A Project report on

Pomegranate fruit disease prediction using machine learning

A Dissertation submitted to JNTU Hyderabad in partial fulfillment of the academic requirements for the award of the degree.

Bachelor of Technology

in

Computer Science and Engineering

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CERTIFICATE

This is to certify that the Major Project Phase I report entitled

" Pomegranate fruit disease prediction using machine learning " being submitted by P. RAMYA SRI (20H51A0520), T. PRABANITH (20H51A05A5), P. SARASWATHI (21H55A0518) in partial fulfillment for the award of **Bachelor of Technology in Computer Science and Engineering** is a record of bonafide work carried out his/her under my guidance and supervision.

The results embodies in this project report have not been submitted to any other University or Institute for the award of any Degree.

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ABSTRACT

Pomegranate is a widely grown plant in India. This highly beneficial fruit is infected by multiple pests and diseases which cause great economical losses. Different forms of pathogen diseases on leaf, stem and the fruits are present. Some of the diseases that affect pomegranate fruits are anthracnose, heart rot and bacterial blight. There is a need for disease control strategies to incorporate timely action on the developed diseases. Thus, there is a need for intelligent and self-learning recognition systems to detect these diseases on time. This study is aiming to classify pomegranate fruits into two classes normal and abnormal using CNN LSTM technique. This research work uses a hybrid CNN LSTM technique to detect four types of diseases present in the pomegranate fruits and classify them into four classes. The results obtained using CNN LSTM are then optimized using dragonfly algorithm. The features like colour, texture and shape of the fruits are collected and fed into the hybrid CNN LSTM. The dataset for the classifier is given as an excel file which is initially pre-processed using map reduce technique and dimensionality reduction carried using Principal Component Analysis and Discriminant analysis. The CNN LSTM classifier identifies the 4 types of diseases and normal fruit. The classification is further optimized using dragonfly algorithm. The optimized weight and cost function has further explored to support the multi-class disease detection process. Experimental results have shown an accuracy of 92% in classification using CNN-LSTM technique and optimization using dragonfly techniques shows an improved classification accuracy of 97.1%.

CHAPTER 1
INTRODUCTION

CHAPTER 1
INTRODUCTION

1.1. Problem Statement

problem Statement of this project is Pomegranate Fruit Disease Prediction Based on Machine Learning" proposes a system that uses Convolutional Neural Network algorithm to predict different diseases. To deal with climatic changes and the its various adverse effects disease prediction system of pomegranate

1.2.c Research Objective

- To identify the disease in the fruit based on training and testing
- To identify the type of disease
- To notify the farmers so that early actions can be taken
- Create database of insecticides for respective disease.
- Apply CNN algorithm to data set and generate model for prediction.
- Predict fruit disease from given input image and display disease.

- To provide remedy for the disease that is predicted.

CHAPTER 2
BACKGROUND WORK

CHAPTER 2

BACKGROUND WORK

INTRODUCTION

2.1.1 Pomegranate fruit classification based on CNN-LSTM Deep leaning

Pomegranate is one of the major fruits produced in India. According to International Trade Centre India stands first in the production of pomegranates worldwide. Approximately 5 percent of the fruits produced in our country are exported every year. Pomegranate export earns a considerable foreign exchange for our country but not much research found to be carried out on pomegranate fruit quality classification. It is therefore essential to classify the fruits into normal and abnormal accurately post-yield given marketing and export. The presence of disease in the fruit can be easily detected by external features like the colour of the fruit, the lesions or black spots, the weight of the fruit, the plant stand and so on. In India the sustainable agriculture development is fundamental to meet food demands, economic growth and poverty reduction. India is leading country for pomegranate production. Climate changes have adverse effect on agriculture and traditional practices followed are planning, fertilizing and harvesting against predetermined schedule. To deal with climatic changes and its various adverse effects disease prediction system for pomegranate farm will help to predict the disease at early stage and will avoid the loss and increase the productivity. In this system data mining technique SVM classifier is used for classification of data. Crop losses for pomegranate due to diseases and pests are quite normal in case of semi-arid region conditions. Bacterial blight, thrips, fruit borer and wilt this diseases in pomegranate are considered powerful attacks leading to economical loss and force farmers to repetitive sprays. Agriculture environment is dynamic entity and changing continuously. Ground water depletion, soil erosion, attack of new pest and diseases, fragmentation of land, rural-urban migration and power supply availability for farm are some of the new challenges presently being encountered in the agricultural sector.

