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PLANT DISEASE DETECTION

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Abstract - Agriculture is extremely important in human life. Almost 60% of the population is engaged in some kind of agriculture, either directly or indirectly. There are no technologies in the traditional system to detect diseases in various crops in an agricultural environment, which is why farmers are not interested in increasing their agricultural productivity day by day. Crop diseases have an impact on the growth of their respective species, so early detection is critical. Many Machine Learning (ML) models have been used to detect and classify crop diseases, but with recent advances in a subset of ML, Deep Learning (DL), this area of research appears to have a lot of promise in terms of improved accuracy. The proposed method uses a convolutional neural network and a Deep Neural Network to identify and recognize crop disease symptoms effectively and accurately. Furthermore, multiple efficiency metrics are used to assess these strategies. Thisarticle offers a thorough description of the DL models that are used to visualize crop diseases. Furthermore, several research gaps are identified from which greater transparency for detecting diseases in plants can be obtained, even before symptoms occur. The proposed methodology aims to develop a convolution neural network-based strategy for detecting plant leaf disease.

***Key Words*:** Plant Disease, Leaf Disease detection

1.INTRODUCTION

Agriculture is extremely important in human life. Almost 60% of the population is engaged in some kind of agriculture, either directly or indirectly. There are no technologies in the traditional system to detect diseases in various crops in an agricultural environment, which is why farmers are not interested in increasing their agricultural productivity day by day. Crop diseases have an impact on the growth of their respective species, so early detection is critical. The proposed method uses a convolutional neural network and a Deep Neural Network to identify and recognize crop disease symptoms effectivelyand accurately. Furthermore, several research gaps are identified from which greater transparency for detecting diseases in plants can be obtained, even before symptoms occur. The proposed methodology aimsto develop a convolution neural network-based strategy for detecting plant leaf disease.

Through the water and soil data, the required crop for the field is suggested by using neural networks. After that the disease prediction of crop which grown is snapped by digital image processing, picture pre-processing, frequency domain image acquisition, segmentation techniques, including extraction and classification are the most common machine vision techniques . The transformedImage's digital objects are next displayed (or) statistically reported and categorized using classifiers. Digital image processing has advanced at an exponential rate in a variety of industries, particularly in contemporary agriculture.

1.1 MACHINE LEARNING

Machine Learning is clearly one of the most powerful and significant technologies in the world today. Machine learning is a technique for converting data into knowledge. There has been an explosion of data in the last 50 years .This massive amount of data is worthless until it is analyzed and uncover the underlying patterns. Machine learning techniques are used to discover useful underlying patterns in complex data that would otherwise be difficult to find. Hidden patterns and problem knowledge can be used to forecast future events and make a variety of complex decisions. Machines must go through a learning process to understand the rules that govern a phenomenon, experimenting with alternative rules and learning from how well they operate .

1.1.1 BASIC TERMINOLOGY

- Dataset: A set of data examples, which contain features importantto solving the problem.
- Features: Important pieces of data that help to understand a problem. These are fed into a Machine Learning algorithm to help it learn.
- Model: A phenomenon's representation (internal model) that a Machine Learning algorithm has learned. This is something it learns fromthe data it sees during training. The model is the output of an algorithm after it has been trained.

1.1.2 TYPES OF MACHINE LEARNING

There are multiple forms of Machine Learning; supervised, unsupervised, semi supervised and reinforcement learning. Each form of Machine Learning has differing approaches, but they all follow the same underlying process and theory.

1.1.2.1 SUPERVISED LEARNING

It is the most widely used machine learning paradigm. Learning algorithm can be feed to a data in the form of example-label pairs one by one, allowing the algorithm to predict the label for each case and providing feedback on whether it anticipated the correct answer or not. The algorithm will learn to estimate the exact nature of the relationship between samplesand labels. The supervised learning algorithm will be able to observe a new, never-seen sample and predict a good label.

