PLANT NUTRIENT DEFICIENCY USING MOBILENET

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Abstract: Agricultural systems rely on adequate water, sunlight, and nutrient uptake for plants. Different plants have different amounts of nutrients, known as macronutrients or micronutrients. Plant growth and development can be affected by macronutrient deficiencies. Nutrient deficiencies are a common condition that can affect plants if not treated promptly. Monitoring for defects is manual and requires more effort, especially in large areas. The rapid development of technology has made it possible to build systems to detect nutrient deficiencies in plants. Missing plants are detected by MobileNet, and the situation is diagnosed from plant images. To determine nutrient deficiencies, plant leaf analysis was performed for leaf condition. You can estimate which nutrients your plant's roots are getting enough of, and symptoms of deficiency can be identified by leaf colour and size. MobileNet is specifically trained for nutrient deficiencies and is used to determine if leaves exhibit symptoms related to nutrient deficiencies.

Key Words: ***Nutrient deficiency leaf, image analysis, Deep learning, CNN, ANN, MobileNet, Densent121, VGG19, InceptionResNet.***

I. INTRODUCTION:

Agriculture in India is the backbone of the country's economy and contributes significantly to the country's GDP and employment. It employs over 50% of India's population and contributes around 17% to India's Gross Domestic Product (GDP). Agriculture has been the main occupation for most Indians for centuries. India is one of the world's largest producers of cereals such as wheat, rice, and legumes, and is also a major producer of fruits, vegetables, and cash crops.

Most farmers are dissatisfied with their farm income. A fact only farmers know is that the cost of harvesting is low when they are in their hands and high when they are not available. The second reason is that most farmers did not get the yields they expected. To help farmers, we surveyed crops and found that nutrient deficiencies are a major problem that reduces crop yields.

Essential nutrients for plants include macronutrients such as nitrogen, phosphorus, potassium, calcium, magnesium, and sulphur, as well as iron, zinc, copper, boron, manganese, and chlorine. Undernutrition can occur for a variety of reasons, including: Poor soil quality, unbalanced fertilization, high soil pH, waterlogging, root damage, pests, and diseases. Deficiency symptoms vary depending on the type of nutrient deficiency, but generally appear as visible abnormalities in the leaves, stems, or roots of the plant. Growth is stunted and leaves turn purple. Similarly, potassium deficiency can cause leaf degeneration and necrosis, and calcium deficiency can cause leaf and stem deformation and wilting. may decline.