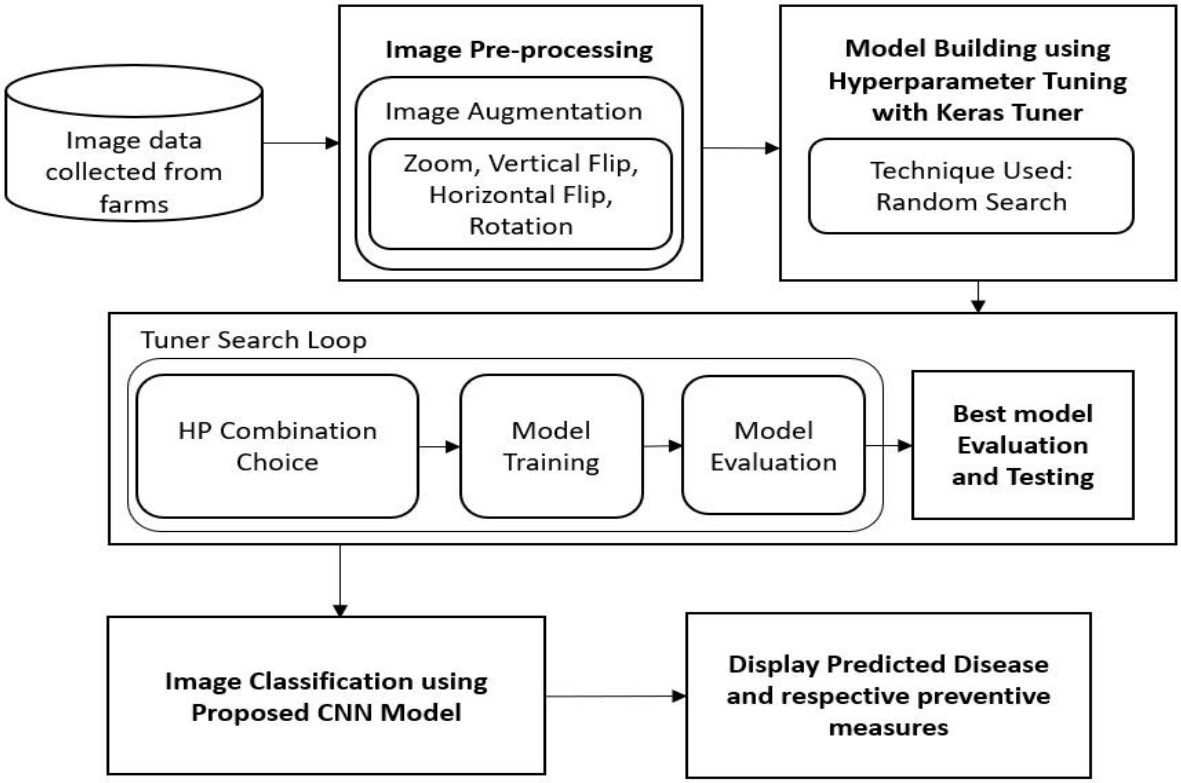
To overcome these issues we have proposed system called an agro advisory. Advisory contains the recommendations to the farmer related to water irrigation, nutrient management and spray scheduling management for diseases and pests with proper application. There are several studies carried out to detect diseases in fruits using Convolutional Neural Network Some of the work related to the application of CNN are given below

This section includes the study of various existing techniques on fruit disease identification and provides a brief overview of significant research conducted in the realm in fruit disease identification and improving the efficiency of the fruit disease identification processes. There are not many studies or research on pomegranate disease detection using machine learning techniques so far.The pomegranate fruits [4] are classified as infected and uninfected using SVM classifier by Manish Bhange and Hingoli Wala.Features such as color histogram, coherence and local binary patterns were employed on the pomegranate images. Then, the extracted features were given to k-mean clustering techniques which effectively classified the detected diseased apples. System wasn't able to handle multi-diseases detection. They obtained an accuracy of 82%. In another paper pomegranate disease classification is done using Ada-boost Ensemble classifier by Pooja Kantale and Shubada Thakare.The researchers have identified and classified three diseases namely anthracnose fruit rot, anthracnose and bacterial blight.The processing time of the Ada-Boost classifier for training is 14.15 sec. The classification accuracy obtained using Ada-boost classifier is 92.9%, 90.6% sensitivity and 89.83% f-score. In another paper by Shaath D M [6] and et al. three diseases of pomegranate fruits such as cercospora, bacterial blight and pomegranate borers are detected using image processing techniques. It gives a detection accuracy of 85%.Using artificial neural networks Mrunmayee Dhakate and Ingole A. B.[7] tries to diagnose diseases in pomegranates and fin this research work feature extraction is done using GLCM method.The ANN classification using Back Propagation algorithm has resulted in an overall accuracy of 90%.Prof. Sona Pawara, Dnyanesh Nawale[8], Kunal Patil, Rakesh Mahajan says early detection of pomegranate disease using machine learning and Internet of Things can be done and also suggested a working model for the same

