Crop Recommendation And Disease Prediction Using IOT And AI

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***Abstract*—Although farmers are the backbone of this emerging country, they face challenges in their daily lives related to finances and finding a place to work. These farmers search far and wide for the ideal location, climate, crop, and so on. By anticipating possible illnesses through image processing and suggesting appropriate crops based on real-time sensor data, you may use IOT and AI technology to improve agricultural operations. Used Sensors: Use sensors for pH, temperature, and soil moisture to gather important information from the agricultural field. Data Transmission: Create a communication network so that sensor-generated data may be sent to an AI model that has already been trained for analysis. Training AI Models: In order to precisely estimate the ideal crop options based on temperature, sand moisture, pH levels, give priority to training the AI model with pertinent data. Crop Recommendation: Create algorithms in the AI model that take into account the sensor data that has been collected in order to suggest the best crops yield in a certain location. An innovative answer to the growing need for effective and sustainable farming methods is the fusion of Internet of Things (IOT) with artificial intelligence (AI) technology. Thus the result of the project is to find a resolution for cost loss issue. In order to improve agricultural operations, this research uses real-time sensor data to select appropriate crops and forecast probable illnesses.**

Keywords: Deep learning, Machine learning, Algorithm and Technologies, Internet of things (IOT), Plant disease, Crop selection

I. INTRODUCTION

Food is the one of the necessary need for the world. The creation and developing of health foods is day to day life is decreasing because of the shortage of educated farmers in this era. The economy of India is still young is centered on agriculture. A few of the difficulties facing agriculture are limited and dispersed chemical used in landing, chemicals used in pests, dung, holding of land, and on forth. The substantial increase in the human population will undoubtedly put a great deal of strain for food supply. In traditional agricultural, farmers need soil with high-quality, naturally occurring nutrients, and a comparatively longer production period. The integration of both Artificial intelligent and Internet of Things can make drastic change in the part of agriculture. By using the AI, can identify and know more details about crops and agriculture. By using the IOT, farmers can communicate with them and got values from there. The actual problem is new farmer didn't know well about disease affected, crop and their yield. So unpredictably they yield different crop for good profit. But unfortunately they will not get the profit as they expect and also they don't know what was the solution for the disease. Farmers in rural areas might believe that it's challenging to identify the diseases that could affect their crops. Going to the agricultural office to find out what the illness could be is not a moderate option. Our main objective is to identify a plant disease by looking as its structure using image analysis and machine learning techniques. Reduced food production as a result of maladies and pests that wipe out crops or sections of plants is the root cause of food's shortages.

Additionally, fewer people in many less developed nations are knowledgeable about illnesses and pest management or control. Utilize image processing techniques in order to recognize and classify possible agricultural illnesses. Disease Prediction: By using image analysis to train the AI model to identify patterns and symptoms of crop illnesses, early disease detection may be achieved. By early identify can protect the crop from major Solution of the Problem. After a disease has been detected, offer suggestions or methods to deal with that particular crop disease, supporting farmers in prompt interventions. Utilize machine learning generate algorithm like KNN to define which crop is best. To generate this technology, it need some parameter values. Here using internet of things to obtain correct parameters. To obtain accurate parameters using IOT sensors like pH sensors, Temperature and humidity sensors and NPK sensors. Mechanization Incorporate automation elements to expedite the decision-making process and provide farmers with up-to-date information for effective and knowledgeable farming methods. So finally after all these analysis, With a 92.4% accuracy rate, we generate an improved performance level using the model's forecast for both disease and crop forecasting.

The following is the paper's contribution:

- A crop choice and disease forecasting system based on IOT and AI has been created.

- ML receives the necessary parameters from IOT sensors, and an algorithm is created.
- The right crop is selected and recommended that suit that field.

- Using camera, the image was sent to the deep learning for image processing and particular algorithm is generated

- Disease will be predicted and suggest solution for that particular disease to protect crop

Here mentioned the order of the project explanation:

The remaining of the document is as follows as a arranged ways: A few pieces of literature on crop prediction and disease prediction using IOT and AI are reviewed in the particular Section II. The suggested system architecture and its levels are listed in Section III. Section IV provides information and system architecture implementation. The outcomes of the suggested architecture under various circumstances in Section V. Finally the result and the conclusion of the paper and the technology is in Section VI.

II. LITERATURE SURVEY

Martin Kuradusenge [1] data mining techniques to forecast agricultural harvests in the future (i.e., maize and Irish potatoes. Polynomial, Support Vector, and Random Forest regressions were used to examine the gathered data. Accomplishing accuracy with 95%. Before start to implement need to know lot of IOT techniques. This paper is very useful to know more about IOT techniques in crop prediction as mentioned in [9].