1.1.2.2 UNSUPERVISED LEARNING

It is very much the opposite of supervised learning. There are no labels on it. Instead, the algorithm would be fed a large amount of data andgiven tools to comprehend the data's features. It can then learn to group, cluster, and organize the data in such a way that a human can understand the newly organized data. Unsupervised learning data-driven can be

calledbecause it is based on data and its properties . The data and how it's structured determine the outcomes of an unsupervised learning task.

1.1.2.3 REINFORCEMENT LEARNING

When compared to supervised and unsupervised learning, it is quitedifferent. Reinforcement learning is based on the behavior of the learner. It requires an agent and an environment for any reinforcement learning task,as well as a mechanism to connect the two through a feedback loop. To link the agent to the environment, It is provided with a set of actions that have an impact on the environment . To keep the environment connected to the agent, it's made to send two signals: an updated status and a reward(reinforcement signal for behavior).

1.1.3 BASIC PROCESS

- Data Collection: Collect the data that the algorithm will learn from.
- Data Preparation: Format and engineer the data into the optimal format, extracting important features and performing dimensionality reduction.
- Training: Also known as the fitting stage, this is where the Machine Learningalgorithm actually learns by showing it the data that has been collected andprepared.
- Evaluation: Test the model to see how well it performs.
- Tuning: Fine tune the model to maximize its performance.

1.1.4 DATASETS

Machine Learning is strongly reliant on data. It's the most important factorthat allows algorithm training to take place. It gains experience by using historicaldata and information . The higher the quality of the dataset gathering, the higher the accuracy. Data collection is the initial step. There is a need of two datasets forthis project. One is used to model the yield prediction method, while the other isused to forecast the weather. Average Rainfall and Average Temperature, for example. These two parameters are anticipated in order to be used as inputs in crop yield prediction. Meteorological API for weather data and Kaggle for crop yield data are the sources of datasets .

The sources of datasets are: Weather APIfor weather data and Kaggle for crop yield data. The yield prediction module dataset requires the following columns: State, District, Crop, Season, Average Temperature, Average Rainfall, Soil Type, Area and Production as these are the major factors that crops depend on. Production is the dependent variable or the class variable . There are eight independent variables and 1 dependent variable. It achieved by merging the datasets. The datasets were merged taking the locationas the common attribute in both. Only two states are considered here, Maharashtra& Karnataka as the suicide rates in farmers in these two States were found to be very high. The transformedImage's digital objects are next displayed (or) statistically reported and categorized using classifiers. Digital image processing has advanced at an exponential rate in a variety of industries, particularly in contemporary agriculture.

2. LITERATURE SURVEY

2.1 CROP YIELD PREDICTION USING MACHINE LEARNING TECHNIQUES

It gives anidea of how crop yield is predicted using decision tree Algorithms and Linear Regression. It also involves collecting various parameter such as crop name, season, area, production, soil parameters. The crop yield prediction is a method to achieve a high yield of the crop using previously available data like crop name, season, area, production, soil parameters continuously involve all features that used for high yield of the crop.Selection of features which are necessary for target feature. Some are not precisely considered as a yield, additionally analysis play an important role in theprediction, linear regression approach having two factors response and explanatory variables. Here input param. The proposed system has the followingsteps for crop yield prediction using linear regression method. Predicting the analyzed data .and which is prediction entity depends on input entities.

Linear Regression model the main steps are as below:

- The first step is to input an experimental information set, may be the cropinformation and soil information along with their outcomes. Few techniques will gather, format and organize the information but only the raw information is scarceto figure with the model.
- Second step is to collect the data and then pre-process the dataset for the junk or noise removal.
- Third step is to separate the data into training and testing datasets: the information must be partitioned into two datasets. The training dataset is havingthe greatest rate of information, so it will train most of the example datasets to produce the yield.
- The fourth step is to apply the linear regression on the trained datasets: herethe system depends on the complexity of data and also the structure as per the need. Accordingly, the event modeling and the structures are adjusted.
- Fifth step is to apply the trained linear regression model on the test datasetsand calculate the R values. This is one of the simple and effective models for cropyield prediction.