2.1.2 IMPLEMENTION

In the current study a deep model is proposed that is based on deep features extracted using CNN and LSTM network. The deep features are extracted from fully connected layers. The extracted deep features are sent as input to the LSTM layer. After LSTM layer a fully connected layer, a softmax layer and a classification layer are used that would sort the images to normal and abnormal which are represented with class labels 0 and 1 respectively. In the current study we extracted deep features by samples to work through before updating the deep network parameters

It can be observed from various researches carried on to detect plant or fruit diseases using deep learning, CNN approach has proven to produce effective accuracy resultsThe present study describes the accuracy obtained from machine-based models to classify pomegranate into two classes normal and abnormal. Healthy fruits are referred to as normal and diseased fruits are referred to as abnormal. The data is collected by observing the important features of fruits that quickly exhibits the quality of fruit and is recorded. Disease prediction in the fruit is connected to many factors such as weight of the fruit, number of spots on the fruit, fruit shape, the plant stand and defoliation in the tree. The classification of pomegranate fruits is carried out by a classifier model that was trained on the training data to predict the class label of new testing data. The novelty that our present work provides is feature extraction task is done using CNN as in previous researches but the LSTM model is combined with CNN to classify fruits which is considerably improving the accuracy of classification.



Figno 2.1.1: proposed system diagram

System specifications

HARDWARE REQUIREMENTS

The hardware requirement specifies each interface of the software elements and the hardware elements of the system. These hardware requirements include configuration characteristics.

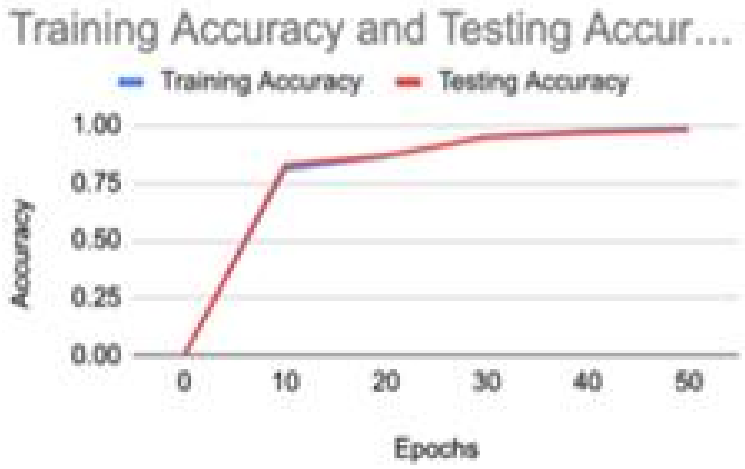
- System : Pentium IV 2.4 GHz.
- Hard Disk : 100 GB.
- Monitor : 15 VGA Color.
- Mouse : Logitech.
- RAM : 1 GB.

SOFTWARE REQUIREMENTS

The software requirements specify the use of all required software products like data management system. The required software product specifies the numbers and version. Each interface specifies the purpose of the interfacing software as related to this software product**.**

- Operating system : Windows 7/10
- Coding Language : Python
- Development Kit : Anaconda IDE
- Dataset : Pomegranate fruit dataset
- Front End : Html,css,js
- Framework : flask

Accuracy Graph



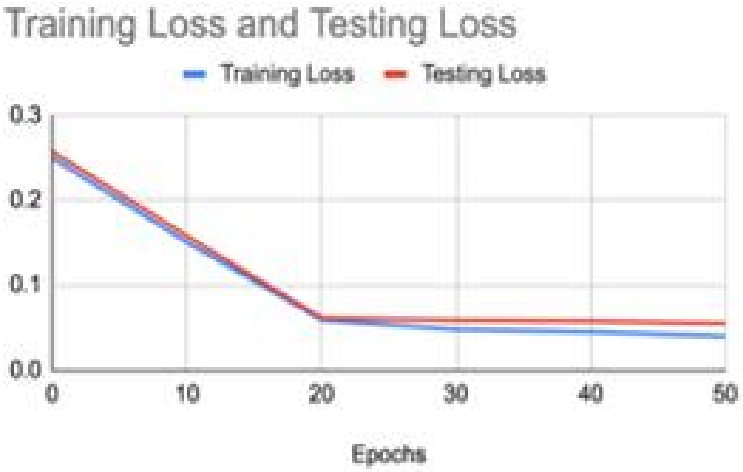


Fig no 2.1.2: gragh

2.1.3 ADVANTAGES

- No require human supervision required.
- Automatic feature extraction.
- Highly accurate at image recognition & classification.
- Weight sharing.
- Minimizes computation.
- Uses same knowledge across all image locations.
- Ability to handle large datasets.
- Hierarchical learning.

