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

Submitted by

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CMR COLLEGE OF ENGINEERING & TECHNOLOGY

KANDLAKOYA, MEDCHAL ROAD, HYDERABAD – 501401

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the Major Project report entitled **" POMEGRANATE FRUIT DISEASE PREDICTION USING MACHINE LEARNING"** being submitted by P. Ramya Sri(20H51A0520), 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 may be a broadly developed planting within Indian. This Profoundly useful natural product is contaminated by numerous bugs and illnesses which cause extraordinary temperate misfortunes. Distinctive Shapes of the pathogens maladies within leaves, Stems and of natural products are show. A few of the maladies that influence pomegranate natural products are anthracnose, heart decay and bacterial curse. There's a require for malady control procedures to incorporate opportune activity on the created infections. Hence, there's a require for shrewdly and self-learning acknowledgment frameworks to identify these illnesses within given Time. This think about is pointing to classifying of pomegranate natural products in twice classes ordinary and unusual utilizing CNN&LSTM procedure. This investigate work utilizes with cross breed CNN&LSTM procedure to distinguish four sort of maladies show within the pomegranate natural products and classifying all of them within 4 different classes. The comes about gotten utilizing CNN&LSTM are at that point optimized utilizing dragon fly calculation. The highlights like color, surface and shape of the natural products are gathered & bolstered into the half breed CNN&LSTM. The datasets with the classifier is understood like an exceed expectations record which is at first pre-processes utilizing outline diminish procedure and dimensionality carried utilizing foremost component investigation and Discriminant investigation.

CHAPTER 1
INTRODUCTION

CHAPTER 1

INTRODUCTION

PROBLEM STATEMENT

- The problem statement for a project on predicting pomegranate fruit diseases using machine learning would involve developing a model to accurately identify and classify diseases affecting pomegranate fruits based on various symptoms or characteristics.
- This involves collecting data on different diseases, such as fungal infections or bacterial diseases, and their corresponding symptoms like discoloration, lesions, or abnormal growth patterns.
- The aim is to create a reliable predictive model that can assist farmers in early detection and management of diseases to minimize crop loss and maximize yield.

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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.

PROJECT SCOPE:

The project aims to develop a machine learning system for predicting diseases in pomegranate fruits, focusing on early detection and mitigation. It involves gathering comprehensive datasets of pomegranate fruit images depicting various stages of health and disease. Through image processing and pattern recognition techniques, the system will extract relevant features to train predictive models. These models will classify fruits into healthy or diseased categories, potentially identifying specific diseases like anthracnose or powdery mildew. The scope extends to developing a user-friendly interface for farmers to easily input images and receive real-time predictions, aiding in timely interventions to prevent disease spread and optimize crop yield. Additionally, the project may explore integrating other data sources such as weather patterns or soil conditions to enhance prediction accuracy and provide comprehensive insights for agricultural decision-making

CHAPTER 2
BACKGROUND WORK

CHAPTER 2
BACKGROUND WORK

POMEGRANATE FRUIT CLASSIFICATION BASED ON CNN-LSTM DEEP LEARNING

INTRODUCTION:

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 color 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 ago 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 MrunmayeeDhakate 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. SonaPawara, 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. [9] Zhang, Chunxia, Xiuqing Wang, and Xudong Li. "Design of the monitoring and controling plant diseases system based uponDSP&FPGA." 2010 Second International Conferences in Network Security, Wireless Communication & Trusted Computing. Vol. 2. IEEE, 2010.

MERITS AND DEMERITS

MERITS:

- 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.

DEMERITS:

- 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.

IMPLEMENTATION:

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.

