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Agro Vision - Crop Yield Prediction and Crop Leaf Disease Detection

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ABSTRACT

Machine Learning and Deep Learning are two new fields of study in the fields of information technology and agriculture. In India, agriculture is one of the most important occupations. As a result of a number of uncontrollable causes, our farmers face various challenges.

For good crop production, we must ensure that a specific crop can yield in a specific area and climatic condition. If a crop isn't producing as it should, it's most likely contaminated with a disease. So, our paper focuses on two parts: crop yield prediction, which will assist farmers in deciding which crop to plant, and crop leaf disease identification, which will assist farmers in quickly identifying the disease with a single click. We would be able to make more strategic crop production decisions with the aid of prediction. We can use machine learning to gain insights into the crop life cycle, which can be very useful.

Machine learning is an effective decision-making tool for forecasting crop yields, as well as determining which crops to plant and what to do during the growing season. Plant diseases are typically caused by rodents, insects, and pathogens, and if not addressed quickly, they can significantly reduce yield. A number of crop diseases are causing agriculturists to lose income. Crop diseases are a huge danger to food security, but due to a lack of competence in many regions of the world, quick detection is challenging. Thanks to a combination of expanding global technology penetration and recent breakthroughs in computer vision enabled by deep learning, smart technology assisted disease diagnosis is now conceivable. In the field of computer vision, detecting plant diseases is a critical research subject. It's a technique for taking pictures of plants with computer vision equipment in order to see whether they contain diseases or pests. Plant disease and pest detection equipment based on computer vision is being used in agriculture to replace conventional naked eye recognition.

The proposed framework has two stages: the first stage deals with training data sets, and the second stage deals with real-world data sets. This involves both stable and diseased data sets for training. The second step entails keeping an eye on the crop and determining the disease.

Keywords— Agriculture, Crop Production, Machine Learning, Decision-Making, Crop Diseases, Disease Detection, Deep Learning, Computer Vision, Training Data

I. INTRODUCTION

One of the most significant occupations practiced in India is agriculture. It is the largest economic area, with about 60 per cent of the country's land being used for agriculture to meet the needs of 1.2 billion people. Agriculture modernization is therefore very necessary and this will lead our country's farmers towards benefit. The earlier yield prediction was carried out by taking into account the experience of the farmer in a specific field and crop. Farmers, on the other hand, are pushed to raise more and more crops since conditions change swiftly from day to day. Many of them do not have appropriate knowledge of the new crops and are unaware of the benefits they gain when farming them, as is the case currently. In addition, through recognizing and predicting crop production in a variety of environmental circumstances, farm productivity can be improved.

It is possible to build an autonomous framework for disease classification of crops with the recent development in image processing and pattern recognition techniques. Firstly, track the plants annually. Photos of diseases are acquired by farmers using cameras or scanners. To interpret the image content by image processing processes, the acquired image must then be processed. A crucial point for crop management is the need for early pest/disease detection. Different procedures are carried out for this purpose, such as manual observation of plants. There are no precise measures provided by this method. Automatic detection is also very critical for disease detection at an early stage. Our aim is to build a system of detection that is versatile and easy to adapt to various applications. Traditional manual counting is tedious, time-consuming and subjective, since it relies on the skill of the observer. We propose to automate recognition and counting based on computer vision in order to solve these difficulties. Computer vision techniques are simpler to apply in our system to acquire high-resolution images of leaves.

I.A.1 PROBLEM STATEMENT

To learn and analyse the farming factors in order to acknowledge the farmers concern and come up with efficient ways to elevate the agricultural sector.

I.A.2 OBJECTIVE

To provide accurate crop prediction and crop disease detection based on data collected from the famers such as crop images, location along with the datasets that we have collected such as previous year crop yield, crops suitable for different soil type, weather parameters for previous years and crop leaf image dataset consisting of both healthy and diseased crop images.