DISADVANTAGES

- High computational requirements.
- Needs large amount of labeled data.
- Large memory footprint.
- Interpretability challenges.
- Limited effectiveness for sequential data.
- Tend to be much slower.
- Training takes a long time.

2.2.1 INTRODUCTION

Disease Prediction of pomegranate using data mining

Pomegranate may be a fruit that grows with an awfully high yield in many nations of Asian countries and one in every one of the foremost profits gaining fruit within the market. However, because of numerous conditions, the plants are infected by numerous diseases that destroy the complete crop departure terribly less product yield. So, the work proposes a picture process and neural network strategies to agitate the most problems with Phytopathology, i.e. detection and classification of wellness. Pomegranate fruit is also attributed to the fact that. That leafs are affected by disease caused by plants and weather. These diseases are like blight microorganism, plant spots, seed places rot and leaf spot. The system uses some pictures for coaching, some for testing functions, and so on.

Numerous trends have emerged in the horticultural sector in the past few years and become a good source of income Generation. Age. Varieties of the fruit are exported all over the world with the growth of cold storage and transport facilities. It is important to maintain required quality of export quality, which is mostly carried out by the visual inspection by exports this is expensive and time-consuming due to the geographic location of the farms. Precision Agriculture helps farmers to equip oneself with sufficient and economic information and control technology due to development and exposure in various fields. The objectives are the rise in profits, the systematization of agricultural inputs and the reduction of environmental damage . Pomegranate (Punica granatum) is a deciduous tree grown in arid and semiarid regions . It grows well in areas with temperatures ranging from 25-35 degrees and an annual rainfall of 500-800 mm. In recent years, diseases have resulted in huge losses in pomegranate produced. These diseases are usually caused by micro-organisms like fungi, bacteria, and viruses. The major diseases are Bacterial Blight, Fruit Spot, Fruit Rot, and Leaf Spot. These diseases are very severe and destroy orchards. The business of fruits indeed belongs in the high-risk category .

An intelligent decision support system uses some high-tech and practical technology to appropriately detect and diagnose the fruit diseases for the prevention and control of fruit diseases. Fruit horticulture is the backbone of agriculture development of any country. The quality of fruit is decided by two factors, one is the weight, nutrients and another one is detection of diseases

2.2.2 IMPLEMENTION

SUPPORT VECTOR MACHINE : Support Vector Machine or SVM is one of the most popular Supervised Learning algorithms, which is used for Classification as well as Regression problems. However, primarily, it is used for Classification problems in Machine Learning. The goal of the SVM algorithm is to create the best line or decision boundary that can segregate n-dimensional space into classes so that we can easily put the new data point in the correct category in the future. This best decision boundary is called a hyperplane. SVM chooses the extreme points/vectors that help in creating the hyperplane. These extreme cases are called as support vectors, and hence algorithm is termed as Support Vector Machine. Consider the below diagram in which there are two different categories that are classified using a decision boundary or hyperplane. Support Vectors are simply the co-ordinates of individual observation. The SVM classifier is a frontier which best segregates the two classes (hyper-plane/ line).

Support Vectors: The data points or vectors that are the closest to the hyperplane and which affect the position of the hyperplane are termed as Support Vector. Since these vectors support the hyperplane, hence called a Support vector.

Multiclass Classification: Multiclass classification is a classification task that consists of more than two classes. The model learns patterns specific to each class and uses those patterns to predict the

classes. The model learns patterns specific to each class and uses those patterns to predict the membership of future data.

RESULT DISCUSSION

To get the optimal as well as quality production there is need to provide water, nutrient and protection of plant from diseases and pests. If we give the exactly amount of the water to the plant then the maximum nutrients that are available in the soil will get absorbed by the plant. Soil is the source of nutrient so farmer must know what kind of the nutrient are there to be available in the soil. Soil test report gives exactly analysis of nutrient available in the soil. By following the report different nutrients which are not available in the soil are supplied.

externally to the plant. Proper management of diseases and pests is required to protect the crop from their attack and the application of sprays with proper schedule from pruning to harvesting period will help. The proposed systems dynamic climate change algorithm will detect the climate on fifth day as compared to open eye observation. This is due to precise real time field information available continuously. In case of open eye observation it is not possible because farmer cannot observe farm continuously being present over there physically and also precise readings are not possible by this method. Hence immediate climate change alert to the farmer will help to take preventative measure at early stage and avoid further crop losses

