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Fertilizer Recommendation for disease Prediction

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Abstract— ***The major problems that the farmers of our country are currently facing includes Crop Failure, Lack of adequate knowledge, Crop damage due to ignorance/carelessness, Lack of professional assistance, Inaccessibility to agro-tech solutions. CROFED will help the farmers to deal with these problems by providing following aids: Crop Recommendation system, Fertiliser suggestion system, Crop Disease Detection System. We will develop an IOT device that will examine the quality of soil and can also detect crop diseases on scanning the leaves of the crops. Soil testing is significant since it allows for the determination of soil fertility and hence crop prediction. Soil pH is a measure of the acidity and alkalinity in soils. pH levels range from 0 to 14, with 7 being neutral, below 7 acidic and above 7 alkaline. We have proposed a system which will have a device which gives pH value and we will estimate Nitrogen (N), Phosphorus (P) and Potassium (K) from the pH of that soil. We are using Machine Learning classification algorithm to predict suitable crops based on the values we get from our device and we will also provide suitable fertilisers required for that land. We believe this will help the farmers in producing greater yield of crops and crop damage can also be prevented to a larger extent.***

Indexed Terms- Crop Recommendation System, Fertilisers Recommendation System, Crop Disease Detection, NPK Ratio, XG Boost, CNN.

I. INTRODUCTION

Agriculture Sector remained resilient even after the pandemic in India. It effectively met rising global food demands while maintaining a continuous supply chain of vital food goods across the country.India's agriculture sector employs a large number of people and is second after China in terms of producing fruits and vegetables. Traditional farming methods, on the other hand, are ineffective. It fails to make proper use of all available resources.Because the primary focus is on production, traditional methods frequently result in soil nutrient depletion and weariness. By producing only certaincrops, the earth is depleted.

The ideal pH range for plant development varies depending on the crop. Most plants thrive in soil pHranges of 6.0-7.5, as this is where the majority of nutrients are accessible. By combining a soil sample with water and measuring the resultant aqueous solution, the pH of the soil may be calculated. pH
7.0 represents neutral, Acidic is below 7.0, and basic or alkaline is above 7.0. The availability of nutrients for plant development is influenced by the pH of the soil.

Aluminium and manganese can become more accessible and hazardous to plants in very acidic soil, whereas calcium, phosphorus, and magnesium are less available. Phosphorus and other micronutrients are present in small amount in more alkaline soil. It's a good idea to evaluate the soil pH before planting a new crop since various plants flourish in different pH ranges. The pH of the soil might indicate if it is acceptable for the plants to be cultivated or whether it has to be altered in order to achieve optimal plant development. When paired with other criteria, pH can aid in the recommendation of fertilisers and the cultivation of the appropriate soil type for the region. For the correct sort of soil growth, the right proportion of nitrogen, potassium, and phosphorus is crucial.

The proposed concept also allows people to detect ailments by simply taking a picture with their smartphones and uploading it to the website. They will be better equipped to recover their crops if they have a better understanding of the sickness that has affected their crop.

II. PROBLEM STATEMENT

Farmers' conventional methods of agricultural cultivation are ineffective. It does not make proper use of all available resources. Farmers are unable to detect crop diseases due to a lack of knowledge and old practices, which often result in soil nutrient deterioration and exhaustion. As a result, crop failure occurs. Growing only certain crops depletes the soil, and if the crops are harmed by illnesses, farmers are uninformed of how to recover such crops. Food needs cannot be met until and unless efficient resource management and use is implemented.

III. LITERATURE SURVEY

[1] shows a case study related to wireless sensor networks for crop monitoring, growth and measurement of meteorological factors. The paper suggests farmers for application of specific pesticides and insecticides in stressful conditions. There was no focus on soil nutrients, the level of soil fertility and monitoring the crop growth or suggest the crop for the next season in the above proposed paper. The solution to the issues in agriculture trends is proposed in this paper. The study suggests that farmers need to increase the fertility of soil and measure all parameters which are required to grow a crop in healthy condition.

[2] data mining algorithms are used on agriculture data. The main criterion for this categorization is that if the pH value is greater than 8.5, the soil is unsuitable for crop cultivation; otherwise, it is. To overcome this problem the proposed system will give necessary suggestion to increase or decrease the pH value of soil.

