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DISEASE PREDICTION OF APPLE LEAF USING MACHINE LEARNING

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Abstract: **Current trends of farming is having a gap to identify the problem upfront even before capturing the results. Similar kind of farming to figure out the problem in farming is apple leaf, instead of finding the problem in later time one need a background in understanding the disease prediction for apple leaf. Considering the factors in effecting the plant growth, image classifications and features between correct abstraction of images, will help us in identifying the apple leaf plant growth. Image classification methods in Machine learning such as Convolutional Neural network emphasis the detailed regression algorithms to predict the plant disease upfront in order to fix the plant with relevant methods. Apple leaf disease is captured with every stage of images of the plants and ensured we ran through lot of train and test datasets to train our algorithm in picturizing the early sign of apple leaf diseases. The number of datasets images have to run through the algorithm of convolution neural network and artificial neural network, in identifying the early predictions of apple leaf diseases. The SVM algorithm helps in understanding the classification of any image across each stage of lifecycle of apple plant. The further of analysis gives a greater flexibility on training the algorithm and its impact across the plant, the final accuracy of identification of any kind of prediction of apple leaf disease and ensuring the required methods to be taken is higher accuracy in compared to other models.**

Keywords: Apple leaf disease, prediction, convolutional neural networks (CNN), feature extraction.

I. Introduction:

Latest technology arises in internet and communications, it is also essential we do the needful things over understanding and ensuring the less damage that occurs in plant life. Out of all studies, we are ensuring the life of a plant will be taken care with outmost steps. All the traditional methods that a person is aware of can be computerized with all the prompts in system. This will ensure when the images are trained with a huge dataset it predicts based on its prompt and labelling of disease of an apple leaf. A leaf plays a huge role in a plant, which health is important for the plant. At the most of the damages that occur in any plant life, one of the huge drawbacks is not being taken care of.

The trained dataset of the lifecycle of the plant will play a huge role in prediction of the behavior and conditions of apple leaf. Once the damage is passed through the roots of plant, then we will

reduce our chance in saving the plant and it will be more time taking in growing the same plant again. All kind of images are classified and labeled to ensure they were tagged in a right manner, once all the information is trained correctly, one can run through the algorithm further to take care of the apple plant leaf.

All the pre trained methods of tagging the images and its steps to take care of the apple leaf further is a groundbreaking step to ensuring the right things happen in right time. If any failure of predicting the disease happens later, the lifecycle of the plant will decrease further.

Machine learning results a different kind of algorithms in place for ensuring right method with greater accuracy out of all kind of algorithms. We received a huge accuracy that is 96% during training and testing the dataset across each image using convolutional neural network and artificial neural networks. The SVM (support vector machine) algorithm will play a huge role in finding the best accuracy in training and testing the datasets, this further helps in finding the disease of predicting the apple leaf. This always ensures we are on right track in growing the apple plant and ensuring it will be followed based on the steps that are given to follow.

Once the plant lifecycle is damaged it will ensure or predict the steps to be taken in order to keep it on track. This kind of predictive methods will help plant and its leaves to grow in the right direction. Convolutional neural network ensures each epoch will be trained correctly and make sure of the right number of features are extracted while training the dataset. All the amount of training results in greater differences of ensuring lifecycle of the plant leaf life. Day to day steps of convolutional neural network image processing and feature extraction to ensure correct labelling is made in finding the disease of apple leaf is crucial.

The correct labelling and prediction result a greater accuracy of finding the amount of disease it has and the steps it can be taken to ensuring the right amount of nutrients are went to the plant. In finding the health of apple leaf is predictable through vast research of training occurred. Once images are collected in obtaining the work of bad and good healthy leaves is captured in understanding of training the images using Support vector machine algorithm, which have produced a high accuracy of 96%. In coming sections, will discuss in detail for each phase of prediction life cycle.

II. Related Work:

In these novel methods of apple leaf disease detection or prediction is highly computed method across different scenarios to consider. Chittabarni Sarkar et al (2023) [1] deals to understand the leaf disease in leaves to provide an impactful summary. Over these traditional methods in finding the imaginary and known diseases beforehand while predicting the algorithm. Machine learning and deep learning techniques plays a huge role in identifying the effects in apple leaf, this was studied from M. Sebastian, S. M S et al (2023) [2] research.

