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Machine Learning for the Prediction of Pomegranate Fruit and Leaf Diseases

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Abstract: *Economic losses for farmers are further exacerbated by agricultural plant diseases. Any portion of the plant, from roots to fruits to leaves to stems, can be damaged by these diseases. In order to increase agricultural output, early disease detection is essential. In conventional farming methods, disease detection is left to the knowledge and experience of seasoned farmers and agricultural experts. However, this approach frequently yields subpar results, causing farmers to incur financial losses. Many scientists have been looking into ways to improve plant disease detection using soft computing and expert systems. Some plant diseases may not have obvious signs, or their symptoms may not appear until late in the growing season, close to harvest, making visual detection of these diseases less trustworthy. The good news is that technological advancements may one day greatly improve agricultural output and longevity. A thorough overview of methods for disease detection in pomegranate plants is provided in this publication. This research delves into the several steps involved in illness detection, from pre-processing to segmentation, feature extraction, and classification. Also included in the study are the strengths and weaknesses of current approaches, as well as a comparison of them..*

Keywords: Disease prediction, segmentation, ML, leaf, pomegranate, fruit illnesses

I. INTRODUCTION

The financial losses endured by farmers are greatly affected by illnesses that affect agricultural plants. Roots, fruits, and leaves are all vulnerable to these diseases. In order to increase agricultural output, early disease detection is essential. Expertise from agricultural specialists and seasoned farmers is crucial for disease detection in conventional agricultural systems. The problem is that farmers lose money because this manual method isn't always accurate. Researchers have been looking into using expert systems and soft computing to improve plant disease recognition accuracy to tackle this issue.

Some plant diseases may not have obvious signs, or their symptoms may not appear until late in the growing season, close to harvest, making visual detection of these diseases less trustworthy. The good news is that technological advancements may one day greatly improve agricultural output and longevity. A thorough overview of methods for disease detection in pomegranate plants is provided in this publication. Topics covered in the research include preprocessing, segmentation, feature extraction, and classification, all of which are important steps in disease identification. The study also compares and contrasts current methodologies, drawing attention to their shortcomings. "

Agriculture has played a crucial role in the evolution of human civilisation and is thus its foundation. Fertilisers, insecticides, crop rotation, irrigation, and other agricultural methods have seen substantial change throughout the years. These farming methods had advanced to the point in the early nineteenth century when the output per acre of land was significantly higher than it had been in the Middle Ages. Therefore, in order to keep this complex system running, it is crucial to handle all agricultural inputs effectively. Degradation of the ecosystem has unfortunately resulted from an obsession with increasing productivity, which has frequently come at the price of ecology.

The prevalence and severity of plant diseases are major contributors to the decline in crop yields and overall food quality. The cultivation of pomegranates is fraught with danger from insect pests and diseases, necessitating exact diagnosis and prompt action to prevent heavy crop losses. Diseases can appear in any part of pomegranate plants, including the fruits, stems, and leaves. Bacterial blight, Alternaria, and pombosis are three of the most common illnesses that can harm pomegranate fruit. In many cases, the illness starts on the stems and works its way down to the leaves and eventually the fruits.

Small, irregular, water-soaked spots, 2–5 mm in size, with a pinhead-sized necrotic centre, are the usual symptoms of the illness on leaves. When exposed to light, these dots become see-through. The spots, which are ringed by unique water-soaked edges, change colour from light brown to dark brown as the disease advances. If the infection is severe, the leaves could fall off. Conditions that are conducive to the disease's spread include high temperatures and higher relative humidity. Infected cuttings brought to other regions or rain sprayed by the wind can infect healthy plants.

In order to analyse plant growth and photosynthesis, leaf area is an important element. Leaf area can be measured using a number of techniques, some of which are destructive while others are non-destructive. The difference between destructive and non-destructive approaches is that the former requires removing the leaf from the plant before measurement, while the latter does not. Using technology, farmers can do a lot more, including determine the state of the leaves, spot possible diseases early on, and make educated treatment decisions. It is now possible to identify the exact kind of leaf disease using a newly established technology.

PROBLEM STATEMENT

Pomegranate plants are susceptible to illnesses and infections, which can spread to other parts of the plant. Not only does this reduce the farmers' revenue, but it also reduces the pomegranate production. At the moment, pomegranate growers have to use their hands to figure out what kind of illness is harming their fruit. This manual method, however, takes a lot of time and is prone to mistakes. It might take a lot of time to personally inspect a large pomegranate field for diseases because the fields are usually rather large.

OBJECTIVE

- Making a unique collection of pictures of fruit and leaves.
- Seeking to improve classification accuracy by exploring different segmentation strategies.
- Determining which illness is obstructing the fruit and leaves.