[3] the proposed system is related to increase net yield rate of the crop, based on the parameter related to the soil and atmosphere. The model gives the Crop prediction which can be carried out by using the "Bayesian algorithm". Data mining is used to extract the large amount of data from the data set and analyses those data to predict the crop yield and suggest the crop. The limitation of this includes atmospheric prediction is not accurate.

[4] In his article, the author proposes a method which helps us predict crop yield by suggesting the best crops. It also focuses on soil types in order to identify which crop should be planted in the field to increase productivity. In terms of crop yield, soil types are vital. By incorporating the weather details of the previous year into the equation, soil information can be obtained. It allows us to predict which crops would be appropriate for a given climate. Using the weather and disease related data sets, the crop quality can also be improved. Prediction algorithms help us to classify the data based on the disease, and data extracted from the classifier is used to predict soil and crop. Due to the changing climatic conditions, accurate results cannot be predicted by this system.

[5] Based on fuzzy logic and neural networks & interval-based partition, the author proposed a model which is used currently in rice to predict crop production using a fuzzy time series model. Using this model and comparing it to an existing algorithm, the result was compared to the reduction in AFER and MSE in the prediction.

[6] Using previous years' data, the author provides a model to forecast rice production based on information that is correct and robust. To improve prediction accuracy, it uses a fuzzy time series approach based on percentage change, effective length and emphatic computations on time series data.

[7] Measuring ph using a glass electrode. principles of the glass-electrode method

[8] Inherently low soil fertility continues to be a barrier to potato production in kenya, threatening food security. the soil fertility status of smallholder potato farms in nyandarua and meru counties was investigated. 198 farms provided soil and plant tissue samples for analysis of selected nutrients (ph, oc, n, p, k, s, ca, mg,

zn, b, and cu). the sufficiency of nutrients for potato growth was determined using critical nutrient levels. soils in the sampled farms were acidic (ph-cacl2 3.9–6.6) with low to high soil organic matter concentration (1.5–97.5 g kg1).

[9] The current work examines and describes image processing strategies for identifying plant diseases in numerous plant species. BPNN, SVM, K-means clustering, and SGDM are the most common approaches used to identify plant diseases. Some of the issues in these approaches include the impact of background data on the final picture, optimization of the methodology for a specific plant leaf disease, and automation of the technique for continuous automated monitoring of plant leaf diseases in real-world field circumstances. According to the review, this disease detection technology has a lot of promise and certain drawbacks, including the capacity to identify plant leaf illnesses. As a result, existing research has room for improvement.

[10] Deep learning algorithms were used in this study to develop a novel way for automatically categorizing and detecting plant illnesses using leaf pictures. The developed computer could detect the presence of leaves and distinguish between healthy leaves and 13 abnormalities that could be seen visually. In the end, the trained model's overall accuracy was 96.3 percent. Because the suggested approach had not been applied in the field of plant disease detection, there was no comparison with similar findings obtained using the exact process. This study will be expanded to include the development of a whole system composed of server-side components including a trained model and an application for smart mobile devices capable of identifying diseases captured by a smart phone camera. The authors anticipate that by expanding this research, they will have a substantial impact on sustainable development, influencing crop quality for future generations.

[11] Plant Leaf Disease Detection and Classification Based on CNN with LVQ Algorithm - Melike Sardogan, Adem Tuncer, Yunus Ozen.

Early disease detection is critical in agriculture for efficient crop yield. The diseases bacterial spot, late blight, septoria leaf spot, and yellow curved leaf have an impact on tomato crop quality. Automatic plant disease classification methods also aid in taking action after detecting symptoms of leaf diseases. This paper describes a Convolutional Neural Network (CNN) model and Learning Vector Quantization (LVQ) algorithm-based method for detecting and classifying tomato leaf disease. The dataset contains 500 images of tomato leaves with four disease symptoms. We created a CNN model for automated feature extraction and classification. Colour information is being extensively employed in plant leaf disease research .The filters in our model are applied to three channels depending on RGB components. For training the network, the LVQ was fed the output feature vector of the convolution component. The experimental findings show that the proposed approach accurately detects four forms of tomato leaf diseases.