II. SCOPE OF THE PROJECT

The aim of the project is to determine an area's crop yield by analysing a dataset that includes some significant or relevant features to crop production, such as temperature, moisture, rainfall, and previous crop production. To predict a continuous value, regression models are used. It is a supervised technique. The coefficients are pre-processed and fit into the trained data during training and construction the regression model. The main focus here is to reduce the cost function by finding the best fit-line. The output function facilitates in error measurement. During training period, error between the predicted and actual values is reduced in order to minimize error function. Python is used for this project. For a developing economy like India, agriculture is the cornerstone, and there is an immense need to preserve agricultural sustainability. It is, therefore, a valuable addition to the economic and agricultural welfare of countries around the world.

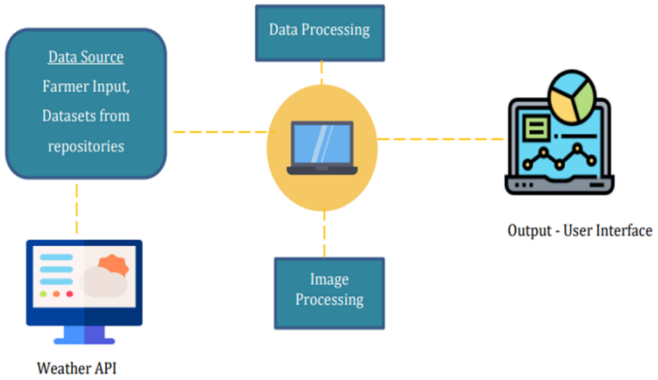

Fig .1 Agrovision Approach

III. PROPOSED SYSTEM

Agriculture is one of India's main game changers and a big money generator. Seasons, markets, and biological rhythms all influence crop production, yet fluctuations in these patterns cause farmers to lose money. This component can be reduced by employing an appropriate strategy based on understanding of soil types, pressure, acceptable weather, and crop kind. Weather and crop kinds, on the other hand, can be predicted using a helpful dataset that can assist farmers in anticipating the most profitable crops to cultivate.

- Analysing different factors on which crop yield depends season, land area, pests etc., using Machine Learning.
- Analysing the distribution of crops all over India based on past year data set and predicting the current production by using different algorithms.
- Provides guidance to farmers regarding new machines that can be used on fields.
- Keeps the farmers updated with the already existing government schemes or new or upcoming schemes.

The project will assist the farmers for selecting the crop properly at the earlier stage according to the climatic conditions of his farm. The proper selection of the crop at earlier stage will ultimately improve the crop yield and help to reduce the depression of the farmer as well as there will be no need of re-cropping but it has its disadvantages –

- Existing system security is always at stake.
- Does not include accurate Crop Yield Prediction and Crop Disease Detection functionalities.
- Disease of crop can be detected with the help of the images of the crop, which does not exist in present system

IV. EXISTING SYSTEM

IV.A.1. A Climate-Smart Agriculture Weather Station

- A climate smart agricultural system is a means of monitoring the weather in a certain location and growing necessary crops in accordance with that climate.
- Uses real-time weather monitoring system
- This will assist farmers in growing the necessary quantity of crops on the required acreage and in determining the maximum and minimum precipitation temperatures in that area.

IV.A.2. Crop Yield Prediction Using Data Mining

- This paper proposes a system for prediction of production of crops in the current year. In order to determine the crop production, it uses a data mining algorithm K-Means.
- This system also employs a fuzzy logic-based prediction technique. Fuzzy logic is a rule-based prediction logic that is used to apply a set of rules to the land for farming, rainfall, and agricultural production. This study provides a comprehensive understanding of how K-Means may be used to examine data sets.
- We will apply the set of rules to anticipate which crop would return the most profit based on previous years' crop costs and current soil and weather data, similar to how they have applied the set of rules in the form of fuzzy logic.

IV.A.3. Image Processing Techniques for Early Pest Identification in Agriculture Crops

- The goal is to classify other stages of the white fly (eggs, larvae) and other bio aggressors (aphids) or plant diseases (powdery mildew). New artifacts for detecting or new image processing programs to retrieve the corresponding information may be implemented using a cognitive approach.
- Using Computer Vision and Algorithms of Artificial Intelligence.
- The collaboration of complementary disciplines and techniques that led to an automated, stable and versatile framework is demonstrated. For fast identification of white-flies, the prototype device proved effective.

