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## **Integrated Approach for Leaf Disease Diagnosis and Yield Prediction in Crops**

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**ABSTRACT:** Agriculture remains the backbone of many countries, providing essential support to farmers. Traditionally, farming has followed time-tested practices passed down through generations. However, changing climate conditions are now compelling farmers to reconsider these conventional methods. With advancements in computer science and machine learning, innovative techniques are emerging to enhance agricultural productivity. In this context, a system is proposed that integrates leaf disease detection and crop prediction based on soil type, along with crop yield forecasting using machine learning algorithms. The system employs two distinct architectures: one for identifying leaf diseases and another for predicting suitable crops and estimating yields. Machine learning models are used to forecast crop yields by analyzing various factors such as weather conditions, soil type, and humidity. For disease detection, image processing techniques are applied to identify infections in leaves and recommend possible treatments. The application has been developed after thorough analysis and experimentation with both machine learning methods and image processing algorithms, yielding accurate results for detecting diseases in crops like tomatoes, grapes, and others.

**KEYWORDS:** agriculture, leaf disease detection, crop prediction, crop yield prediction, machine learning, image processing.

#### I. INTRODUCTION

For centuries agriculture has been the main source to provide food and raw materials to many people across globe. The production and outcome from it is changing since the climatic change around the world. The production is declining and not meeting the need of growing population. The farmers are facing problem with declining crop production as well the income they earn from it. The farmers are not able to deal with changing environment, disturbed rainfall and the crop are diseased to give low yield. They lack knowledge for the good production of crop. The ignorance towards new techniques and disapproval for adaptation for same causes more problem.

Thus, emerging field of technology help for this crisis faced by farmers. They provide information to the farmers for good farming so that they can produce good and more yeild. With machine learning techniques the weather conditions can be predicted. The image processing techniques help in image perspective. The following objective is to provide a system that provides farmers with the necessary information in the selection process. In today's society, information technology is used in many areas around the world. Data mining is the part of data that we can use to solve the above agricultural problems. Analyse crop patterns with the help of historical data and plot them with statistical data. Monitor crop yields and find ways to increase yields. A profitable product is recommended for all types of soil. Help farmers choose crops. Provide information on appropriate fertilizer and irrigation methods for the selected crops. The main idea of data is to extract only important data from big data. More precisely, it is the process of extracting useful information from many documents. The paper represents a system where crop is predicted depending on soil, weather conditions, temperature. The crop yield is predicted to ensure market requirement and the leaf images of plant are used to predict the disease and remedial suggestion to farmer to remove the same.

The paper is organized with presenting the implementation of leaf disease detection while giving the analysis for earlier used systems. Section I gives detail introduction while section II gives the overall systems survey when used by farmers. The section III gives architecture for both crop prediction and leaf diseases detection with discussion for methodology. The section IV gives results and analysis for the implementation.

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#### **II. RELATED WORK**

- 1) Crop Yield Prediction Using Deep Reinforcement Learning Model for Sustainable Agrarian Application Name of authors: DHIVYA ELAVARASAN AND P. M. DURAIRAJ VINCENT Year of Publication: 2021 Paper Review: The proposed work constructs a Deep Recurrent Q-Network model which is a Recurrent Neural Network deep learning algorithm over the Q-Learning reinforcement learning algorithm to forecast the crop yield. The sequentially stacked layers of Recurrent Neural network is fed by the data parameters. The Q- learning network constructs a crop yield prediction environment based on the input parameters. A linear layer maps the Recurrent Neural Network output values to the Qvalues. The reinforcement learning agent incorporates a combination of parametric features with the threshold that assist in predicting crop yield. Finally, the agent receives an aggregate score for the actions performed by minimizing the error and maximizing the forecast accuracy. The proposed model efficiently predicts the crop yield outperforming existing models by preserving the original data distribution with an accuracy of 93.7%.
- 2) System for agriculture recommendation using data mining Name of authors: Nilesh Dumbre, Omkar Chikane and Gitesh More Year of Publication: 2021 Paper Review: The objective of System for Agriculture Recommendation System using Data Mining is to improve the production of crops as well as improve the economic conditions of farmers. At the same time using the available resources optimally and efficiently in today's critical situation of natural resources like lack of availability of sufficient water, electricity and degrading quality of fertile land. The system will extracting databases for crop selection when farmer required and sends that data firstly to the user's computer and then the message to farmer. The system will mining the suitable crop for particular farm of a farmer and generates results in user compatible format.[2]
- 3) Smart Crop Prediction using IoT and Machine Learning Name of authors: Archana Gupta, Dharmil Nagda, Pratiksha Nikhare and Atharva Sandbhor action . Agriculture plays a vital role in the Indian economy. Over 70% of the rural households depend on agriculture. Agriculture is an important sector of Indian economy as it contributes about 17 percent to the total GDP and provides employment to over 60% of the population. Indian agriculture has registered impressive growth over last few decades. On the website, farmer gets the most suitable crop as an output. Along with this, the end user is provided with all the information about the crop and the best suitable fertilizer. The system can be enhanced further to add following functionality: Use of soil moisture sensors, environment sensors, pH sensors to increase the accuracy while predicting the crop. Location's market requirements can be consider, farmer's crop while suggesting the suitable crop.[3]
- 4) This paper aims to introduction of an Iot to the smart agriculture with Aurdino UNO and on field sensors. To face nature challenges, we need to involve the emerging technologies like Internet of Things (IoT) into agricultural sector along with various machinery or devices. IoT will be beneficial to connect the devices, collect and distribute the data on Internet there by provide new approaches to farmers and the producers to make smarter decisions, reduce costs, provide efficiency and boost the production. The data acquired from sensors gives the condition at field like temperature, moisture in soil, leaf wetness and humidity. Smart agriculture employs a technique called precision farming where all the environmental aspects required by the crop to grow are constantly monitored.[4]
- 5) The paper presents a solution based on IoT (Internet Of Things) and so that it leads to the use of technology on fulfilling cultivation purposes effectively and efficiently by getting correct information about nutrition conditions for a successful cultivation. Several techniques were proposed previously by authors for N, P, K prediction from humidity, Electric Conductivity (EC), pH and temperature. The common way is doing lab testing rather using relevant sensors. The chief goal of the research is to reduce time by using relevant sensors to get readings. Crop suggestion modules have deployed previously using Support Vector Machine Algorithm and normal lab testing.[5]