ARCHITECTURE DIAGRAM

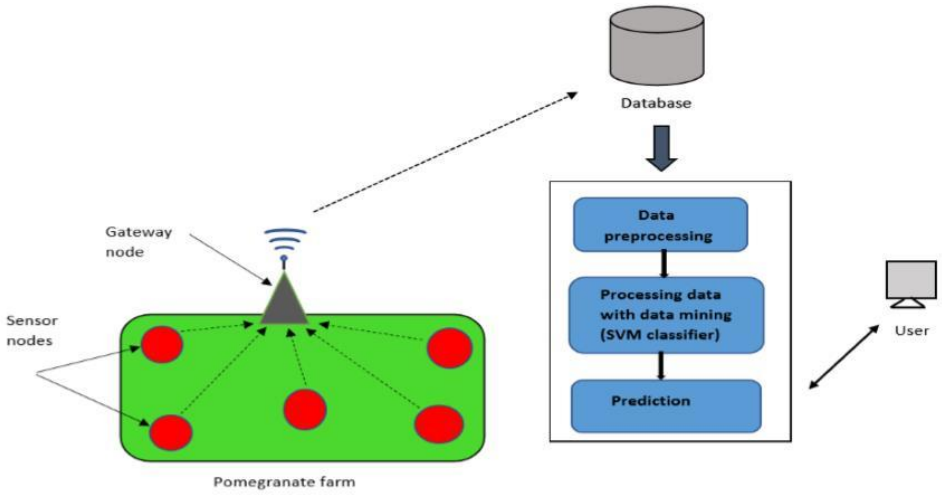


Fig no 2.2.1:Architecture diagram

Accuracy

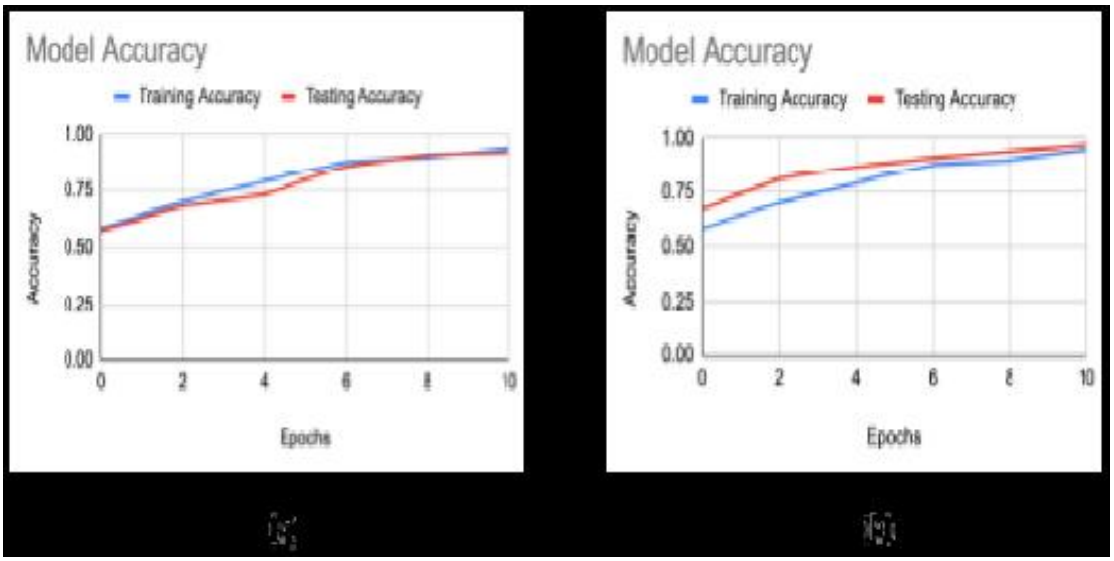


Fig 2.2.2: Accuracy

2.2.3 ADVANTAGES

- SVM works relatively well when there is a clear margin of separation between classes.
- SVM is more effective in high dimensional spaces.
- SVM is effective in cases where the number of dimensions is greater than the number of samples.
- SVM is relatively memory efficient
- Disadvantages of Support Vector Machine:
- SVM algorithm is not suitable for large data sets.
- SVM does not perform very well when the data set has more noise i.e. target classes are overlapping.
- In cases where the number of features for each data point exceeds the number of training data samples, the SVM will underperform.
- As the support vector classifier works by putting data points, above and below the classifying hyperplane there is no probabilistic explanation for the classification

DISADVANTAGES

- Unsuitable to Large Datasets
- Large training time
- More features, more complexities
- Bad performance on high noise
- Does not determine Local optima