II. LITERATURE SURVEY

Based on the results of the last survey, we will compare and contrast the different methods used to determine fruit quality and identify diseases. In our method, we will build a strong training model by using deep learning techniques, more especially the CNN algorithm. The goal of developing this algorithm is to obtain accurate and dependable disease and fruit quality detection by utilising an existing dataset that is specifically designed for pomegranate crops. Central to our approach is convolutional neural networks (CNNs), a subset of deep learning neural networks. Essentially, convolutional neural networks (CNNs) function as a machine learning system that can evaluate input images, identify and attribute importance to various parts of those images. Thanks to its expertise, CNN is able to accurately distinguish between different parts of the image.

Paper Title	Mechanism	Advantages
1. Research on Detection Technology of Various Fruit Disease Spots Based on Mask R-CNN	Mask R-CNN, improved target detection algorithm based on Faster RCNN, instance segmentation.	- Enhanced multiscale feature fusion. - Effective for large-scale targets in lesion detection.
2. Detection of Quality in Orange Fruit Image using SVM Classifier	Support Vector Machine (SVM) for classification, Artificial Neural Network (ANN) modeling.	- SVM is an accurate classifier. - SVM is suitable for multi-class classification.
3. A Deep Neural Network-based disease detection scheme for Citrus	Deep Learning (DL) with CNN, data augmentation.	- Effective in detecting defects in citrus fruits. - Works well with a wide

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fruits		collection of data. - Data augmentation enhances the model's performance.
4. Image-based Plant Disease Detection in Pomegranate Plant for Bacterial Blight	Thresholding segmentation, Local Binary Pattern feature extraction, Feed Forward Neural Network.	- Achieved greater accuracy in disease type detection.
5. Fruit Quality Evaluation using Machine Learning: A Review	K-Nearest Neighbors (KNN), Support Vector Machine (SVM), Artificial Neural Network (ANN).	- SVM works well when there is a clear margin of separation between classes. - SVM is relatively memory-efficient.
6. Fruit Disease Classification and Identification using Image Processing	K-means clustering for segmentation, multi-class support vector machine (SVM) for classification, GLCM for texture features representation.	- Achieves greater accuracy using GLCM, ISADH, CLBP, and ZM.
7. Detection and Classification of Fruit Diseases using Image Processing & Cloud Computing	MATLAB for image processing, classification based on K-Means, Neural Network, and SVM techniques.	- Computation can be done with ease.
9. A Review on Pomegranate Disease Classification Using Machine Learning and Image Segmentation Techniques	Pre-processing, features extraction using k-means clustering, Particle Swarm Optimization (PSO) technique for feature optimization, and machine learning.	- Machine learning algorithms provide good outcomes for disease detection and identification.
10. Detection of Banana Leaf and Fruit Diseases Using Neural Networks	Image acquisition, image preprocessing, classification using ANN algorithm.	- Higher accuracy achieved with maximum threshold values in histogram results.

III. EXISTING SYSTEM

Climate change and other environmental variables are primarily to blame for the alarming increase in the occurrence and spread of many diseases. The main method for illness identification in the past has been plain old naked eye examinations. However, there are often discrepancies in the grading findings between inspectors because of factors including diverse working conditions, individual judgement, and levels of weariness. Because of the noise in the input photos, it is clear that some methods are less accurate than others. With the hope of developing more accurate ways of illness detection.

IV. PROPOSED SYSTEM

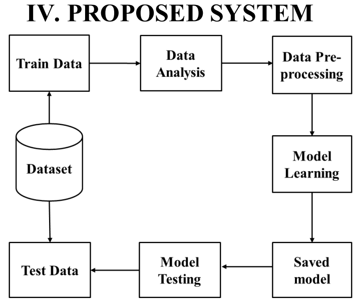

Fig.1 System Architecture

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A variety of image processing methods are employed by a suggested system to identify and categorise fruit illnesses. Acquiring images, preprocessing them, extracting descriptors from them, and finally, diagnosing and classifying diseases are the four primary steps in this procedure [10]. Figure 1 is a graphic that shows the two main stages of this approach: training and testing.

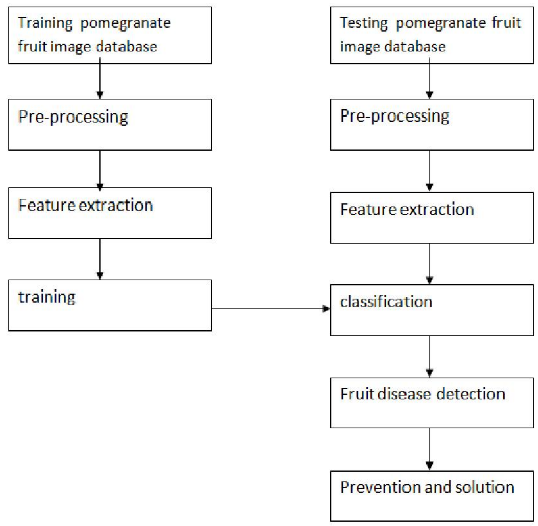

Fig.2 Proposed Framework

A. Image Acquisition: We gathered images of six distinct pomegranate kinds, including both healthy and damaged fruits. These pictures were taken using a digital camera and saved as JPEG files.