Technological improvements have led to the adoption of the hydroponics smart greenhouse approach with a 93% accuracy rate. The massive average, an indicator of efficiency for the score assigned to F1, yields an accuracy of 33%, whereas the average with weights, which displays the quantity of instances connected to different class categories in [2], yields an accuracy of 93%. In this paper, s. metal introduced the crop monitoring system using IOT with analysis of hydroponic system. Here cloud computing is used with wireless wire connection. [8] paper discuss about the spoiler or destruction of crop in specific soil due to the excess rainfall and etc.

It has offered as machine learning (ML) and maintenance of data information have grown so quickly, the essential principles, significant applications, and pending challenges of machine learning (ML) in work risk management (WRM) are separated into two sections in this review to account for the fundamental understandings and pursuits associated with AI and ML. Machine learning may be divided into three primary categories: reinforcement learning, clustering, and prediction. Over the course of the following ten years, [3] is anticipated that the broad use of ML techniques would hasten the creation of long-term WRM strategies. crop yield prediction is the process of estimating a crop's yield using past data as well as a variety of factors, including temperature, weather, soil, and water. This [4] primarily focuses on the agriculture sector, as indicated in the abstract. This study examines and defines the use of the linear regression technique to estimate agricultural productivity based on data from the prior year. The Linear Regression Machine method is used to forecast precise outcomes.

In this system, Shima Ramesh [5] have presented Crop diseases in the area of images based on leaves categorization with the emergence in accurate methods. This work employs Random forest to separate good and ill leaves from the collected datasets. Histogram in the Oriented Gradient (HOG) is used to extract characteristics from a picture.

[6] discussed about the sufficient IOT devices for the farmers and also less knowledge for the new farmer. So the importance of IOT device for farmer and also crop suggestion using mobile application. By the way 24*7 connection and usage of irrigation and checking of it using mobile application.

[7] Convolutional neural network (CNN) architecture is given to display the image's classification, and also check in nutrient deficiency especially zinc in groundnut to help the farmers to yield groundnut in the field. So it will be useful to refer the ground nut plant. From [10], the modern farming using IOT to make use of sensors in various implementation in agriculture for making easy maintenance to yield more crop. IOT sensors like pH sensors, moisture, temperature and TDS are used to developed for optimal crop growth and Yolov5 is used in [11] for plant disease prediction with accuracy of 89%. Machine learning algorithm and deep learning algorithm like a CNN (conventional neural network) in particularly maize disease in [12].

To know more about behavior of the soil by using wireless sensor network(WSN) and applicate in machine learning algorithm to yield for crop production that was mentioned in [13]. Supervised algorithm is used in [14] to help farmers to identify crop prediction especially random forest. The result of [15] is to developed in application. That application contains best crop and fertilizer, soil's fertility, Irrigation level and detect disease that all are mentioned as Agro engineering.

Multiple machine learning algorithms are used and compared to predict which crop is best. At last KNN is the best to use in [16]. IOT monitoring system that is used to monitor and fortune about crop in future and also identify the problems happening in the future as soon as possible rectify it in [17].

using the ATMEGA controller in [18], identify the weather condition and natural disaster like flood and drought will predict to improve crop production. In [19] introduced about precision agriculture (PA) especially in weather condition by using both IOT and Machine learning.

LPWAN (low power wire area network) technology is used in [20] to solve food security problem for agricultural sector.By using this LPWAN low power of WAN is used. So it canbe used for many farmers to increase the productivity.

From the related works, verified lots of paper and came to conclusion that is to assess field variables including

temperature, soil moisture content, and pH levels, the current approach uses sensors. makes use of sensor data to automate the application of water, guaranteeing ideal irrigation depending on current field conditions. enhances crop nutrition by implementing partial automation for nutrient administration and modifying levels depending on sensordata. helps farmers manage water and nutrients moreeffectively by using sensor-generated data to make smartdecisions. The combination of AI and image processing isnecessary to improve illness identification and resolution,even if the existing technique is effective for field-levelmonitoring but lacks advanced disease prediction capabilities.

III. METHODOLOGY

Incorporates AI to optimize plant cultivation under variable field circumstances by making precise crop selections based on sensor data. uses image processing methods integrated into the AI framework to accurately and early identify agricultural crop selection as mentioned in Fig 1 and makes use of IOT to present farmers with real-time disease alerts and suggested solutions, improving their response time to crop health problems which combines sensor data, AI forecasts, and image processing output to present a thorough picture of crop health and field circumstances. By combining AI, image processing, and IOT in a seamless manner, the suggested approach guarantees intelligent decision-making and encourages proactive and effective farming practices.