2.3.1 INTRODUCTION

Fruits classification and detection application using deep learning

In India the sustainable agriculture development is necessary to meet food demands, economic growth and poverty reduction. India is leading country for pomegranate production. Climate changes have adverse effect on agriculture and traditional practices followed are planning, fertilizing and harvesting against predetermined schedule. To deal with climatic changes and its various adverse effects disease prediction system for pomegranate farm will help to predict the disease at early stage and will avoid the loss and increase the productivity. In this system data mining technique SVM classifier is used for classification of data. 2. LITERATURE SURVEY development are not fulfilled so as to reduce the chemical treatments.[2] 2.3. Predicting Crop Diseases Using Data Mining Approaches: Classification In this system extensive analysis of different data mining classifiers is done on different feature sets to predict the grass grub damage. Also various ensemble models are designed by combining different classifiers to improve accuracy of weak classifiers.[3] 2.4. A Neural Network approach for Disease Forecasting in Grapes using Weather Parameters In this system considerable benefits can be accrued in terms of crop and environmental protection more efficiently by using the information generated on the weather forecast and disease forecast and immediately disseminating to the farmers through ICT.[4] 2.5. Agriculture Field Monitoring and Analysis using Wireless Sensor Networks for improving Crop Production In this paper the overall WSN system architecture and data architecture is defined. The designs of the subsystems/modules are included to avoid agricultural land from weather effects, bugs and so on and make great sense for farming production.[5] 3. ARCHITECTURE DIAGRAM 2.1. An Agro Advisory for Pomegranate Field Using Wireless Sensor Network An agro advisory system is proposed for pomegranate field using wireless sensor network based on real time environmental conditions. The climatic changes are identified and accordingly diseases are tackled. Optimized usage of water, nutrients for crops and pesticides are suggested to the farmers.[1] 2.2 Data mining model for early fruit disease detection The system to detect the diseases in pomegranate fruit at early stages. Model indicates when conditions for diseases

2.3.2 IMPLEMENTION

Convolutional neural network: Its performance is similar to the Artificial Neural Networks (ANNs) [27] that consist of several neurons. Each neuron communicates directly to the convoluted network layer by possessing self-learning quality. The neuron receives an input and data operations, so as to find out their relevant classes. The weight score is taken as an objective function to learn the features and classify the diseases. The final layer of the CNN presents the error functions connected to the classes. CNN architecture [28] is shown in the figure 4.CNN consists of three layers, namely, convolutional layers; pooling layers and the fully connected layers.

Long short-term memory (LSTM): It performs similar to the Recurrent Neural Network (RNNs) [29]. Additionally, it learns the feature vectors in long-term dependencies and also preserves the learnt information as a default. It helps to reduce the computational complexity. It works in a chain module, regardless, each module has a different form. It consists of four interactive layers which is shown in figure 6. Initially, the required information is considered by the LSTM [30] networks to apply the sigmoid function. The irrelevant data are identified and eliminated by this network. Each cell unit maintains a timestamp to process the information. With the estimated weight function, sigmoid layers decide the new information and it is being updated incessantly until the new cell states are updated. Finally, the sigmoid layer evaluates the output based on the RMSE value of each cell. Cells with least RMSE are considered as the output layer.

Hybrid LSTM-CNN [31]: In our study, the main novelty lies in hybridizing the LSTM with CNN for fruit diseases classification. The ReLu unit of CNN combines with the LSTM networks. Since we deal with the different types of diseases, the deployment of LSTM network will help the activation unit of CNN to easily compute the multiple classes. The dependencies nature of LSTM model performs more effectively in formatting the input image data for the input layer. Here, sequential steps of vector data with specified time steps have fastened the pooling layer of the CNN architecture. It explores the hidden data patterns from the observed training module with the limited time steps. CNN is used for feature extraction on input data combined with LSTMs to support sequence prediction

Optimization of the proposed model: This section discusses the optimization process of the proposed fruit disease identification model using weed dragonfly optimization algorithm [30]. This study attempts to find the optimized data patterns, so as to assist the future datasets to be classified with more accuracy. 4.3.1 Dragonfly Algorithm (DA) Dragonfly Algorithm [32] was first proposed by Seyedali Mirjalili in 2015.This algorithm is an inspiration of static and dynamic behaviour of dragonflies. A is an optimization algorithm used in the synaptic weights optimization in neural networks