Although a lot of research has been conducted for developing the decision support system for farmers, the most of the research focus on the crop management, crop disease management and crop yield forecasting. But the farmer's crop selection at the earlier stage is one of the most important factors since appropriate crop selection at the earlier stage will help farmers to improve crop management and crop yield. Crop forecast is a common issue that arises. A farmer was curious about how much output he should expect during the rising season. Previously, this yield estimate was based on a farmer's long-term expertise with specific yields, crops, and meteorological circumstances. Instead of worrying about crop forecast, farmers go straight for yield prediction with the current technique. Unless the correct crop is forecasted, the yield will be better, and pesticides, environmental and climatic parameters related to the crop will not be considered using existing methods.

V. DJANGO

Django is a Python-based open-source backend web application platform. The main goals are simplicity, versatility, reliability, and scalability. In Django, each function and component has its own name (for example, HTTP responses are called "views"). It also has a more user-friendly admin panel than Laravel or Yei, as well as other technical features.

Fig .2 Django Features

VI. MACHINE LEARNING

Machine learning is a sort of artificial intelligence that allows software applications to improve their accuracy in predicting outcomes without being particularly programmed to do so. Various statistical and mathematical methods are used to measure the efficiency of ML models and algorithms. The trained model can be used after the conclusion of the learning process to identify, predict, or cluster new research data using the knowledge gained during the training process.

VII. DEEP LEARNING FOR COMPUTER VISION

Computer vision is an area that involves making " see 'a machine. Instead of the human eye, this device uses a camera and computer to locate, monitor and quantify targets for further processing of images. Example of image processing includes:

- Normalizing the image's photometric attributes, such as brightness and colour.
- Cropping the bounds of the image, such as centring an object in a photograph.
- Removing digital noise from an image, such as digital artifacts from low light levels.

With the development of computer vision, such technology has been widely used in the field of

agricultural automation and plays a key role in its development. Deep learning in computer vision has made rapid progress over a short period. Some of the applications where deep learning is used in computer vision include face recognition systems, self-driving cars, etc. Convolutional neural networks, also known as convnets, a type of deep learning model universally used in computer vision applications. So, the objective of CNN is to perform two tasks: first is feature extraction and second is aggregating all the extracted features and making a prediction based on it.

VIII. WEB DEVELOPMENT

A web application is a computer program that performs tasks over the Internet using web browsers and web technologies. A mixture of server-side scripts (PHP and ASP) are used by Web applications to manage information storage and retrieval, and client-side scripts (JavaScript and HTML) are used to display information to users. Online applications are normally encoded in languages supported by the browser, such as JavaScript and HTML, as these languages depend on the browser to make the program executable. Some of the apps are complex, requiring processing on the server side. Others are entirely static, with no server processing needed. A web application includes a web server to handle client requests, an application server to carry out the requested tasks, and often a database to store the information. Technology for application servers varies from ASP.NET, ASP and ColdFusion, to PHP and JSP.

IX. DATABASE

A database is a set of data that has been structured so that it can be easily accessed and maintained. To make it easier to locate relevant information, you can organise data into tables, rows, and columns, as well as index if. database handlers design a database such that all users have access to the data from a single collection of applications. The database's primary goal is to manage a vast volume of data by storing, extracting, and handling it. Databases are used to manage a large number of complex websites on the Internet today. Consider a model that tests the availability of hotel rooms. It's an example of a database-driven interactive website. Databases such as MySQL, Sybase, Oracle, MongoDB, Informix, PostgreSQL, SQL Server, and others are accessible.

X. SYSTEM ARCHITECTURE

The System takes input from user i.e., user location, crop decided to grow and no. of hectares of land.