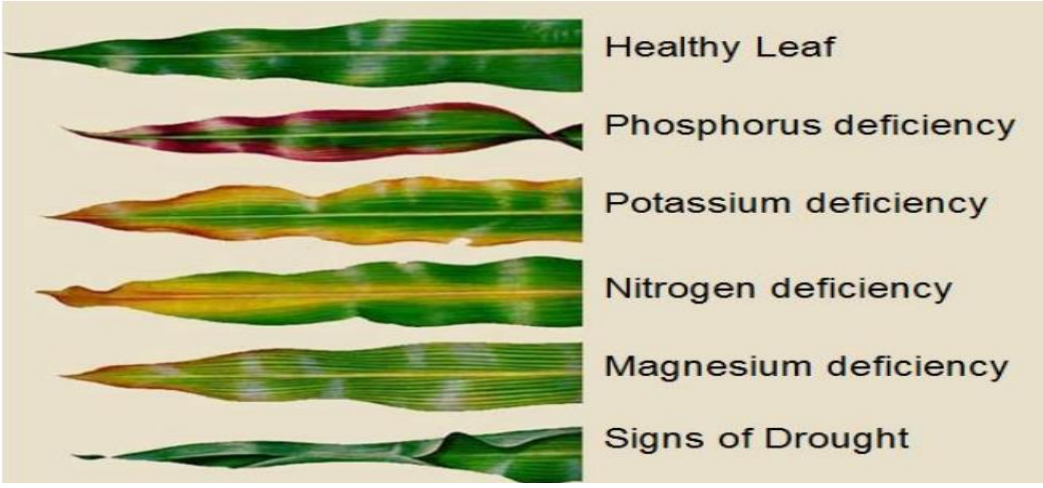

Fig 1.1 Example of maize leaves with nutrient deficiency

Therefore, it is important to identify specific nutrient deficiencies and take corrective action to address them. This may include adjusting soil pH, providing appropriate fertilizers and soil amendments, or taking steps to improve soil health. By regularly monitoring plant growth and appearance, nutrient deficiencies can be identified early and corrective action taken before they become bigger problems.So, the main goal of the project is to create a web application that takes input as plant leaves, produces output as missing nutrients, and provides solutions.

II. LITERATURE SURVEY:

In order to better assess the nutritional status of plants, data science is employed in [1]. It is critical to determine which wavelengths are instructive and to use this knowledge to customise the sensor configuration. Costly wide-range spectrometers are employed to produce the data that this type of analysis-specific labs need. Data acquisition is slowed since it is prohibitively expensive to purchase multiple of them. In order to make data capture more affordable, our analysis aims to lower the wavelength range required.

Palm HAND, a cutting-edge application for smart devices that enables farmers to get in-situ identification of nutrient deficiencies of Mg, K, or N in oil-palm plantations using leaf photos, is used in [2] for the identification of nutrient deficiencies in oil palm and identify geolocate nutrient deficiencies in oil-palm plantations. If there is an Internet connection, the programme functions as an Internet of Things (IoT) device in Microsoft's Azure Cloud to obtain storage and visualisation of historical data that can be gathered by numerous concurrent users.

Pictures of oil palm leaves will be taken using a high-end digital imaging technology to analyse the leaves' surface as described in [3] under the heading "Image Processing for Nutritional Deficiencies Identification in Elaeis Guineensis." The form, texture, and colour of the illness kind will also influence the development of feature extraction algorithms. The fuzzy classifier will receive the feature vectors as inputs. Overall, the suggested approach will help the oil palm industries meet market demand.

Image Processing and Machine Learning is used in [4] provide an automated and reliable economic solution for nutrient deficiency identification. The dataset for deficient leaves and healthy leaves are created using image processing approach for RGB colour feature extraction, real-time texture detection, edge detection, etc. This created dataset will be given to supervised machine learning as training dataset for further detection and identification of exact nutrient deficiency and healthy plants in order to take preventive measures to maximize the yield.

The Author introducing Convolutional Neural Networks in [5] is used to the prediction responses from all selected blocks in the input leaf image are then combined. The proportion for each type of response is computed and fed to a multi-layer perceptron with one hidden layer to produce a final response for the leaf-level decision. A technique based on histogram analysis is adopted to separate abnormal regions in an input leaf image.

Mendely, Kaggle's rice deficiency dataset, and Transfer Learning Models are utilised in [6] to discover rice insufficiency. Training, testing, and validation sets were created using enhanced Mendeley and Kaggle datasets. Six TL models were then trained separately on each of these datasets. The networks were accurately trained using the categorical cross-entropy loss function and the Adam optimizer. The four TL models with the best performance were combined to create 11 ensemble classifiers. To choose the best model for diagnosing a rice shortage, all the classifiers were evaluated using performance metrics such a confusion matrix, precision, recall, F1-score, and accuracy.

The optical sensor method is an effective and trustworthy approach for detecting cotton flaws and is utilised in [7], a strategy for doing so. Yet, with some restrictions, some researchers concentrate on these professional procedures.

III. METHODOLOGY:

3.1 Plant Nutrient deficiency identification

Collect a dataset of images of healthy plants and plants with nutrient deficiencies. We can use images from public datasets or create our own dataset by taking pictures of plants with different types of nutrient deficiencies. Label the images in our dataset to indicate which plants are healthy and which have nutrient deficiencies. Train a deep learning model on our labelled dataset. You can use a pre-trained model like ANN, CNN, INCESPTIONRESNET, DENSNET, VGG, and MOBILENET as a starting point, and fine-tune it on your dataset. For getting better accuracy we prefer MOBILENET.