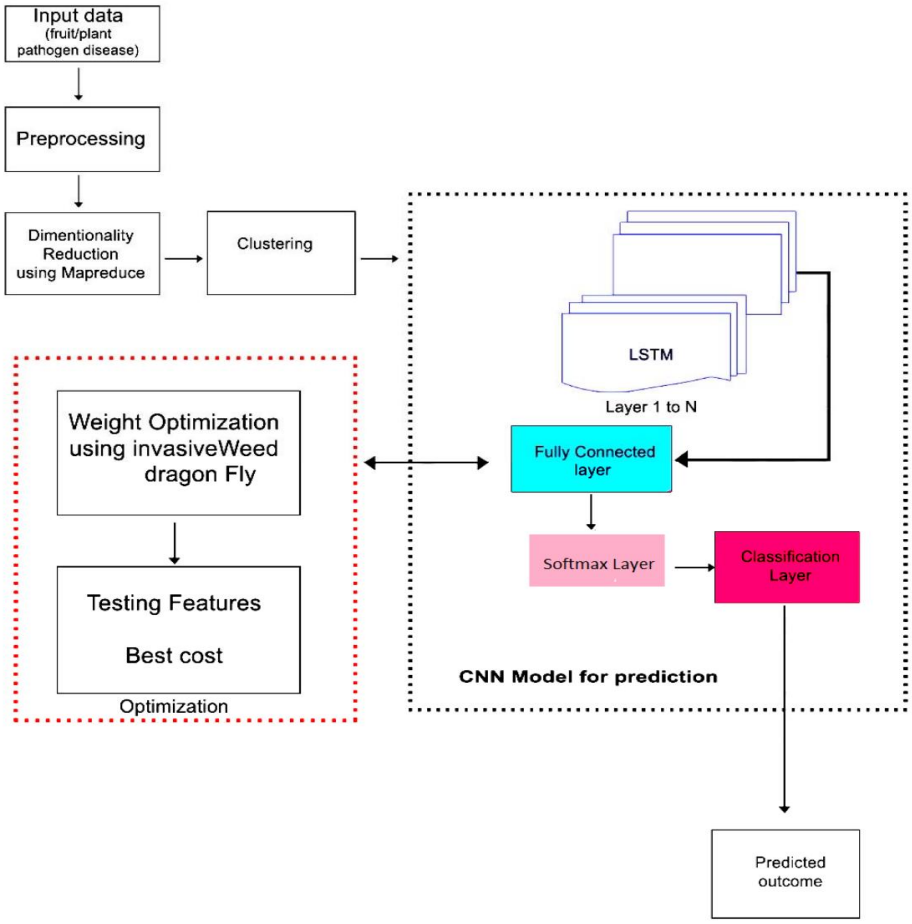


Fig 2.3.1: proposed model diagram

Results and Discussion

In this section, the results of the proposed automatic fruit classifcation system are discussed. In this work, an online framework, make sense, has been used to label the images and export them into corresponding XML fles. Te labeled images are preprocessed in the Robofow tool by performing conventional preprocessing techniques, e.g., auto-orientation, object isolation (crop and extract bounding boxes into individual images), and resizing. Te data augmentation process has been done to create new training examples for the model to learn from by generating augmented versions of each image in the training set [14]. In this work, bounding box level augmentation instead of picture level has been executed as the bounding box accomplishes better accuracy. Random horizontal and vertical fips, ± 90°rotation, normalization, and brightness adjustment are implemented. the data augmentation techniques make the model insensitive to camera orientation, generalize better to various contexts, and reduce overftting and underftting problems.

In this work, the YOLOv7 deep learning model has been implemented in the Robofow environment and PyTorch framework. Hyperparameters to train the YOLOv7 model have been illustrated in Table 5. Tedataset has been trained for ten epochs and 16 batch sizes and the training stops if the validation generalization loss does not improve. Te YOLOv7 model achieved 96.1% accuracy, 0.93 and 0.89 precision and recall, respectively, for the FID-30 dataset of 30 fruit categories *Results for the Custom Dataset.* In this section, the proposed models' performance has been evaluated using the custom dataset obtained by the authors of the manuscript. Te proposed VGG16 and ResNet50 convolutional neural. networks have attained 99% and 98% accuracy, respectively, on the test data after the end of the tenth epoch. Te confusion matrix in demonstrates how the models performed on the test dataset for eight classes of fruits. the behavior of training and validation accuracies concerning epoch numbers for the VGG16 technique. According to Figure 17, the training and validation losses of theVGG16 framework reduce signifcantly with the change of epochs. Interestingly, the results for the ResNet50 model for the custom dataset have not been reported, as the VGG16 model performed slightly better than the ResNet50 technique.

ACCURACY

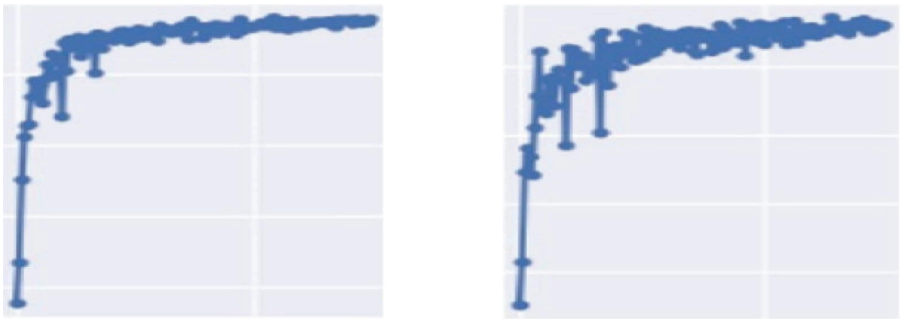


Fig 2.3.2:Accuracy

2.3.3 ADVANTAGES:

- They are much better at handling long-term dependencies. This is due to their ability to remember information for extended periods of time.
- LSTMs are much less susceptible to the vanishing gradient problem. This is because they use a different kind of activation function, known as an LSTM cell, which helps to preserve information over long sequences.
- LSTMs are very efficient at modeling complex sequential data. This is because they can learn high-level representations that capture the structure of the data.