[12] Deep learning models for plant disease detection and diagnosis

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Through deep learning approaches, convolutional neural network models were constructed in this paper to detect and diagnose plant diseases using simple leaf photos of healthy and ill plants. The models were trained using an open collection of 87,848 photos, which contained 25 different plants in 58 separate classes of [plant, illness] pairs, including healthy plants. Several model architectures were trained, with the top performing model achieving a success rate of 99.53 percent in detecting the corresponding [plant, illness] pair (or healthy plant). The model's very high success rate makes it a very useful advising or early warning tool, and it might be expanded to enable an integrated plant disease identification system that

operates in real-world production circumstances

[13] Plant Disease Detection and Classification using CNN Model with Optimized Activation Function S. Yegneshwar Yadhav; T. Senthilkumar; S. Jayanthy; J. Judeson Antony Kovilpillai

This research discusses the application of Convolutional Neural Networks (CNN) algorithms for the optimum real-time detection of diseases that impact the plant and the afflicted area, so that proper fertilisers can be employed to prevent additional harm to plants from pathogenic viruses. The activation function is at the heart of the CNN model since it combines non-linearity to create a true artificial intelligence system for classification. ReLu is one of the best activation functions, however it has the problem that its derivative is 0 for negative values, resulting in neuronal necrosis.To increase the accuracy and performance of the system using a TensorFlow framework, a new mathematical activation function is constructed and compared with current activation functions.Experiment findings on trained databases demonstrate that the created activation function increased CNN model accuracy and performance by 95%.The suggested optimizer improves the training speed of the CNN model by 83 percent when implemented in an ARM processor. A further area impacted by illness is computed using the K - means clustering approach for fertiliser optimization

[14] Transfer Learning Based Plant Diseases Detection Using ResNet50

Plant diseases are a principal threat to the safety of food. In agriculture sectors, it is the greatest challenge to identify plant diseases. The state-of-the-art Convolutional Neural Network (CNN) gives excellent results to solve image classification tasks in computer vision. Transfer Learning enables us to develop a deep CNN network in a most cost effective way. In this work, a Transfer Learning based CNN model was developed for the identification of plant diseases precisely. The dataset, we have used is consists of 70295 training images and 17572 validation images holding 38 different classes of plant leaves images. We have focused mainly on ResNet50 network, a popular CNN architecture as our pre-trained model in Transfer Learning. Additionally, several Transfer Learning architectures were experimented with few other popular pre-trained models (VGG16, VGG19, AlexNet) and compared with the proposed model. The proposed model has given the best performance of 99.80 % training accuracy.

[15] Disease Detection and Classification in Agricultural Plants Using Convolutional Neural Networks — A Visual Understanding

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All deep learning models start with a convolutional neural network. As a result, a Convolutional Neural Network model was designed and developed to identify and classify plant diseases using photos of healthy and diseased apple and tomato leaves. Each convolutional layer is followed by a pooling layer in the model. The presence of disease is determined using two fully connected dense layers and the sigmoid function. The model was trained using a 3663 picture dataset of apple and tomato leaves, resulting in an accuracy of 87 percent. With the dropout value adjusted to 0.2, the overfitting problem is discovered and removed. The model is also run on GPU Tesla to evaluate its speed and accuracy because it permits parallel processing. As a result, the report inspires researchers to design an integrated plant disease identification system that delivers accurate results in real time.

IV. PROPOSED SYSTEM

SENSOR FOR pH the hydrogen-ion in the soil is measured using a PH meter, an electric instrument. A voltage test is used by a pH meter to detect hydrogen ion concentration and consequently pH. It is used to determine the soil's acidity or alkalinity. A solution with more H+ ions will stay acidic, whereas a solution with OH- ions would remain alkaline. The pH of 1 soil is exceedingly acidic, whereas the pH of 14 soil is excessively alkaline. Pure water, being a neutral solution, has a pH of 7. The pH of various soil samples is determined using a pH meter. It is more precise than using pH strips.

Fig: pH probe & Senso

Input Supply Voltage	5 VDC
Measuring Range	0-14 pH
Measuring Temperature	-5 – 50 degrees C
Accuracy	+0.01- -0.01
Response Time	<= 1 min

Table: Specification of pH meter

Proposed Model Framework-

The proposed system is used to determine the nutrient quantity of soil through NPK Ratio and predict various diseases crops may be infected with. As we know all the nutrients present in the soil but what amount of nutrients are present in the particular field. Every soil has different micronutrient. But to measure the amount of nutrient available in the soil we are going to design a device which will give proper reading of the micronutrient and that can be used to predict crops, fertilizers and crop diseases.