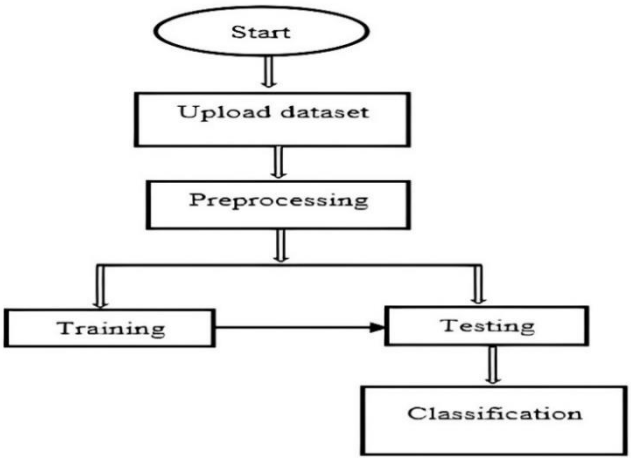

Fig 3.1 Block diagram

Once the model is trained, we can use it to analyse new images of plants and detect nutrient deficiencies. To do this, we would pass an image of a plant through the model and look at the output to see if the model has detected any nutrient deficiencies. To make the system more user-friendly, we could create a web app that allows users to take a picture of a plant and get an immediate diagnosis of any nutrient deficiencies. The app could also provide recommendations for how to address the deficiency, such as adding fertilizer or adjusting the pH of the soil.

Finally, we could continue to improve the system by collecting more data and re-training the model periodically to make it more accurate and robust.

Create Dataset:

The dataset containing images of the plant nutrient deficiencies images and are to be classified into training and testing dataset with the test size of 30-20%.

Pre-processing:

Resizing and reshaping the images into appropriate format to train our model

Training:

Use the pre-processed training dataset is used to train our model using Deep learning and machine learning algorithms along with DenseNet transfer learning methods.

Classification:

The results of our model are display of plant nutrient deficiencies images are either with different labels

3.2 Algorithm for plant nutrient deficiency

Step 1: User must be logged on to the system
Step 2: If the user is new, they must register.
Step 3: If the user is already registered, he can enter his email address and password to login
Step 4: User must upload an image
Step 5: User must select a model from a list of models
Step 6: Based on the model selection, the user gets the results.

IV. Experimental Results and Analysis:

4.1 Libraries used

In this project, we are using python language to develop the project and we need to import the following libraries which are to be used for further processing the input and output.

a) NumPy:

The fundamental Python library for scientific computing is called NumPy. A multidimensional array object, various derived objects (like masked arrays and matrices), and a variety of routines for quick operations on arrays are provided by this Python library. These operations include discrete Fourier transforms, basic linear algebra, basic statistical operations, random simulation, and much more. The nd-array object is at the centre of the NumPy package.

b) Pandas:

Pandas is an open-source Python library that provides high-performance capabilities for data manipulation and analysis. The term "Pandas" refers to a multidimensional data econometric technique called "Panel Data." Many academic and professional fields, including finance, economics, statistics, analytics, etc., use Python with Pandas.

c) Matplotlib:

Matplotlib is an excellent Python visualisation package for 2D array displays. To handle the larger SciPy stack, a multi-platform data visualisation toolkit called Matplotlib was developed and is based on NumPy arrays. John Hunter introduced it for the first time in 2002. One of visualization's main benefits is that it allows us visual access to enormous amounts of data in easily understandable forms. In Matplotlib, there are many different types of plots, such as line, bar, scatter, and histograms.

4.2 Models Used

In this project, we use different models for training like ANN, CNN, INCESPTIONRESNET, DENSNET, VGG, and MOBILENET. Here is an overview of how these different deep learning models could be used for the task of identifying plant nutrient deficiency.