2.2 CROP YIELD PREDICTION USING MACHINE LEARNING ALGORITHM

The authors have experimented the crop yield prediction by using random forest machine learning algorithm. and also fetched the weather details using weather API.

Data Pre-Processing:

Data Preprocessing is a method that is used to convert the raw data into a clean data set. The data are gathered from different sources, it is collected in rawformat which is not feasible for the analysis. By applying different techniques like replacing missing values and null values, data can be transformed into an understandable format. The final step on data preprocessing is the splitting of training and testing data.

Factors affecting Crop yield and production :

There are a lot of factors that affects the yield of any crop and its production. These are basically the features that help in predicting the production of any crop over the year. It

has included the factors like Temperature, Rainfall, Area, Humidity and Windspeed Comparison and Selection of Machine LearningAlgorithm Before deciding on an algorithm to use, first it needs to evaluate and compare, then choose the best one that fits this specific dataset. The following machine learning algorithms are used for selection and accuracy comparison:

- Logistic Regression - Logistic regression is a supervised learning classification algorithm used to predict the probability of a target variable. The nature of target or dependent variable is dichotomous, which means there would be only two possible classes. When logistic regression algorithm applied on dataset it providesan accuracy of 87.8%.

- Naive Bayes - Naive Bayes classifier assumes that the presence of a particular feature in a class is unrelated to the presence of any other feature. Naïve Bayes model is easy to build and particularly useful for very large data sets. Along with simplicity System Architecture System architecture represented mainly consists of weather API where, data such as temperature, humidity, rainfall are fetched. The data fetched from the API are sent to the server module. The data gets storedon to the database on the server.

2.3 AN APPROPRIATE MODEL PREDICTING DISEASES OFCROPS USING MACHINE LEARNING ALGORITHMS

It offers additional information about wireless sensor network material necessary for the planning and construction of Wireless Sensor Networks, help analyze actual data from WSN in the field and existing data sets are utilized to anticipate crop diseases and pest patterns. The proposed system is described in following parts Data Set, Materials, Methodology used. A. Data Set are made into Two data set based on existing information from government portal website of agriculture.

Crop Data Set:

This Crop data set consists of Crop name, Soil Samples Values (Nitrogen, Phosphor, Potassium), pH values, Temperature and humidity Pest Data Set. This Pest data set consists of Pest name, Crop name, temperature, humidity. This data set are used as training in the model. B. Materials and Setup In order to study the real time prediction WSN test bed is required to installthis following component are required :

- Raspberry Pi - A computational processing board base for sensor operations of fetching and sending data towards end terminal from sensor.
- Air Pi - A computational processing board for sensing exterior temperature, humidity and air pressure. Grove Sensor - A sensor for sensing the pH value of the soil.
- Mics-2714 Sensor - A sensor for sensing Nitrogen content in the soil.
- VG400 Sensor - A sensor for sensing the soil moisture.
- THERM200 Sensor - A sensor for sensing the soil temperature.
- CC2530 ZigBee - A medium for communication be-tween sensor board.
- GSM data modem - A medium for communication between main sensorboard to lab terminal.

An end-to-end WSN system will be developed in the test bed field of battery powered nodes embedded with wireless sensors(temperature sensor, humidity sensor, Ph sensor, soil moisture sensor) connected to Raspberry Pi computational board will be used to continuously monitor sensory soil parameters and a main node with above all material with weather board and GSM module will monitor sensor node, weather board data (temperature sensor, humidity sensor and air pressure).

Methodology:

In this section model is made to process the sensor data and get output prediction on plant diseases and pest. Where Raw data is taken from filed and variable is assigned to the data and null, overrange and under range variable is deleted in Data Preprocessing stage. Then this Raw Data is categorizing into Exterior Temperature, Soil Temperature and Soil Sample Dataset.

Flow for Plant diseases: A Sample Data Set of Crops consists of Crop Name, Soil Nutrients like Nitro-gen, Phosphor, pH value, also Temperature and Humidity required for crops growth is giving as training datasetto Naïve Bayes Kernel Model with input with Raw Data set of Soil Samples and Exterior Temperature. Output from this model is pattern comparison of both dataset.