B. Image Preprocessing: To boost performance and computational efficiency, the acquired photos are first scaled to a standard resolution. Noise is removed using a variety of image processing techniques. One method to lessen the impact of sharp edges is to apply a Gaussian low-pass filter on the downsized photos [8]. In order to distinguish between the diseased and unaffected regions, k-means clustering is applied to color-based images for segmentation.

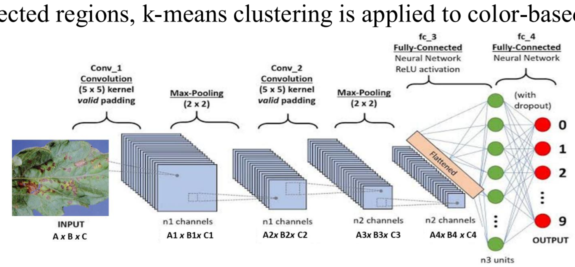

Fig. 3 Image Preprocessing

C. Feature Extraction: This process involves reducing dimensionality by extracting important information from the image, which is called image descriptors or features.

D. Categorization of Diseases: The presented work entails developing a PNN classifier that can identify illness types using image attributes taken from colour and texture. Using the image descriptor database, a system object is constructed. A testing dataset is chosen at random. A training dataset is assembled. Finally, the network is trained using backpropagation with a two-layer feedforward neural network that has 20 neurones in its hidden layer. This classifier is developed in four stages. The training process continues until the MSE is minimised. Once trained, the system takes on the role of a classifier, receiving the query image's attributes as input and generating the required output—the classification of the image as either Bacterial Blight or Wilt complicated. When it comes to illness classification, K-Nearest Neighbours (KNN) and Support Vector Machine (SVM) classifiers are also utilised.

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E. Disease Detection:

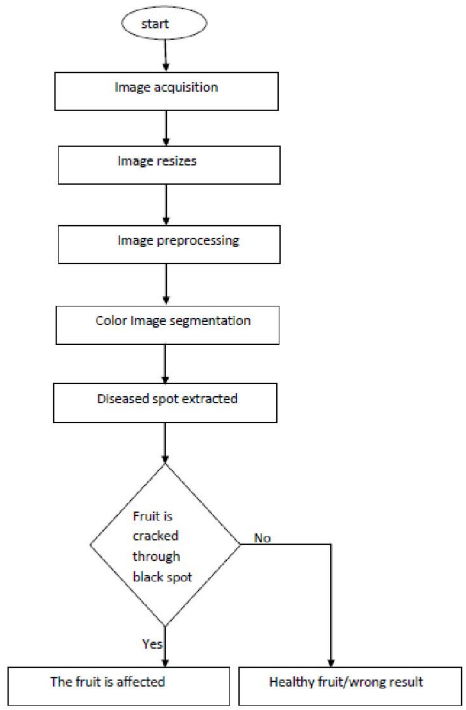

Fig.4 Disease detection Process

In order to detect diseases, the acquired image undergoes image preprocessing, which involves the use of algorithms to eliminate shadows. Algorithms for enhancing images are also utilised. Morphological techniques like erosion and dilation are employed to eradicate shadows. During the post-processing step of the image, the impacted area is located and its characteristics are examined by employing the k-means clustering method. Based on the traits that are noticed, the pomegranate fruit is classified. Bacterial blight, for example, is characterised by the presence of black patches bordered by yellow. Fruit splits could be caused by anthracnose, whereas large patches could be scab. When all of these characteristics are considered, pomegranate fruit illnesses can be positively identified.

V. DISCUSSION AND SUMMARY

The present state of the art is advanced by outlining many points for further research:

Historically, databases that were compiled by hand have been the backbone of disease detection research. One of the biggest obstacles to vision-based plant disease identification is the absence of easily accessible and comprehensive databases. It is crucial to have standardised databases for the detection of Pomegranate diseases.

It is a difficult field of research to address instances where two diseases are found on the same fruit or when symptoms of separate conditions are identical. Finding reliable ways to detect and distinguish between different diseases in the same fruit, including different phases of each disease, is of the utmost importance.

The majority of current studies only address a few of disorders. New methods should be created to detect and categorise pomegranate fruit infections, even the most recent ones.