Artificial Neural Networks (ANN) are a type of deep learning model that can be used for image classification tasks. They work by learning a set of weights that are used to calculate the output of the model. ANN can be trained on a dataset of labelled images to classify new images into different categories.

Convolutional Neural Networks (CNN) are a type of ANN that are specifically designed for image analysis tasks. They work by applying a set of convolutional filters to an input image to extract features at different scales. CNN have been shown to be very effective at image classification tasks, including identifying plant nutrient deficiencies.

InceptionResNet, DenseNet, VGG, and MobileNet are all variations of CNN that have been optimized for different trade-offs between accuracy, speed, and memory usage. InceptionResNet and DenseNet are both deep CNN that have been shown to achieve high accuracy on image classification tasks. VGG is a deep CNN that is known for its simplicity and effectiveness, while MobileNet is a lightweight CNN that has been optimized for mobile devices.

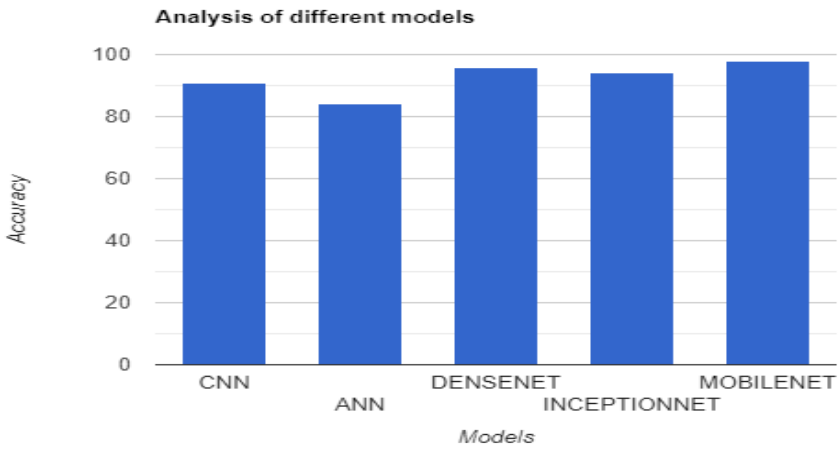

Fig. 4.2.1: Analysis of different models

The performance of these different deep learning models for identifying plant nutrient deficiency would depend on the quality and size of the dataset, as well as the specific implementation details. Typically, researchers would split the dataset into training and testing sets, and use techniques like cross-validation to evaluate the performance of different models. They would also likely compare the accuracy, speed, and memory usage of different models to determine which one is best suited for their specific application.

4.3 Web application for identification of plant nutrient deficiency

CNN

By using this model, we identified that the leaf has Magnesium Deficiencies with an Accuracy of 90.909.