Flow of Pest Control: A Second Sample Data Set of Crop and Pest consists of Crop name, pest name, optimum temperature of soil and atmospheric temperaturehelpful to pest and fungus to grow is giving as training dataset to same Naïve Bayes Kernel Model with input with Raw Data set of Exterior and Soil Temperature. Output from this model is pattern comparison of both data set.

2.4 TOMATO LEAF DISEASE DETECTION USING DEEP LEARNING TECHNIQUES

This approach uses a CNN algorithm to extract hierarchical features based on the input pixel intensity and comparing it with a trained dataset image. Through lowering the inaccuracy across the entire dataset, all the leaf characteristics are optimized. The objective of the paper is to propose a methodology that could classify the tomato leaf diseases and suggest the best solution to overcome the same. This has been implemented effectively using image processing technique and the latest niche algorithms and using the open-source programming language Python.

Pre-processing:

The image pre-processing is the initial step. During the pre-processing step, the Gaussian filter with a smoothened approach is applied to tomato leaf for reduce the noise and remove the blur from image to improve the enhancement of tomato leaf image.

Image Extraction:

The most important step in image recognition is feature extraction. This feature extraction is done by using the DWT and GLCM. For feature extraction, DWT utilizes the coefficients with sub-bands and computed correlation of GLCM is used to classify the leaf image or the segment of a leaf image depending uponvarious luminous levels.

IDWT: Discrete Wavelet Transform (DWT) is applied on the improved enhancement of tomato leaf image and implies can take the discrete wavelet transform of the tomato leaf and utilizes the coefficients to generation of the sameto a numerical

precision. The wavelet features are extracted by using DWT formtomato leaf healthy and affected images and the DWT transformation convert digital signal into wavelet signal. The DWT descriptor can be extracted features for all directions like vertical, horizontal, and diagonal from sub-bands of tomato images and can be retrieve the detailed content of the tomato leaf image by usinglow and high pass filter technique.

GLCM: The image made out of pixels each with a luminous level and the GLCMis used to classify the leaf image or the segment of a leaf image depending upon various luminous levels. For each GLCM can be extracted the spatial coordinates with common correlation statistical property and the find probability of occurrence between each pixel value with adjacent pixel value.

Segmentation:

Segmentation is the process of categorizing the leaf image into smaller portions of texture, containing similar characteristics. The proposed method is used to segmentation process to determine the boundary of the tomato leaf and label it into pieces.

Convolutional Neural Network:

A convolutional Neural Network algorithm used in this proposed method is a hierarchical feature extraction that maps the pixel values and evaluates the same with the trained dataset image. It classified by several fully connected layersin the subsequent step and all adjustable parameters of the leaf portions are optimized by reducing the error over the training set. The compared image is classified into disease affected and normal leaf as the image classifier technique that has been deployed. The results of the same are stored into the database for further detection and analysis.

The proposed method tested on OpenCV is one of the most widely used libraries for computer vision applications. OpenCV-Python is the API for OpenCV and fast and also the best choice for implementing the Image Processingconcepts of leaf disease detection. It gives the detection of tomato leaf disease forthe prediction of affected and normal leaf.

3. PROPOSED METHOLOGY

3.1 AN INTEGRATED MULTI-DIMENSIONAL TECHNOLOGY TOINCREASE CROP PRODUCTION AND PREDICT CROP DISEASE

The major scope of this study has been to upgrade and automate the irrigation system. Initially, rain is forecasted to determine the availability of water resources in the region. The soil quality, including PH, nutrition, and temperature,is then assessed and anticipated. The suggested approach intends to assist farmersin efficiently managing their agricultural farms with limited resources. In order to construct a smart irrigation system, this system integrates DL characteristics. The crop production analysis system generates results with high productivity forthe specified parameters based on matching accuracy and crop name. The Convolution Neural Network (CNN) Model is trained for crop disease prediction,and the system determines if a particular leaf picture is damaged or healthy. The suggested system is integrated into a single web application, farmers can easily utilize it to estimate the best crop that gives the most yield for their land characteristics, as well as crop health, by just uploading a crop image into the web application. If the crop is harmed, the users are advised to seek treatment for the ailment. Relying on the nitrogen, phosphorus, and potassium concentration of the soil, a nutrient management prediction is made.