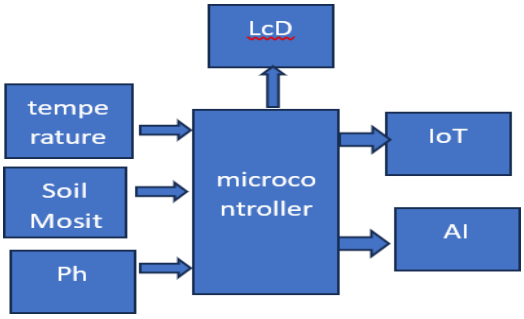

Fig. 1. IOT(crop selection) – crop selection module

A. Arduino Universal Networking Objects (UNO)

A microcontroller board depend on the ATmega328P is called the Arduino Universal Networking Objects (UNO). It offers an easy-to-use platform on which to construct all kinds of electrical projects. The agricultural system's primary control device is the Arduino Universal Networking Objects (UNO), gathering data from sensors, analyzing it, and sending it to the AI model.

B. LCD(Liquid Crystal Display)

Farmers may interact visually with real-time data, including temperature, pH levels, soil moisture, crop suggestions, and disease alerts, thanks to the LCD display. It improves communication between users and helps professionals make better decisions.

C. Temperature sensor

The agricultural field's ambient temperature is detected by the temperature sensor. Understanding the environmental factors that impact crop development requires knowledge of these data. The AI model receives the temperature data that has been gathered and uses it to inform algorithms for disease prediction and crop suggestion.

D. Soil Moisture Sensor

The sensor for soil moisture determines how much water is in the soil. To maximize irrigation and avoid under- or overwatering crops, this knowledge is essential. After receiving the information from the soil moisture sensor, the AI model makes recommendations based on appropriate crops depending on moisture content.

E. pH Sensor

The soil's acidity or alkalinity is determined by the pH sensor. Since various crops do better at different pH values, it is crucial to monitor and modify the pH of the soil throughout cultivation. The AI model incorporates the pH sensor data into its decision-making process to make sure crop suggestions take the acidity or alkalinity of the soil into account.

F. Crop selection

By using this IOT, Parameters will display in the LCD and also display in mobile using wireless Bluetooth. As mentioned in the Fig.2 that parameters Will be send to the machine learning and k-nearest neighbor algorithm to predictthe best suitable crop with datasets. By using this technologythe best and accurate crop will be selected.

G. Disease prediction

In Fig.2. From camera, need to capture image and process with the deep learning with image datasets to predict the disease with the pesticides. By Using this prediction technology farmers can easily identified what disease is affected and what was the solution.

H. Dataset

TWO SET OF DATASETS:

- WITH IMAGE (for disease prediction)
- WITH VALUES (for crop)

WITH IMAGE (for disease prediction)

Image processing is used in the agricultural system described to forecast possible crop illnesses. This entails taking pictures of plants in the field with cameras or other sensors. The AI model then processes the photos with computer vision techniques.

WITH VALUES (for crop)

Important environmental parameter values are included in the dataset that the AI model that recommends crops uses. For the model to be trained to produce accurate predictions based on real-time sensor data, this dataset is essential.