Some systems depend on datasets that are manually entered, and every disease can have different stages with varied symptoms. When it comes to diagnosing various phases of disease and offering specific treatments for them, there is a big knowledge gap.

A lot of the systems out there are only semi-automatic. In order to create completely automated systems that can manage new diseases and improve the accuracy of disease diagnosis, collaborations with agricultural institutions and research centres are necessary.

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There is no suggestion in the current literature for a real-time method to identify diseases in pomegranate plants. 6. Improving the system's output requires research into image segmentation algorithms, illness feature fusion approaches, and selection algorithms.

It is crucial to have a readily available decision support system or application for farmers. With this setup, farmers may use their sensors to take pictures of their plants and upload them to the database that helps them make decisions. In this way, the technology could identify plant diseases in their early stages and suggest treatments.

Pomegranate plant variety affect the limitations of current plant disease detection systems in terms of database size, picture quality, and methodologies..

VI. RESULTS

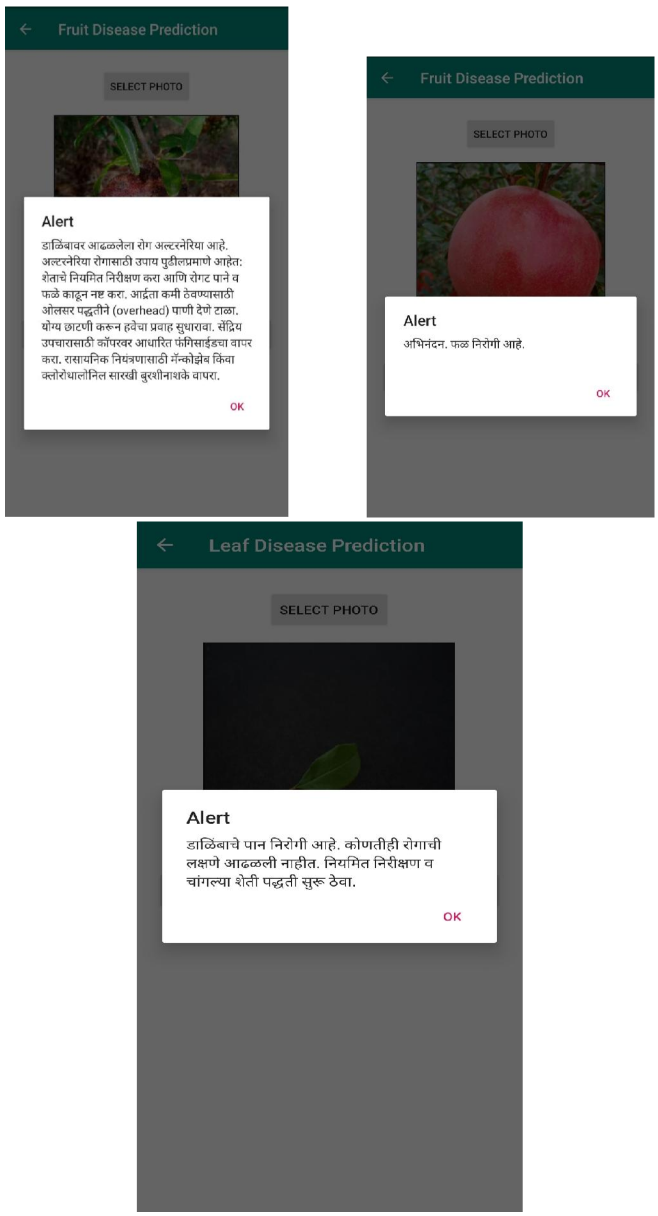

Fig.5 Output of System

VII. FUTURE SCOPE

It is possible to broaden the scope of the present work to include the detection and categorisation of other diseases in photos of flowers, leaves, and fruits as well. The usage of three-dimensional (3-D) photographs is another an area that might be explored further in this study. One possible usage for this technique is in solar greenhouses. It can also be expanded to include the detection, identification, and categorisation of various plants used in various agricultural products. Additionally, this work has the potential to be expanded upon to offer online resources and knowledge on different plants to both farmers and biological experts. This would greatly benefit their research and agricultural endeavours.

VIII. CONCLUSION

Improving overall efficiency and effectiveness by addressing the limits of manual fruit disease detection methods is the primary purpose of this research article. It will be achieved through the proposed system. There is a lot of efficiency and importance in the area of fruit disease detection. The primary objective is to survey the current state of the art in fruit disease detection and classification, with an emphasis on recent developments in the field. With an emphasis on pomegranate fruit, the suggested methods allow for efficient analysis of both healthy and damaged fruits, particularly those affected by Bacterial Blight. As soon as a disease is detected, specialists in agriculture advise on the best course of treatment to prevent additional damage.

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