3.2 SYSTEM SPECIFICATION

3.2.1 SOFTWARE REQUIREMENTS:

This section gives the details of the software that are used for the development.

- Server Environment: Flask
- User Interface: Browser
- Web Browser: Google Chrome
- Operating System: Windows 10 /Linux

3.2.2 HARDWARE REQUIREMENTS

This section gives the details and specification of hardware on which the system is expected to work.

- Processor: Dual core
- RAM : 2GB

3.3 SOFTWARE DESCRIPTION

3.3.1 Python :

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built-in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue languageto connect existing components together. Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and canbe freely distributed.

3.3.2 Anaconda:

Anaconda is an open-source distribution of the Python and R programminglanguages for data science that aims to simplify package management and deployment. Package versions in Anaconda are managed by the package management system, Conda, which analyzes the current environment before executing an installation to avoid disrupting other frameworks and packages. Over 250 items are installed automatically with the Anaconda distribution. PyPI provides access to over 7500 additional open-source packages, as well as the Conda package and virtual environment manager.

3.3.3 Flask :

Flask is a web application framework written in Python. It was developed by Armin Ronacher, who led a team of international Python enthusiasts called Poocco. Flask is based on the Werkzeg WSGI toolkit and the Jinja2 template engine. Both are Pocco projects.

3.3.4 Visual Studio Code:

Visual Studio Code (famously known as VS Code) is a free open-source text editor by Microsoft. VS Code is available for Windows, Linux, and macOS.Although the editor is relatively lightweight, it includes some powerful features

that have made VS Code one of the most popular development environment toolsin recent times. VS Code supports a wide array of programming languages from Java, C++,and Python to CSS, Go, and Docker file. Moreover, VS Code allows to add onand even creating new extensions including code linters, debuggers, and cloud and web development support.

3.3.5 HTML :

HTML is an acronym which stands for Hyper Text Markup Language which is used for creating web pages and web applications. Let's see what is meant by Hypertext Markup Language, and Web page.

Hyper Text Markup Language : Hypertext simply means "Text within Text." A text has a link within it, is a hypertext. Whenever a link is clicked which brings a new webpage. Hypertext is a way to link two or more web pages (HTML documents) with each other.

Markup language: A markup language is a programming language for applyinglayout and formatting principles to text documents. The markup language enhances the interactivity and dynamic nature of text. It can turn text into images,tables, links, etc.

3.3.6 CSS:

CSS (Cascading Style Sheets) allows to create great-looking web pages, but how does it work under the hood? This article explains what CSS is with a simple syntax example and also covers some key terms about the language. A document is usually a text file structured using a markup language HTML is the most common markup language, there are other markup languages such as SVGor XML. CSS can be used for very basic document text styling for example, for changing the color and size of headings and links. It can be used to create a layout.It can even be used for effects such asanimation. Have a look at the links in this paragraph for specific examples.

3.3.7 Pandas :

Pandas is a widely used open-source Python library for data science, data analysis, and machine learning activities. It is built on top of NumPy, a library that supports multi-dimensional arrays. Pandas, as one of the most popular data wrangling programs, is normally included in every Python distribution, from those that come with an operating system to commercial vendor distributions like Active State's.

3.3.8 NumPy:

NumPy is the fundamental package for scientific computing in Python. It is a Python library that provides a multidimensional array object, various derivedobjects (such as masked arrays and matrices), and an assortment of routines for fast operations on arrays, including mathematical, logical, shape manipulation, sorting, selecting, I/O, discrete Fourier transforms, basic linear algebra, basic statistical operations, random simulation and much more.