Following are the main objectives of the proposed system-

Design and develop a microcontroller-based sensor interfacing for reading soil parameters (NPK value).
Converting the sensor value which in analog signal to digital signal for further processing
Sending all reading to system using USB ports available.
Developing website application for displaying the result and generating the report.

Based on the result give suggestion to improve the quality of soil.

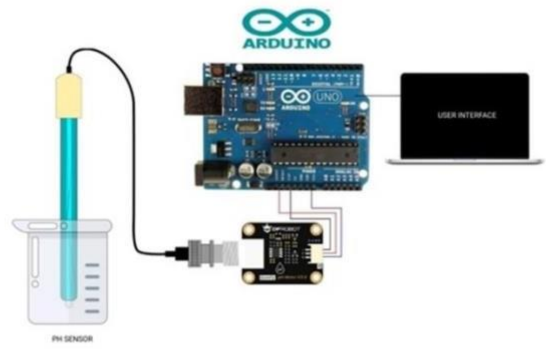

Fig: System design

Features of the proposed system: - In this systemthe micro-controller device is connected to the system through USB ports available and transmits the data from the device to the system. The result is generated from the received data and suggestions are given.

1: CROP RECOMMENDATION: - The NPK value of the soil is calculated using the pH value supplied from the instrument. An API is used to collect temperature and humidity. The pH value, NPK value, temperature, humidity, and rainfall are the characteristics that are used to forecast the best crop to grow in a given place. The crop is predicted using a machine learning model called XG Boost, which has a 99 percent accuracy rate.

2: FERTILISER RECOMMENDATION: - Based on the NPK value acquired from the device for a certain soil, a suitable fertilizer is advised for the crop. Proper recommendations for increasing soil fertility are presented (NPK).

3: DISEASE DETECTION: - The visual data collected from the user is used to detect crop-based illnesses. Deep learning techniques and CNN models are used to forecast if the crop is affected with which disease, and a viable remedy is then offered to the user.

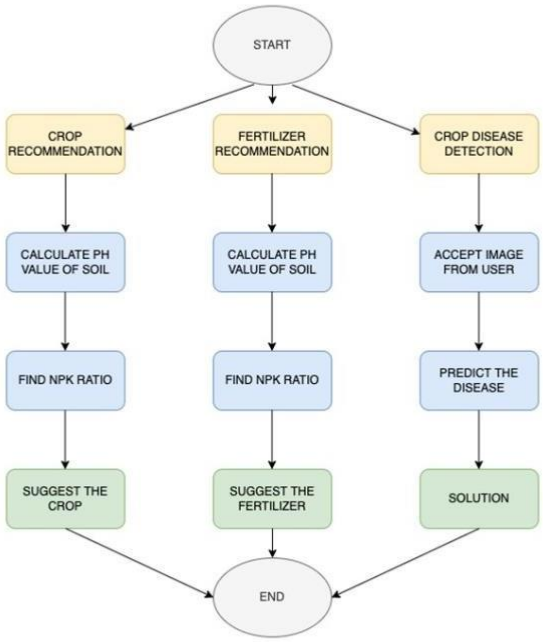

Fig: Flowchart of Proposed System

V. RESULTS

In this project, we are obtaining adequate findings for proper crop production and fertilizer to recommend to farmers for crop cultivation. The disease detection tool also provides the finest advice for recovering from crop disease, ensuring that the crop or specific land is not ruined and that soil fertility and crop yield are increased.