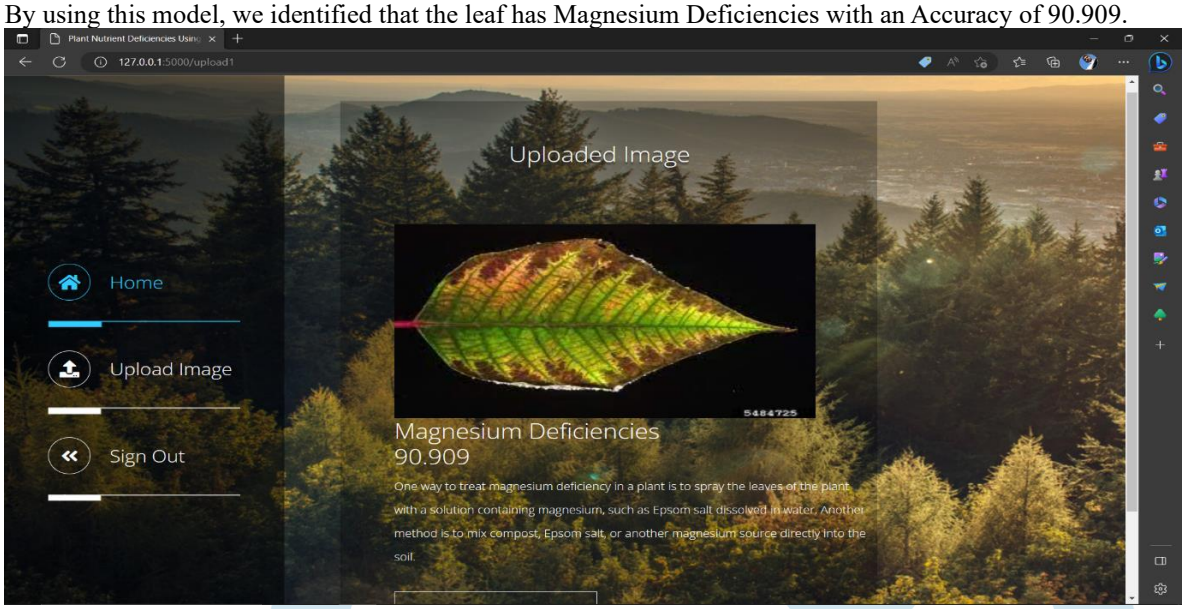

Fig.4.3.1 Deficiency Identification Using CNN

ANN

By using this model, we identified that the leaf has Magnesium Deficiencies with an Accuracy of 84.091.

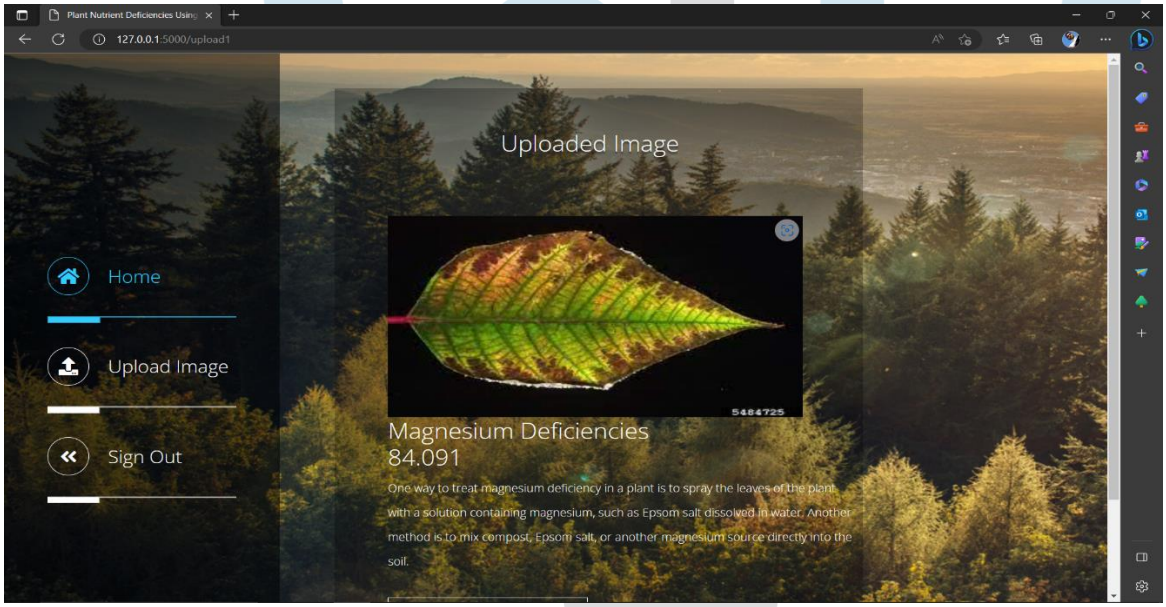

Fig.4.3.2 Deficiency Identification Using ANN

DENSENET

By using this model, we identified that the leaf has Magnesium Deficiencies with an Accuracy of 95.864.