Also, grape leaf disease prediction with the help of machine learning algorithms such as SVM, random forest and adaboost from S. M. Jaisakthi et al (2019) [3] Huang, Zhaohua, et al (2020) [4] research shows SVM provided the best results although the accuracy is of 93%. Each kind of leaf is preprocessed with a huge impactful machine learning

algorithms, [5,6,7,8,9] with accuracy provided by each algorithm in a comparative study.

Apple leaf disease prediction from P. Lottes et al (2018) [16] enabled a huge convolutional neural network-based identification of weed growth. All the leaf diseases prediction can prevent in longer run of the plant growth. A. Bonkra et al (2023) [20] study shows a tremendous need of machine learning and artificial intelligence need for finding the best combination for prediction of apple leaf diseases.

In contrast to all the existing methodologies, training with a huge dataset and finding the best suited algorithm with a highest accuracy is challenging. This was detailed holding the proposed model in coming sections. Our model produced 96% accuracy out of all traditional systems, also it stands out in producing the recommendation for taking care of apple leaves if any diseases are predicted.

III. Methodology:

In the methodology tab, will be discussing the following workflows

S.no	Module	Purpose
1	Data set collection	The purpose of the module is to extract the dataset, which consists of Images of apple leaf
2	Machine learning algorithm training	Train the model with corresponding algorithms
		finding the possibility of accuracy
3	Proposed Model	SVM provided a greater flexibility in highest accuracy model, once it is extracted from train dataset
4	Machine learning algorithms	Accomodating the machine learning algorithms after training with K nearest neighbor, Regression and SVM algorithms
5	Recommendation system	Final output of the model is whether it is diseased or not, if it is diseased what precautions need to be used to take care of the crop

1) Data set collection:

Dataset collection for apple leaf disease in each phase of lifecycle is crucial in understanding or training the deep convolutional neural network. Around hundreds of images were preprocessed to understanding the algorithm. Each factor or disease have different kinds of images to

study, considering all these we took the varying images. The upfront of procuring of dataset enabled a greater study in enhancing the algorithm accuracy.

Around a span of 2 years of dataset was collected and analyzed in thorough phases of lab in understanding each stage of life of an apple leaf. Once dataset is collected, it is further analyzed in preprocessing for more understanding of apple leaf diseases in different phases. The factors are inclusive of many things it can be climate, water, soil and humid or any other external subjects.

This huge dataset for preprocessing the algorithm will enable us to find a greater flexibility in building a machine learning and deep convolutional neural network model. In turn it will create a massive impact for identification of algorithm, in return it will be tagged and labelled with different factors that are going to impact or effect the apple leaf in obtaining the diseases.

2) Methods:

Once dataset has been extracted and preprocessing of the images has been completed. The tagging and labelling based on various factors have to happen correctly. The deep convolutional neural network and artificial neural network together combines with emerging trends in machine learning algorithms.

$$\min \frac{1}{2}\|w\|^2 + C\sum_{i=1}^{n}\xi_i$$

Support vector machine algorithms perform a huge range of feature and data augmentation from the image of various apple leaf diseases. The various methods have various drawbacks in each algorithm, that we trained. Regression algorithms have also worked on training the dataset to predict the future of apple leaf disease. The above equation determines the SVM methods in pre training the images with hyperspectral or multispectral imaging.

3) Proposed system:

Considering the farmers factors and environmental variations, there will be a huge impact in health of an apple leaf. If any kind of impactful things were detected upfront then, you will find easy to nourish the plant. Taking care of the plant or its leaves is more beneficial than worrying of it later when complete destruction happens. In a span of 2 years, have collected a huge dataset of various stages of apple plant lifecycle throughout its stage's pictures, all these data are further used for our model in extraction.

If any image is identified as beneficial have been tagged and labelled as the following conditions, such as healthy, weak, not nourished, disease types and environmental defects. All these conditions are further taken into consideration and studied with local farmers in understanding how machine learning can be helpful.

In detail nourishing of the plants based on its condition, any farmer needed to aware if they are new to farming of apple plantation to avoid the risks of damaging. These all recommendation-based systems have been arranged to help any kind of crop with greater flexibility to know the future of plant.

The flexibility in adapting the technology in farming leaves a greater risk of damaging the crop and the time of growing.