DISADVANTAGES:

- They are more complicated than traditional RNNs and require more training data in order to learn effectively.
- they are not well-suited for online learning tasks, such as prediction or classification tasks where the input data is not a sequence. Third, LSTMs can be slow to train on large datasets. This is due to the fact that they must learn the parameters of the LSTM cells, which can be computationally intensive.
- LSTMs may not be appropriate for all types of data. For example, they may not work well with highly nonlinear data or data with a lot of noise.

CHAPTER 3
RESULTS AND DISCUSSION

CHAPTER 3

RESULTS AND DISCUSSION

The proposed framework is examined using Python, a high-level programming language. It provides a tremendous amount of mathematical functions for linear algebra, filtering, optimization and differential equations. The 9 features such as number of fruit spots, fruit colour, fruit shape, weight, defoliation, plant stand, leaf appearance, leaf colour, leaf spots are recorded accurately to detect the four diseases and the normal fruit.In the total dataset collected and pre-processed 80% of the data has been used as training data set and remaining 20% has been used as testing data. The hybrid CNN-LSTM Model has generated a 5-class classification accuracy of 92.14% with the number of epochs 10 and with a learning rate of 0.001.The same size training and testing data set fed into the weed dragon fly algorithm has produced an accuracy of 97.1% with the number of epochs 10 and learning rate 0.001.

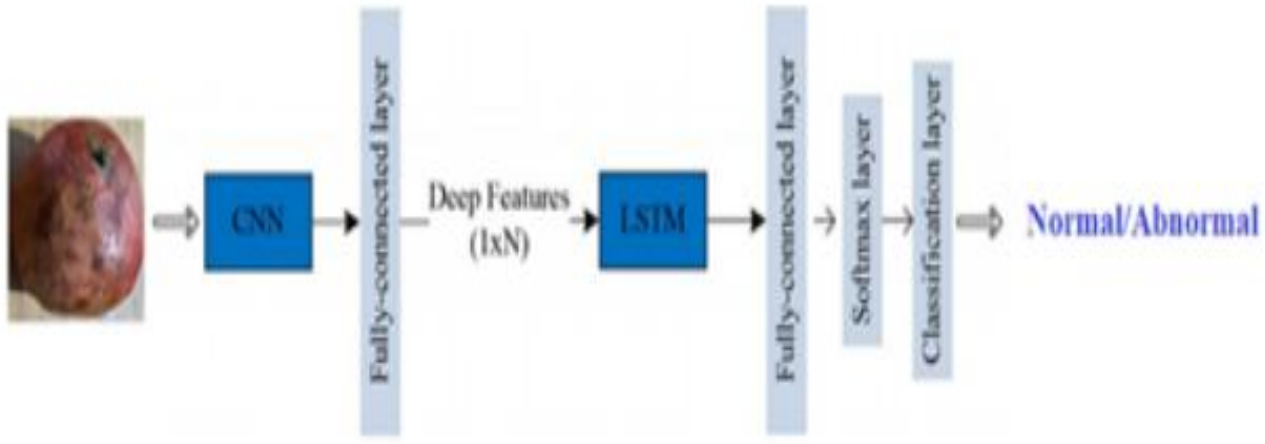


Fig 2.4.1:flow chart

Fig 2.4.2: pomegranate disease

CHAPTER 4
CONCLUSION

CHAPTER 4
CONCLUSION

In this project, the diseases in pomegranate fruits using hybrid LSTM-CNN. Initially, the dataset is collected by visiting pomegranate orchards around Bangalore. The input records are organized into an excel file and MapReduce technique that eliminates the irrelevant and duplicate records is used. Then, an improved segmentation approach via Principal Component Analysis and Discriminant analysis are done on the input by collecting the colour, texture and shape features of the fruits. These extracted features are then fed into the hybrid CNN- LSTM. It explores the hidden data patterns from the observed training module with the limited time steps. CNN is used for feature extraction on input data combined with LSTMs to support sequence prediction. Here, sequential steps of vector data with specified time steps have fastened the pooling layer of the CNN architecture. Experimental results have shown that the optimization of the classifier using dragonfly technique has efficiently increased the accuracy rate with the least computation time and effort. Disease prediction System in Pomegranate farm helps to predict the disease at early stage using SVM classifier and sends the notification to the farmer regarding the current metrological parameters and name of the pesticides to be sprayed. This will help the farmers to increase their productivity and quality of pomegranate.

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