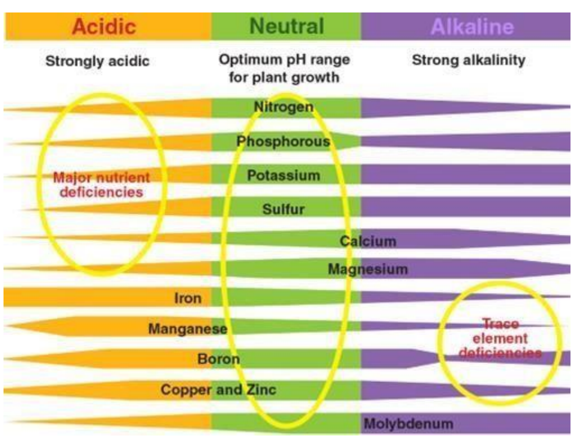

Fig: - Nutrient Availability and Soil pH

The ideal pH range for plant development varies depending on the crop. Most plants thrive in soil pH ranges of 6.0-7.5, as this is where most nutrients are accessible. The availability of nutrients to plants is influenced by the pH of the soil. The key nutrients required in relatively high amounts are nitrogen, phosphorus, and potassium. Calcium, magnesium, and sulphur are secondary nutrients that the plant need in smaller amounts. Zinc and manganese are micronutrients that plants require in minute amounts. Most secondary and micronutrient deficiencies may be readily remedied by maintaining the soil pH at its ideal level.

The activity of soil microorganisms is also influenced by soil pH. In very acidic soil, the population of bacteria that breakdown organic matter decreases and their activity is hampered, resulting in an accumulation of organic matter and bound nutrients, mainly nitrogen.

pH Level	Status
< 3.5	Root Damage
4.0 -4.5	Poor Nutrition uptake
5.0-5.5	Good pH Level
5.6-6.0	Perfect pH Level
6.1-7.0	Acceptable pH balance
7.5-8.0	Poor Nutrition uptake
>8.0	Root Damage

Fig: Effect of pH on soil.

Increasing Soil pH

The soil pH can be raised by using a material that contains some kind of lime (calcium carbonate), such as ground agricultural limestone and wood ashes. The finer the limestone, the faster it starts to work. To modify the soil pH, different soils will require varying amounts of lime. Potassium and calcium are abundant in wood ashes, but phosphate, boron, and other minerals are in trace levels. Although not as efficient as limestone, repeated use of these can significantly raise the soil pH.

Decreasing Soil pH

Aluminium sulphate and sulphur, in addition to ammonium-based fertilisers and organic matter, are common ingredients used to lower soil pH. Aluminium sulphate is recommended because the aluminium lowers the pH of the soil as soon as it dissolves. Too much of this, however, is hazardous to plants. Because sulphur must be turned to sulfuric acid by soil microorganisms, it takes time to have an effect.

Fig: Embedded Model for predicting quality of soil

VI. COMPARATIVE STUDY

The Several prototypes have been suggested in this sector that are assisting in the resolution of agricultural challenges. A comparable model is presented in paper [16], and the principle is partly similar, but we tried to cut the cost substantially, and our model's accuracy is also higher due to the usage of the XG Boost model. Our system also has certain extra characteristics, such as crop disease prediction, which has boosted our project and has significant promise in tackling important agricultural concerns.

vast potential of Indian agriculture remains unexplored, and we still have a long way to go in this field of study, as we need to make the device more compact, lightweight, and inexpensive to farmers. The technology will assist farmers by providing required advice on crops, their growth, and other basic information. It will also offer the location of the nearest store where farmers can purchase fertilizer and other materials. It would also assist farmers in selling their commodities to merchants by providing accurate information on market prices and merchant details. The device can also help farmers calculate crop MSP. The disease detection feature can also be improved by adding dedicated cameras to the device, which will improve the device's accuracy even further.

VII. FUTURE SCOPE

The vast potential of Indian agriculture remains unexplored, and we still have a long way to go in this field of study, as we need to make the device more compact, lightweight, and inexpensive to farmers. The technology will assist farmers by providing required advice on crops, their growth, and other basic information. It will also offer the location of the nearest store where farmers can purchase fertilizer and other materials. It would also assist farmers in selling their commodities to merchants by providing accurate information on market prices and merchant details.

The device can also help farmers calculate crop MSP. The disease detection feature can also be improved by adding dedicated cameras to the device, which will improve the device's accuracy even further.

VIII. CONCLUSION

The device is created primarily for farmers. Farmers are the backbone of our country, and India is the world's second largest food producer. As a result, this technology will assist farmers in determining soil fertility and recommending which crops to grow. It also recommends the fertilizer that should be used to boost productivity. It detects many diseases in crops and recommends appropriate treatments to help them recover. It gives farmers the vital information about farming techniques to assist them enhance crop productivity.

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