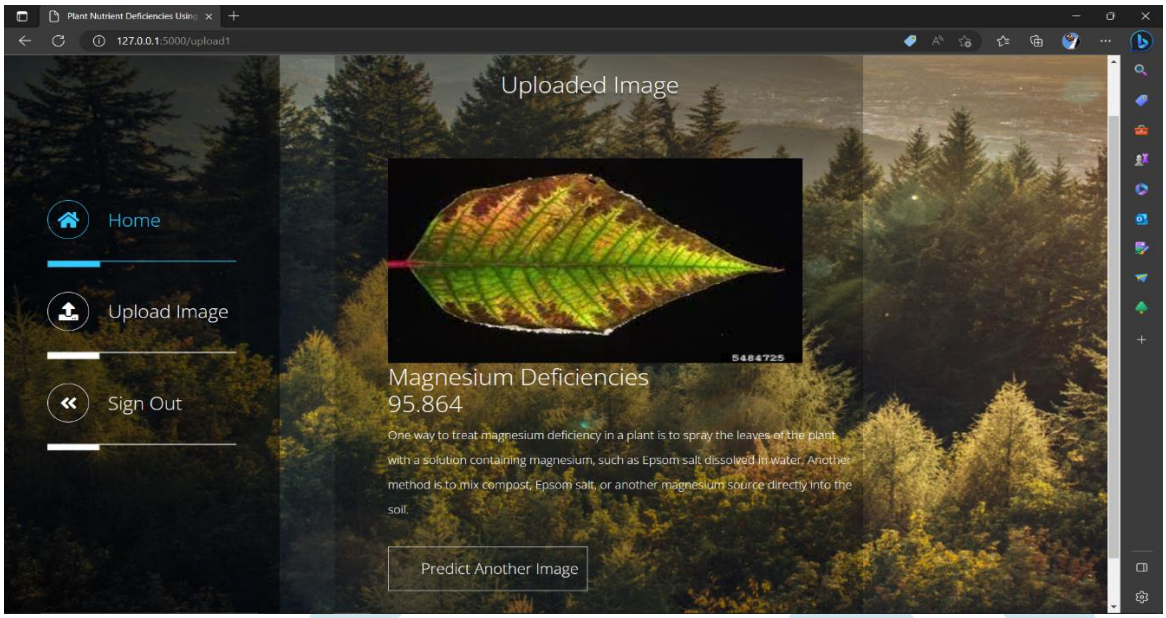

Fig.4.3.3 Deficiency Identification Using DenseNet

INCEPTION RESNET

By using this model, we identified that the leaf has Magnesium Deficiencies with an Accuracy of 94.318.