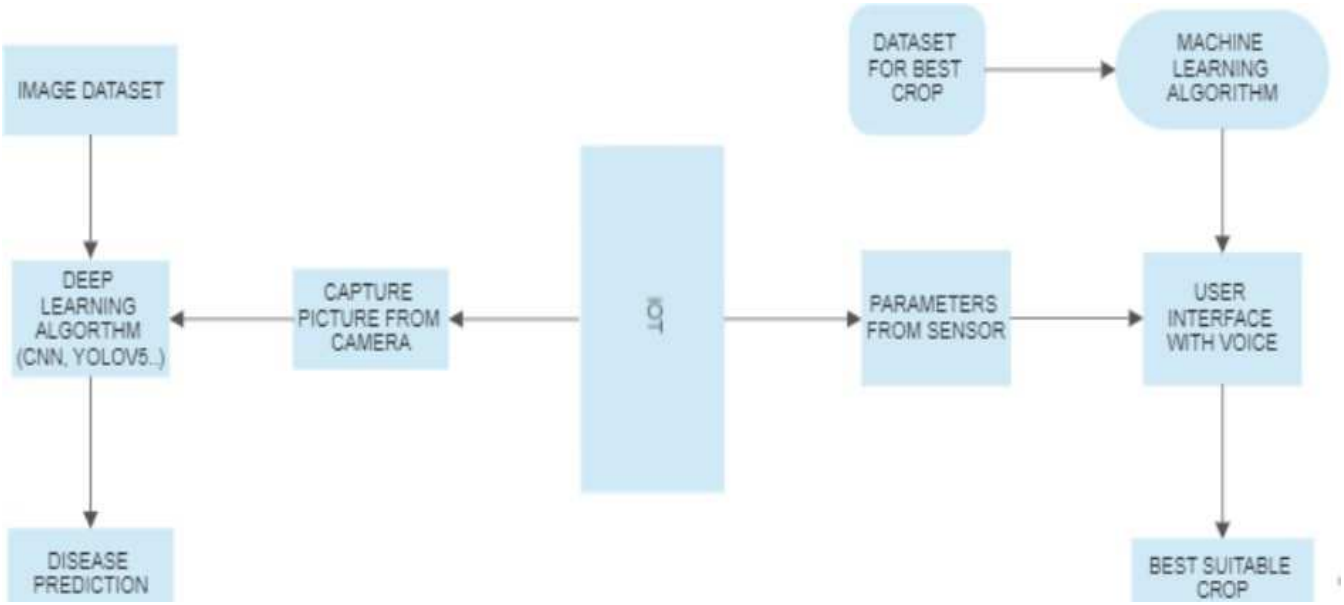

Fig. 2. Overview Architecture

IV. EXPERIMENTAL ANALYSIS

Here some analysis of data to know more about dataset. As already discussed it is the one of the best innovative technology in agriculture's field and yield. The fusion of IOT and Artificial Intelligence can change the traditional agriculture into modern technology. In this project dataset analysis plays vital role because there are two type of datasets are used. One of the dataset is used to predict crop suggestion for machine learning.

On the other hand, other dataset is used for deep learning that consists of images to predict disease. This below Fig 3 resembles the overall details of the dataset 1. It consists of Maximum value, Minimum value, Type of dataset, Missing value and DQ issues. By using this analysis can easily work with project to get perfect result

	Data Type	Missing Values%	Unique Values%	Minimum Value	Maximum Value
NITROGEN	int64	0.000000	6	0.000000	140.000000
PHOSPHORUS	int64	0.000000	5	5.000000	145.000000
POTASSIUM	int64	0.000000	3	5.000000	205.000000
TEMPERATURE	float64	0.000000	NA	8.825675	43.675493
HUMIDITY	float64	0.000000	NA	14.258040	99.981876
PH	float64	0.000000	NA	3.504752	9.935091
RAINFALL	float64	0.000000	NA	20.211267	298.560117
CROP	object	0.000000	1		

Fig. 3. Detail of Dataset1

Like analysis of Fig.5 for crop, all analysis is important to gather details. The phosphorus is the nutrients of crop that is mentioned in Fig.3. Here is the analysis of phosphorus that is Fig.4.

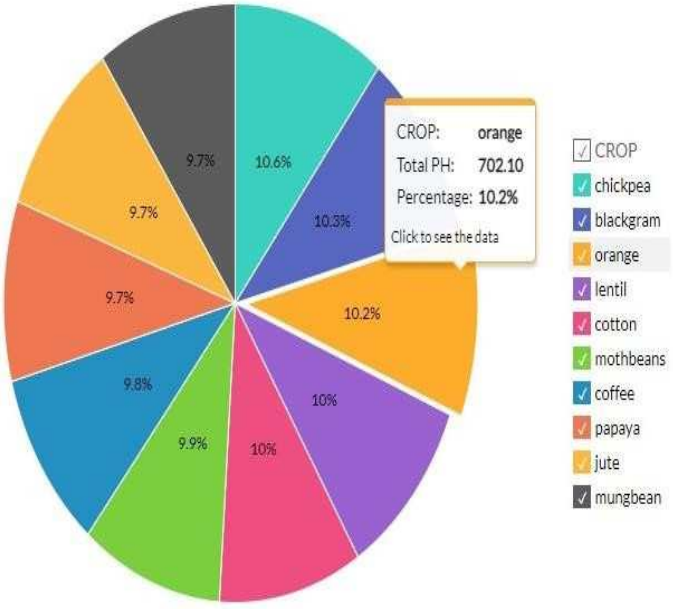

Fig. 5. Pie chart of Crop

From the Fig.3, Display that it contains crop in the dataset. So Fig.4. Display what are the crops are presented and their percentage. Thus the analysis for the experiment was completed and mainly used for implementation.