3.3.9 Pillow :

Python Imaging Library (expansion of PIL) is the de facto image processing package for Python language. It incorporates lightweight image processing tools that aids in editing, creating and saving images. Support for Python Imaging Library got discontinued in 2011, but a project named pillow forked the original PIL project and added Python3.x support to it. Pillow was announced as a replacement for PIL for future usage. Pillow supports a large number of image file formats including BMP, PNG, JPEG, and TIFF. The library encourages adding support for newer formats in the library by creating new file decoders.

3.3.10 Gunicorn:

Gunicorn is built so many different web servers can interact with it. It alsodoes not really care what is used to build the web application - as long as it can be interacted with using the WSGI interface. Gunicorn takes care of everything which happens in-between the web server and web application:

- Communicating with multiple web servers
- Reacting to lots of web requests at once and distributing the load
- Keeping multiple processes of the web application running

As described in PEP3333, the Python Web Server Gateway Interface (WSGI) is a way to make sure that web servers and python web applications can talk to each other.

3.4 IMPLENTATION OF THE PROPOSED SYSTEM

The lists of modules used in this work are:

- Best Crop Prediction module
- Fertilizer Suggestion module
- Crop Disease Identification Module

3.4.1 Best Crop Prediction module :

This module returns the predicted crop for production based on the user'sinput. If the user wants to know the production of a crop, the system takes the Nitrogen, Phosphorous, Potassium, Rainfall, City and State details of the useragricultural land as the input as well. The Machine Learning model is trained with 15 different crops and each Crop is trained with 100 different nutrition parameters. The 15 are listed below:

- Rice
- Maize
- Chickpea
- Kidney beans
- Black gram
- Lentil
- Pomegranate
- Banana
- Mango
- Grapes
- Watermelon
- Jack Fruit
- Apple
- Muskmelon
- Orange
- Papaya

3.4.1 Data Fields

COLUMN NAME	DATA TYPE	DESCRIPTION
N	Integer	Ratio of Nitrogencontent in soil.
P	Integer	Ratio of Phosphorous content in soil.
K	Integer	Ratio of Potassium content in soil.
Temperature	Float	Temperature In Degree Celsius.
Humidity	Float	Relative Humidity In Percentage
PH	Float	Ph Value Of The Soil
Rainfall	Float	Rainfall In Mm

These are the following steps of the algorithm implemented:

Step 1: N, P, K, Temperature, Humidity, PH, Rainfall is given as inputs. These values are given as input to the random forest implementation Model.

Step 2: The algorithm returns the predicted production of the given crop.

3.4.2 Fertilizer Suggestion module

This module is used to suggest the farmer on usage of fertilizer based on Nitrogen, Phosphorous, Potassium and crop which user want to grow are given as an input. There are six classes in fertilizer suggestion module:

- N High
- N Low
- K High
- K Low
- P High
- P Low

3.4.3 Crop Disease Identification Module

In this module, the user uploads the image of the affected crop and the image is passed to CNN Resnet Algorithm trained model to predict the disease affected to the crop. The predicted disease is displayed in new page of UI. and ifno disease is attacked to the crop, it says that the crop is healthy. If the crop is affected it suggests the treatment for the disease.

4. RESULT AND DISCUSSION

The proposed model is accurate in forecasting which crop will produce themost for the given land environment. This approach assists farmers in determining the crop's health in advance. The system is designed to detect crop disease early on and provide treatment information for the disease that has been identified. A single application integrates the crop production, disease predictionsystems and fertilizer suggestion. The Random Forest algorithm for crop prediction produces results with an accuracy of 99%. The Resnet algorithm for crop disease prediction produces results with an accuracy of 99.2%.