4) Comparision against systems:

Out of all machine learning based systems, the problems in understanding the lifecycle of the plant and recommendation to take care of the plant in future is highly accurate and helpful to farmers. This kind of systems with greater accuracy is quite challenging to develop, with highest research of real time data. This will only leave a high chance to stand out against all the current research trends. Existing methodologies have the yolo and other convolutional neural networks, which were used and further analyzed in finding the disease prediction of an apple leaf.

Although each have different parameters to consider, our model has acquired the 96% accuracy which in the end is more helpful in finding a greater flexibility to recommend the farmers what steps they can take care to nourish the crop. Out of all traditional methods in finding the disease of apple leaf, it is time to take the research to current trends to help them nourish the life growth of apple plant crop.

Multiple attention and feature extraction is needed for a plant lifecycle to capture its health of any crop. These different various factors have been captured in nourishment of apple leaf disease prediction and recommending the farmer during the part. Apple leaf diseases are tagged and labelled during the phase of training the different will be tested with test dataset images. Apple leaf disease prediction across other machine learning algorithms doesn't give highest accuracy than compared to our model in considering an impacting factor.

In identification of apple leaf disease early prediction is necessary, if this model is implemented in current farming it will create a tremendous result in knowing the future of plant and nourish it accordingly.

5) Flowchart:

In Fig 1 start of the model have different stages in finding correct dataset accuracy. Find the image dataset, in our case it is 2 years large dataset with holding image preprocessing. The any kind of dataset that is processed with a perfect enablement of annotation, tagging and labelling between images creates a vast range of research in proposing and concluding any kind of problem into a solution-based approach.

Once the dataset has been extracted and images preprocessed the feature identification against each image helps in training the dataset. The convolutional neural network and artificial neural network in providing a greater accurate model. Once training of the dataset is completed which gives a huge impact in classifying the model against the status is healthy or not healthy of apple leaf disease.

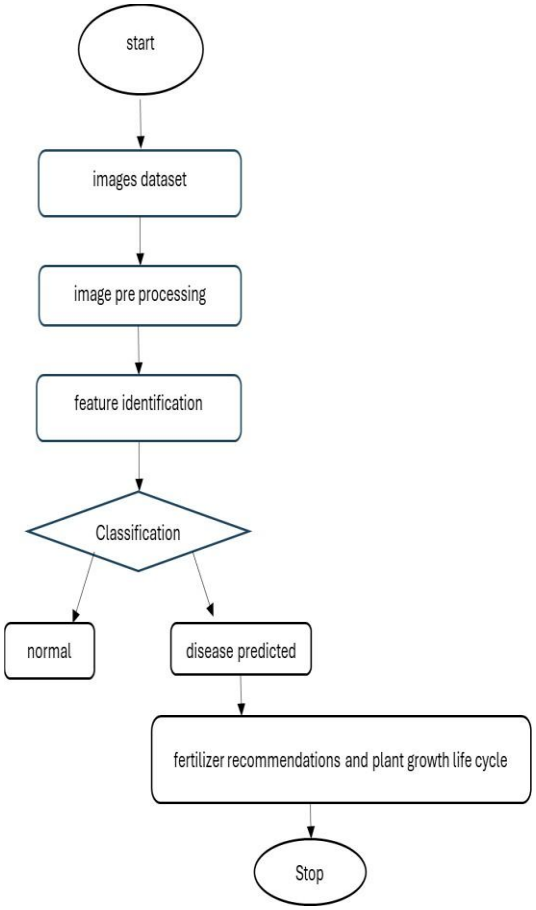

Figure 1: Flow chart

If the prediction is normal then it is no harm for nourishing the plant of apple. Disease is predicted then fertilizer recommendations and how to nourish the plant growth life cycle. These kind of recommendations and disease predicted against the apple leaf will enable us to faster growth benefits and amount of time that have taken in growth of the plant.

Pseudo method flow: Input: Images with all the corresponding labelling, Output: Text – after detecting whether the apple plant leaf is infected or not, if yes, what need to be done to be taken care of.

Step 1: Start

Step 2: Input the images as a dataset to allow tagging and labelling the images

Step 3: Once tagging and labelling of images are pre-processed the images were trained with machine learning models

Step 4: Machine learning algorithms including all possible algorithms were trained against SVM support vector machine, regression methods., out of which SVM provided highest accuracy.