#### **III. PROPOSED METHODOLOGY**

#### **Data Collection Phase**

- a. Collect environmental sensor readings and capture field images
- b. Store raw data with timestamps and geolocation





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#### Processing Phase

- c. Apply pre-processing pipelines to both data streams
- d. Extract features from images via CNN
- e. Normalize and combine feature sets

#### **Analysis Phase**

- f. Pass processed features to appropriate models
- g. Generate yield predictions using regression model
- h. Determine crop classification using SVM
- i. Calculate confidence scores for predictions
- j.

#### Output Phase

- k. Display integrated results to user interface
- 1. Generate recommendation reports
- m. Update dataset with new labeled data for continuous improvement

This detailed algorithm and methodology provide the technical foundation for implementing the unified agricultural image processing and prediction system shown in the diagram.

#### 1) Crop Prediction:

- The major components of the system, which are(Fig):
- Pre-processing: The dataset is taken for pre- processing technique which is used to transform the raw data in a useful and efficient format.
- Regression: The regression is used as model.
- Yield Predicted: The model is trained with data and crop is predicted.
- Classification: The classification is applied with SVM.
- Crop Predicted: The crop is predicted

2) Leaf Disease Detection:

- The major components of the system, which are(Fig):
- Image Capture : Image is captured
- Pre-processing: The dataset is taken for pre- processing technique which is used to trans- form the raw data in a useful and efficient format.
- Greyscale Conversion: The image is converted to grayscale.
- Edge Detection: Edge are detected .
- Segmentation : it is segmented or classified.
- Disease detection : The disease is detected.





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#### Fig: Architectural Diagram

#### IV. PROPOSED ALGORITHM

The system is designed to predict the crop to be planted in soil and crop yield depending on npk value of soil and weather, humidity of the specific place. Fig1 is architecture diagram for crop prediction and crop yield prediction. The machine learning concept of relearning is used for crop prediction. The past data is used for training the model. The query data is input and pre-processed. When classification is applied for data with help of SVM, the crop is predicted while when regression is used on pre-processed data the yield is predicted mechanisms.

#### Weather/Environmental Input:

Data Collection: Sensors collect NPK (Nitrogen, Phosphorus, Potassium) values, soil type, humidity, and temperature Data Validation: Outlier detection and range checking to ensure readings are within expected parameters Missing Value Handling: Interpolation techniques for missing sensor data using moving averages or nearest neighbour values.

#### Image Input:

Image Acquisition: Camera/webcam captures RGB images of crops and fields Resolution Standardization: Images are resized to consistent dimensions (e.g., 256×256 pixels) Quality Assessment: Brightness, contrast, and blur detection algorithms to filter poor-quality images.

1) Support Vector Machine:

SVM is a machine learning technique to separate data which tries to maximize the gap between the ategories. This Algorithm helps to classify the textual feedback and classifies according to emotions.

Input: D Dataset, Semantic of Tokens, Feeds; Output: Classification of Application Step1: for each Feed id in D do Step2: Get on-demand features and stored on vector x for tweet id Step3: x.add (Get Features (Feed id)); Step4: end for Step5: for each Feed in x vector do

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Step6: Fetch first feature and stored in b, and other features in w Step7: h w, b (x) = g (z) here, z = (w T x + b) Step8: if (z $\leq 0$ ) Step9: assign g(z) = 1; Step10: else g(z) = -1; Step11: end if

#### 2) CNN:

Step 1: Dataset containing images along with reference caption is fed into the system

Step 2: The convolutional neural network is used a encoder which extractsimage features 'f' pixel by pixel.

Step 3: Matrix factorization is performed on the extracted pixels. The matrix of m x n.

Step 4: Max pooling is performed on this matrix where maximum value isselected and again fixed into matrix. Step 5: Normalization is performed where the every negative value is con-verted to zero.

Step 6: To convert values to zero rectified linear units are used where eachvalue is filtered and negative value is set to zero.

Step 7: The hidden layers take the input values from the visible layers and assign the weights after calculating maximum probability.



#### V. SIMULATION RESULTS





Fig 2







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Fig 5

#### VI. CONCLUSION AND FUTURE WORK

Crop forecast and crop yield forecast will ensure crop yield. The system will be trained on standard profile values for NPK and the type of soil required for successful cultivation. The system will be tested on real data with NPK values and soil types. SVM is used to estimate decision tree product yield.Rice yield prediction using linear regression machine learning algorithm. To verify the accuracy of the data, we tested the method for predicting the crops to be planted and the yield from the next crop. We compare the training data with the test data to choose the next crop to grow. Imaging is used to detect leaf diseases.The system can be enhanced by creating an android app which will be of ease of use for farmers where they can know about the crop yield, as leaf disease, prevention for same as well market value for the product.

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