- Based on the location and chosen crop, system takes previous years data (soil attributes, rainfall, and weather) from the repositories and analyses the data and predicts which crop yields more or is more preferred to grow based on datasets of weather, soil and more.
- For crop disease detection, it takes that crop images as input from the user. Based on the image processing model it classifies the crop disease and also comes up with best possible solutions for it.
- Data Source – User Input, Weather API, Datasets from repositories
- Data Processing – ML Model consisting KNN, SVM, decision tree, Random Forest.
- Image Processing – Convolutional Neutral Networks.
- Results - User Interface
- It keeps the farmers up to date with the new farming equipment, technologies and strategies to increase the yield.
- From sowing seeds to harvest, Agrovision will assist farmers in all stages of farming

USE CASES IN SYSTEM

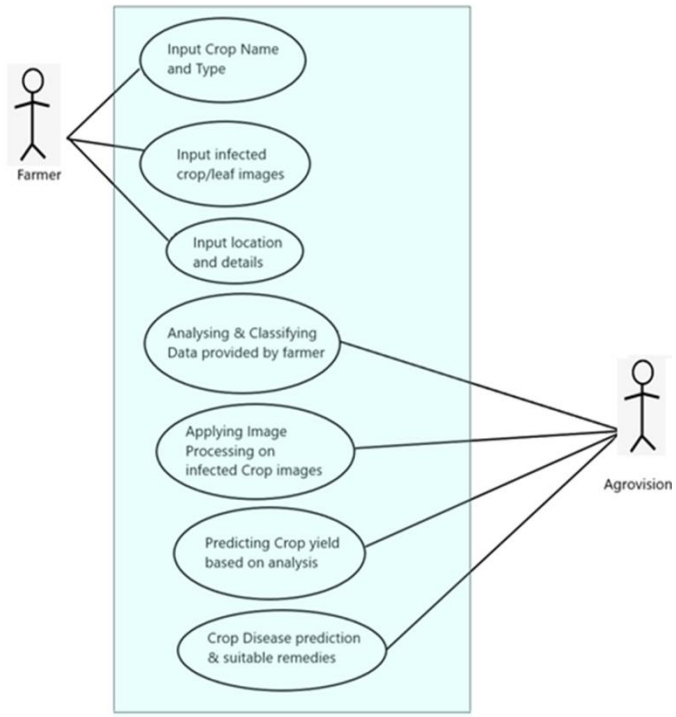

Fig .3 Use cases of Agrovision

DATA FLOW DIAGRAM

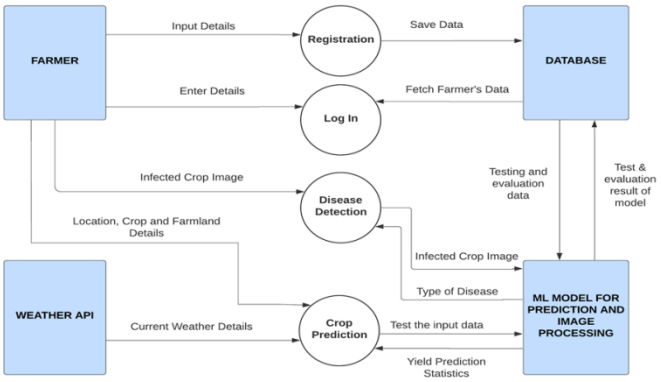

Fig .4 Data Flow Diagram of Agrovision

ACTIVITY DIGRAM

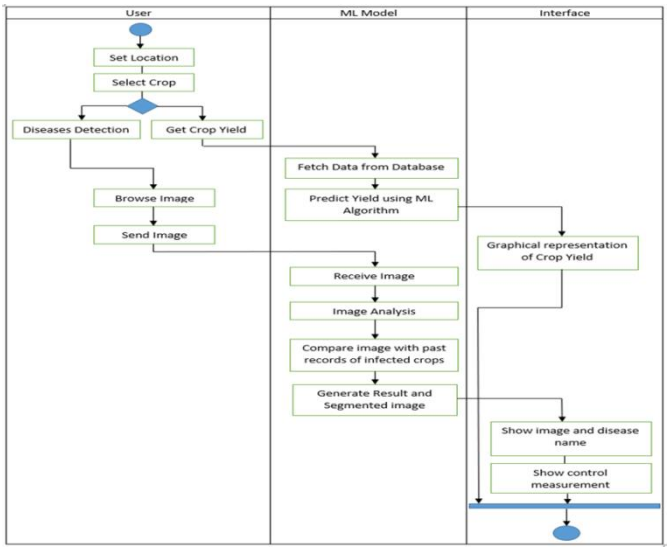

Fig .5 Activity Diagram of Agrovision

FLOW CHART

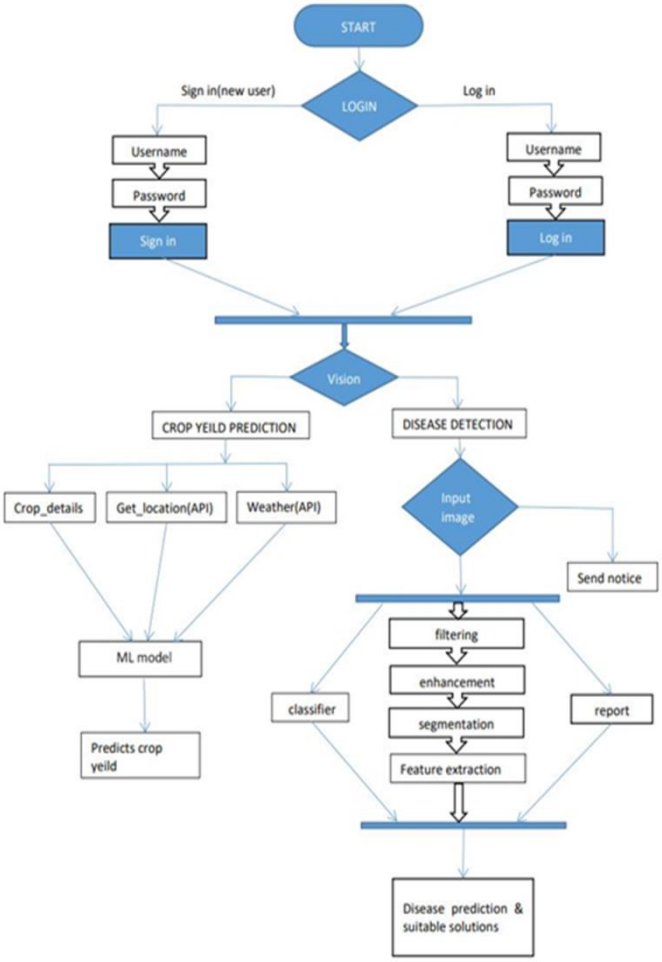

Fig .6 Flowchart of Agrovision

XI. FUTURE WORK

As the methodologies of smart farming increase, there will be a huge requirement for the implementation of newer technologies. The framework can be expanded to help farmers by uploading the farming picture to the mobile application. The efficiency of pre-processing is restricted by the amount of unwanted data, such as leaves and grass, etc. Because of this undesirable information present in the input picture, it can cause problems both during training and classification. The image parameters used for study, such as climate factor, moisture, and past data collection. In the future, IOT will be used to connect all farming devices over the Internet. The sensors can be used in farming to collect information on current farm conditions, and devices can increase moisture, acidity, etc. accordingly. The vehicles used in farm like tractor will be connected to internet in future which will, in real time pass data to farmer about crop harvesting and the disease crops may be suffering from thus helping the farmer in taking appropriate action. Further the best profitable crop can also be found in light of the monetary and inflation ratio.

XII.CONCLUSION

Agriculture has always been the most important sector for survival. There are a lot of difficulties faced by our farmers these days due to various unpredictable reasons. Hence, as engineers, we need to collaborate with farmers and provide them a solution to improve the quality and quantity of crops. Our project is the first step towards it. Prediction can help us make strategic decisions in crop production. With machine learning, we get insights about the crop life which can be very beneficial. Our model has learned with the train datasets and test datasets to produce optimal solution. We are given input as farmers current farming land location, farmer decided crop, and number of hectares of land in the application. Our system analysed the data and produced the predicted profitable crop and its required fertilizers list, overall yield per hectare and also shows total value of the crop based on current market price.

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