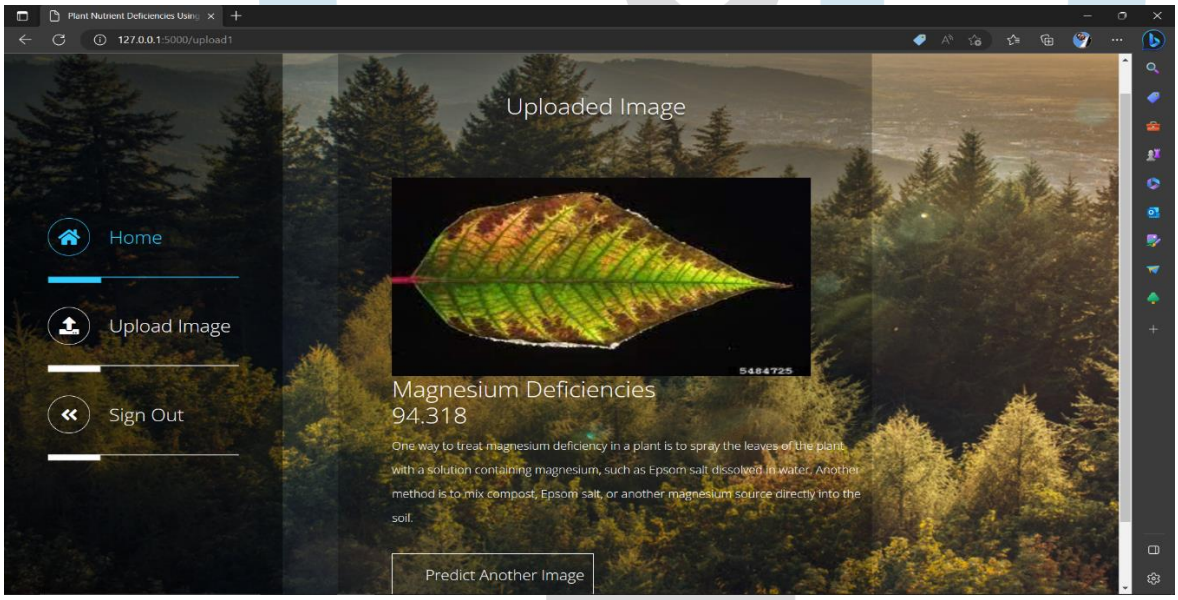

Fig.4.3.4 Deficiency Identification Using Inception ResNet

MOBIENET

By using this model, we identified that the leaf has Magnesium Deficiencies with an Accuracy of 97.727.

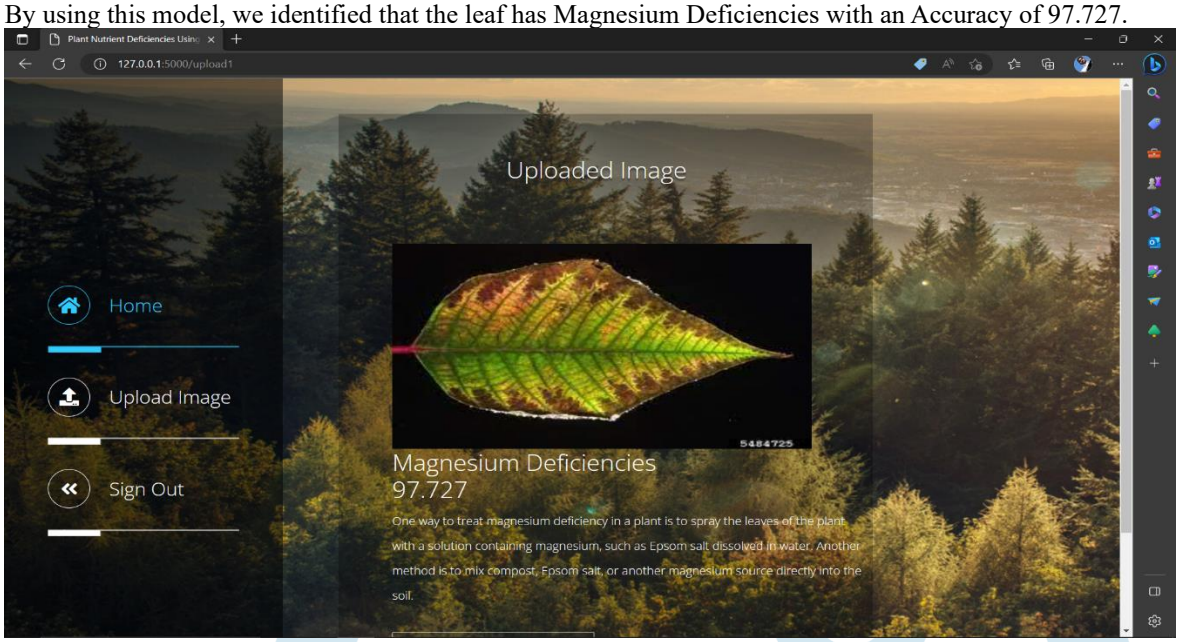

Fig.4.3.5 Deficiency Identification Using MobileNet

V. CONCLUSION:

In this project, we successfully identified nutritional deficiencies in plants with low or high nutritional value by classifying photos using deep learning and machine learning. We create web applications that enable simple user interaction. Here, we looked at a dataset of photos showing nutrient deficiencies in plants, taken from various kinds and types of plants (healthy or unwell), and we used a variety of training models, including ANN, CNN, INCESPTIONRESNET, DENSNET, VGG, and MOBILENET. Following training, we put it to the test by uploading and classifying photographs.

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