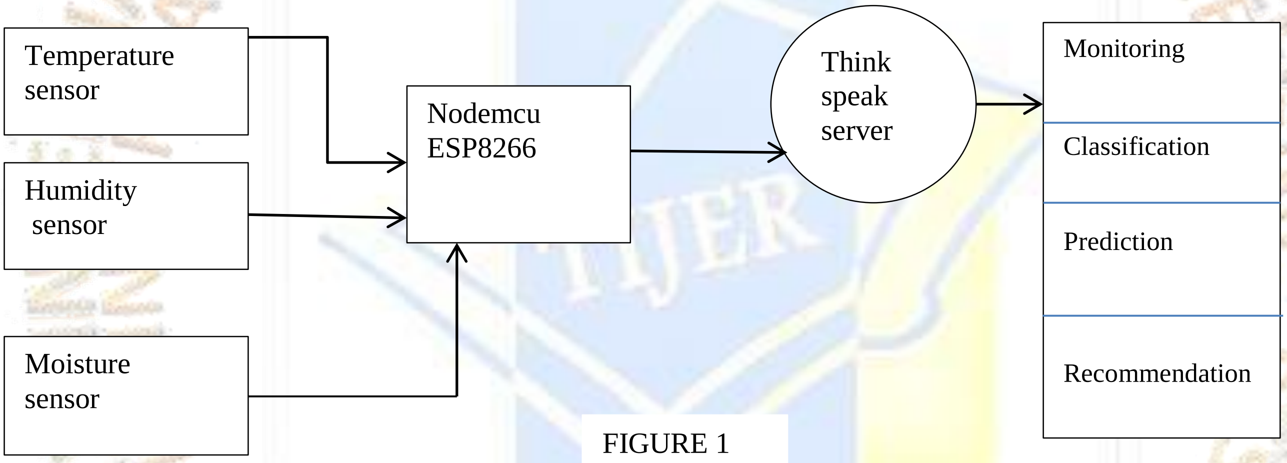

FIGURE 1

In accordance with Figure 1, when the microcontroller receives power, the sensers detect the characteristics of the soil and show the values on an LCD. Every hour, live data are gathered and saved on the Thinkspeak Platform. The VAR (Vector Autoregression) model is used on this data to anticipate temperature, moisture content, and humidity for the time the farmer intends to cultivate the crop. In order to compare the combination of the aforementioned results and the predefined data set, i.e. the actual crop requirements present in the crop data store, three different ML algorithms—Decision Tree, K-NN, and Support Vector Machine—are fed the forecasted temperature,humidity and moisture. After analysing the accuracy obtained by several machine learning algorithms, the user is shown the crop that is the most precise and suitable. The result is that the farmer gets the best yield possible from the website.

IV. RESULTS

The training dataset used offers details on temperature, humidity, moisture factors, crop pH, and other characteristics connected to these.The accuracy of three different types of machine learning algorithms—Decision Tree, KNN, and Support Vector Machine (SVM)—is compared. Support vector machines are used to predict the crop since they have the highest accuracy of all.

	field1	field2	field3	crops
0	34.5	42.1	0	1
1	34.5	42.4	0	0
2	34.5	43.3	0	1
3	34.5	43.4	0	0
4	34.6	43.8	1	0
...	...	...	...	...
689	31.7	78.3	0	1
690	31.6	78.3	0	1
691	31.5	78.6	0	0
692	34.2	34.4	0	1
693	33.9	34.8	0	0

Field 1:temperature
Field 2:Humidity
Field 3:Moisture

V. CONCLUSION

In this work, we offer a novel approach to smart agriculture that makes use of two rising technologies: the Internet of Things and machine learning. Using both live and historical data helps to improve the accuracy of the outcome. Comparing several ML algorithms also improves the system's accuracy. This method will be utilised to alleviate farmers' challenges while increasing the amount and quality of their job. The use of IoT and machine learning in soil analysis has enormous potential to revolutionise agriculture by giving farmers with real-time insights, optimising resource allocation, and encouraging sustainable agricultural practises. This technology-driven approach has the potential to raise food production, farm efficiency, and long-term environmental stewardship in the agricultural sector.

VI. FUTURE SCOPE

The system can be improved further by including the following features:the use of environmental sensors and pH sensors to improve crop prediction accuracy .While recommending a crop,the location's market requirements and neighbouring farmer's crop might be taken into account.

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