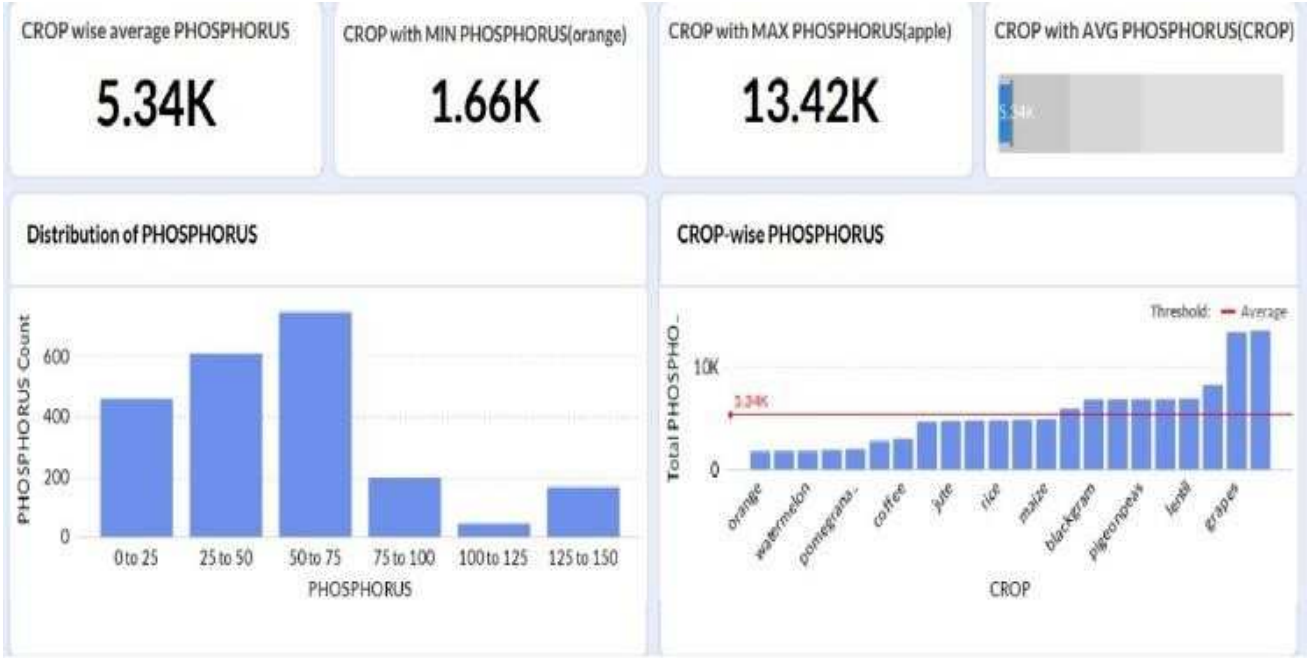

Fig. 4. Analysis of Phosphorus

V. CONCLUSION

In summary, this agricultural project's use of IOT and AI technology marks a substantial leap in contemporary farming methods. The project's use of sensors to detect important field factors and AI algorithms to provide accurate crop suggestions guarantees an effective and data-driven farming strategy. Using image processing tools to detect diseases early improves the project's capacity to efficiently monitor and maintain crop health. Moreover, real-time communication is facilitated by the use of IOT, giving farmers instant notifications and advice. In the era of smart agriculture, this extensive and networked system facilitates efficient decision-making while also enabling farmers to maximize resource use, leading to the adoption of sustainable and intelligent agricultural techniques.

VI. RESULT

The prototype is mentioned above is tested under various type of soils and disease affected plants. So the result is presented. After getting the parameters from the LCD (liquid crystal display) and run the python code of machine learning with dataset. Once placed all the parameters, the best suitable crop will be displayed based upon the dataset with the voice to help the new framer to yield the best crop.

VII. FUTURE SCOPE

Future research might investigate how to integrate cutting-edge technology like edge computing and 5G connection to improve the agricultural system's responsiveness and efficiency. By putting edge computing into practice, sensor data might be processed locally, cutting down on latency and improving decision-making in real time. Furthermore, by taking use of 5G networks' high speed and low latency, data transfer between field devices and the central AI model may be further optimized, guaranteeing quick and easy transport.

Furthermore, the accuracy of illness prediction from photos might be increased by including more complex machine learning models, such as deep learning architectures, which would increase the overall dependability of the system. Further research into the incorporation of environmental variables like humidity and solar radiation intensity into the AI model may also lead to a more thorough comprehension of the ideal growing circumstances. Lastly, adding user input and regularly adding fresh information to the AI model will increase the system's efficacy and flexibility in various agricultural contexts.

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