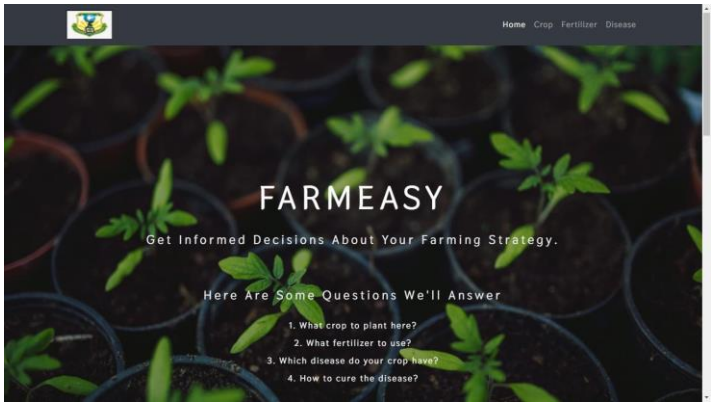

Fig 4.1 Integrated Web Application Output

4.1 BEST CROP PREDICTION

In Crop Prediction, the user enters the Nitrogen, Phosphorous, Potassium,Rainfall, City and State details of the user agricultural land and submits the form.Then the weather condition of the land is fetched using the weather api and the details are passed to the Random Forest algorithm and suggests the best crop which suits for the given land condition.

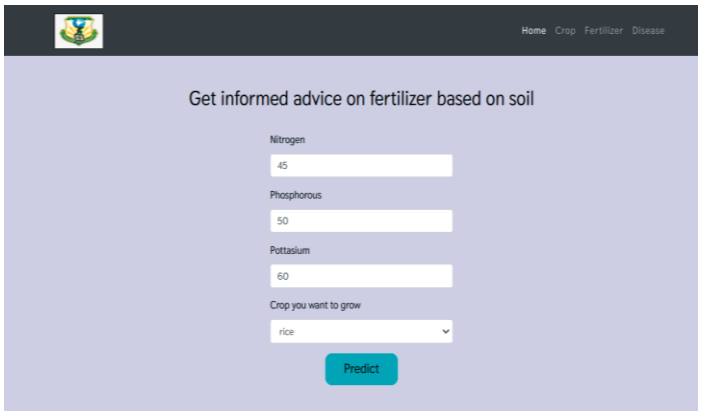

Fig 4.2 Crop prediction Input Screen

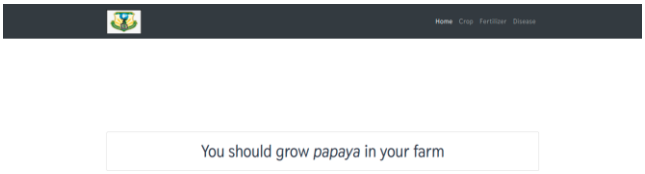

Fig 4.3 Crop prediction output screen

4.2 FERTILIZER SUGGESTION

In Fertilizer Suggestion Page, the user can enter the details of the Nitrogen,Phosphorous, Potassium values of the user land and the values are passed to the algorithm to predict which fertilizer should be used for given land conditions. If any of the values such as nitrogen, Phosphorous, Potassium, is low then the algorithm suggests the fertilizer to increase the respective mineral in the soil.