Step 5: Predict the whether it is healthy or diseased, from the test dataset.

Step 6: if it is diseased then predict which fertilizer and how to nourish the plant for future growth.

Step 7: Repeat from step 2 to 6

Step 8: Stop

Considering the step-by-step methods flow will ensure all processes are taken care of without worrying of plant growth in future.

IV. Results:

Training the convolutional neural network and artificial neural network against the larger huge dataset images results the ground breaking results.

The training dataset is divided and classified into different classes based on its labelling of images. This will ensure clear cut difference can be captured if any similar kind of diseased plant situation occurs.

Once the dataset is preprocessed to ensuring the training is completed with all possible epochs and providing correlation between images while extracting features. Feature extraction and finding uniqueness or similarity check between the images will create an impactful result. Out of which all the unique traditional methodologies

various factors will impact the apple leaf diseases.

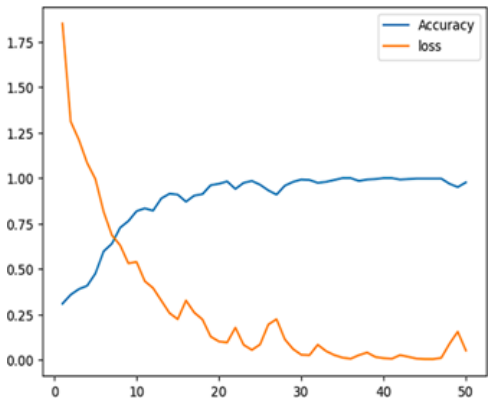

Figure 2: Graphical representation of Accuracy and loss

These Recommendation system for farming will help the crop ecosystem across multiple ways. During these factors while capturing the diseases in any kind of known feature, it will be predicted and recommend the methods to take care of the leaf or plant. While capturing one of the diseased apple leaf Fig.3 images which result a detailed issue of the leaf diseases. The predicted disease which are more accurate across different algorithms.

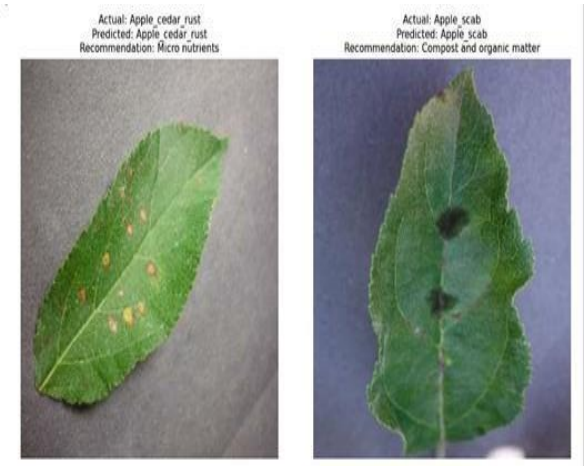

Fig.3: Disease prediction and recommendation steps

Final accuracy after training with different machine learning models, the below SVM algorithm has provided the best suited accuracy of 96% remaining regressions and decision tree algorithm provided 91%, 89% accuracy. Out of which the best suited algorithm is Support vector machine algorithm against all the machine learning algorithms.

```
3/3 [==============================] - 1s 138ms/step - loss: 0.1795 - accuracy: 0.9688
[0.17950564622879028, 0.96875]
```

Figure 4: Accuracy and loss of SVM algorithm

Figure 4 provides the detailed summary of the accuracy and loss against the best suited algorithm. With the test dataset, this can ensure a greater accuracy can be achieved against all the possible models. Higher the test dataset is effective the accuracy will be achieved.

V. Conclusion:

Detecting an early sign of disease on apple leaf will save the whole crop yield. If any new person starts farming without of any upfront knowledge, this will be a guide of tutorial to understand on studying the leaf and plant lifecycle. Our model will ensure higher dataset will be equipped to do the study of research in finding the difficulties for any plant in order to avoid of greater loss of apple leaf growth. Our model ensures we get 96% accuracy using the deep convolutional neural networks in training the model and best suited machine learning algorithms.

Altogether will result in greater flexibility in finding the best suited

methods for farmers in providing a helpful tool to change the world of farming.

VI. Future Scope:

In future, we wanted to enhance our model in more realistic ways to capture more kind of labels in annotating the images of plants, which will be one and many platforms for farming technology.

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