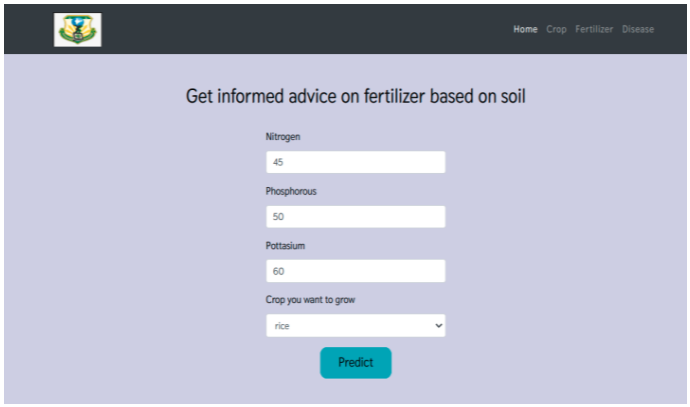

Fig 4.4 Fertilizer Suggestion Input Screen

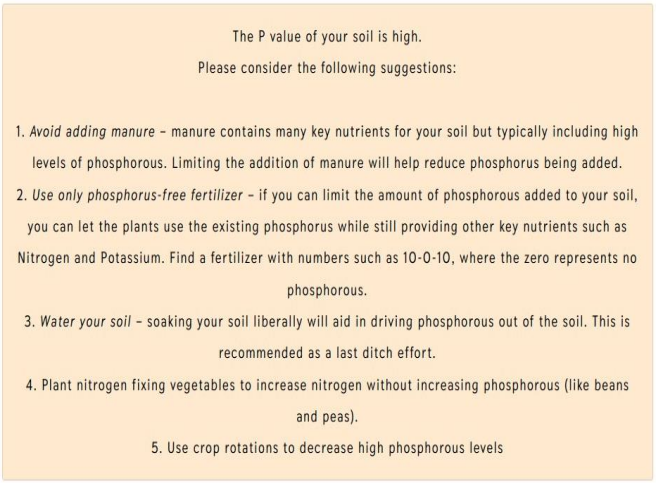

Fig 4.5 Fertilizer Suggestion Output Screen

4.3 CROP DISEASE IDENTIFICATION

In Crop Disease Identification, the user uploads the image of the affected crop and the image is passed to the CNN Resnet Algorithm to predict the diseaseaffected to the crop. The predicted disease is displayed in new page of UI. and ifno disease is attacked to the crop, it says that the crop is healthy.

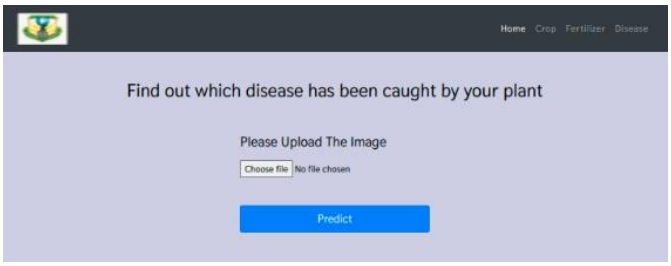

Fig 4.6 Crop Disease Prediction Input Screen

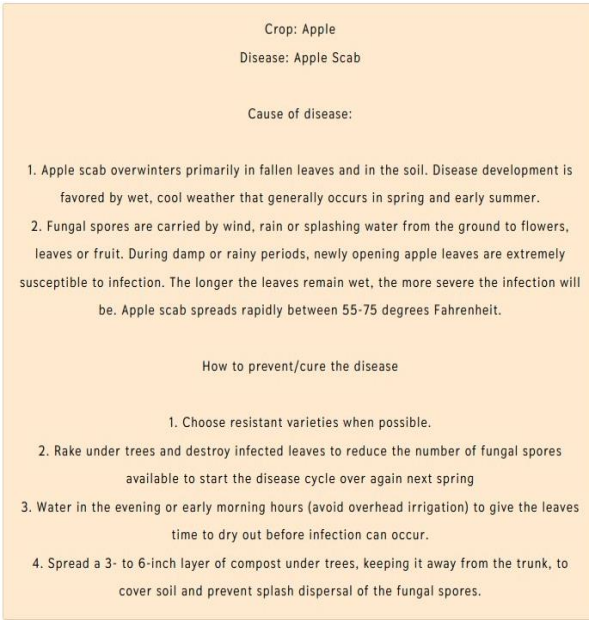

Fig 4.7 Crop Disease Prediction Output Screen

5. CONCLUSION

This study discussed the evolution of crop production in agriculture as wellas the prediction of crop disease. This is extremely important for increasing crop productivity and growing a healthy crop by recognizing and treating problematic crops ahead of time. The application also suggests the fertilizer to be used for better crop production based on given land condition Planting a crop that meets the land conditions and aids in the treatment of crop disease would boost crop production. The Suitable Crop Suggestion System utilizes Random Forest Algorithm to predict the suitable crop for the given land condition. The Crop Disease Prediction System utilizes Resnet Classification to Identify the disease attacked in the Crop. The proposed model is accurate in forecasting which crop will produce the most for the given land environment. This approach assists farmers in determining the crop's health in advance. The system is designed to detect crop disease early on and provide treatment information for the disease that has been identified.

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