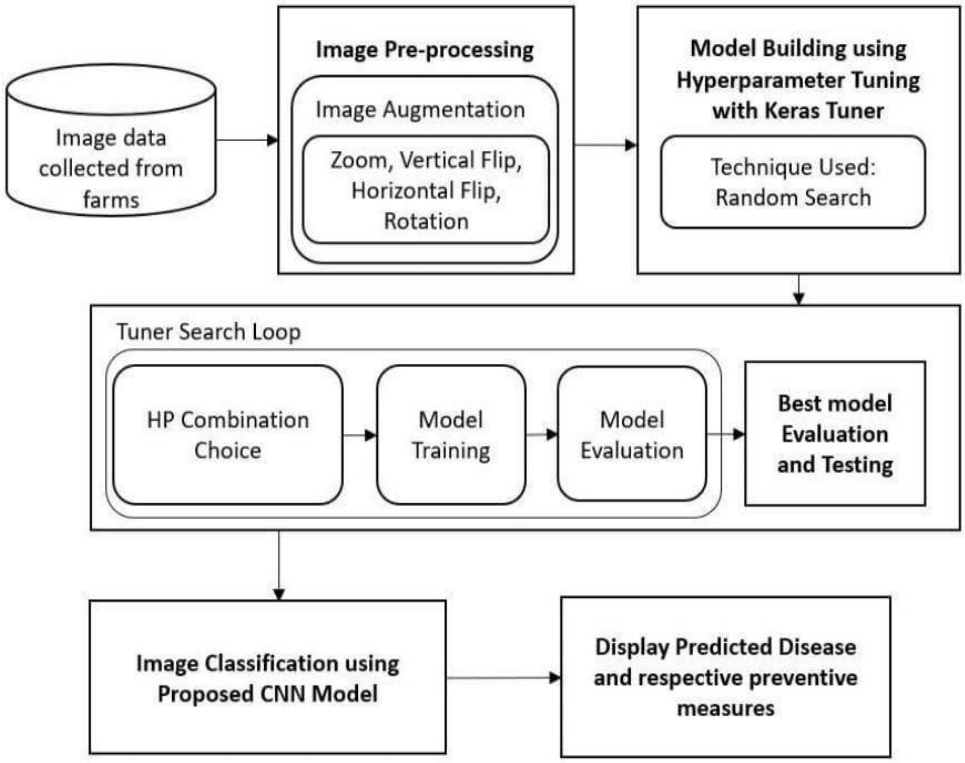


Fig 2.1.3.1: Proposed system diagram

DISEASE PREDICTION OF POMEGRANATE USING DATA MINING

INTRODUCTION:

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.

MERITS AND DEMERITS :

MERITS:

- 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

DEMERITS:

- 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
- Unsuitable to Large Datasets
- Large training time
- More features, more complexities
- Bad performance on high noise

IMPLEMENTATION:

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.

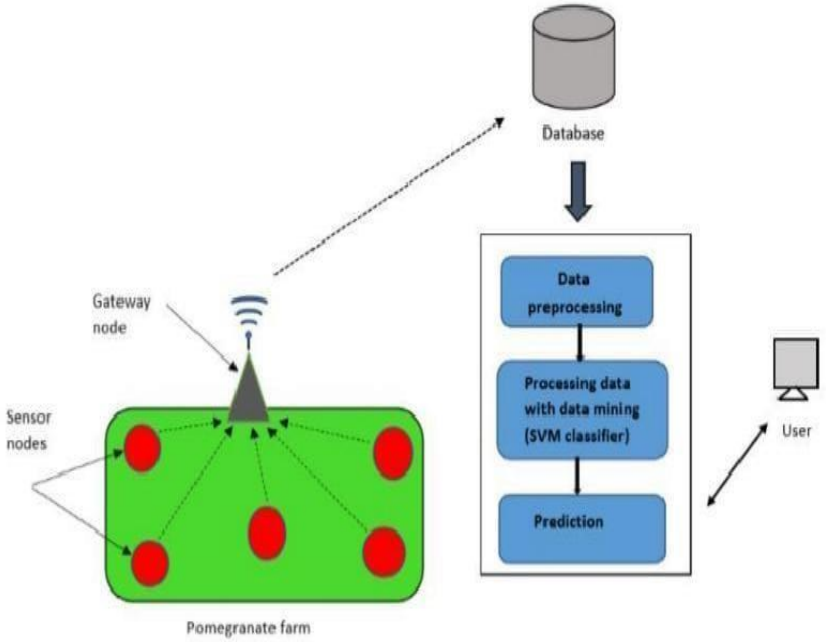


Fig 2.2.3.1:Proposed system diagram

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

FRUITS CLASSIFICATION AND DETECTION APPLICATIONUSING DEEP LEARNING

INTRODUCTION:

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. Litercture 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. Alsovarious 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 MERITS, DEMERITS AND CHALLENGES:

MERITS:

- 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 modelling complex sequential data. This is because they can learn high-level representations that capture the structure of the data

DEMERITS:

- 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

2.3.2 IMPLEMENTATION:

Convolutional neural network:

Its performance is similar to the Artificial Neural Networks (ANNs) 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 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) . Additionally, it learnsthe 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 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. 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 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

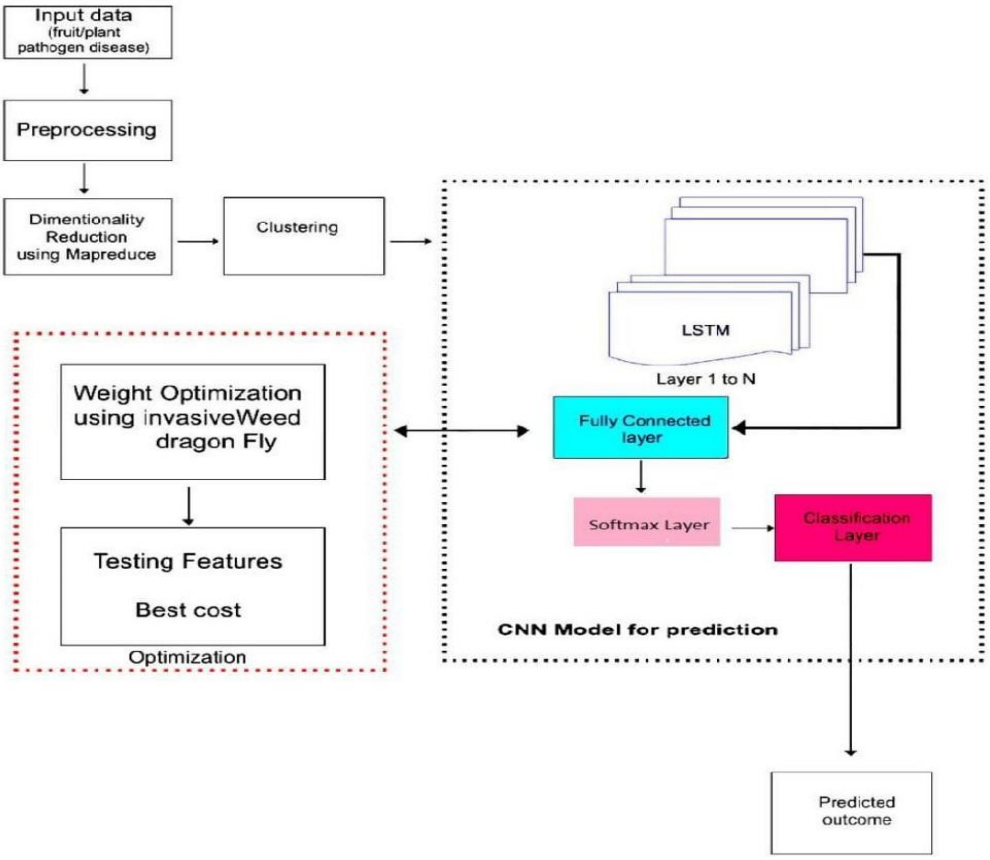


Fig :2.3.2.1: proposed system diagram

In this section, the results of the proposed automatic fruit classification system are discussed. In this work, an online framework, make sense, has been used to label the images and export them into corresponding XML files. The labelled images are pre processed in the Robo flow tool by performing conventional preprocessing techniques, e.g., auto-orientation, object isolation (crop and extract bounding boxes into individual images), and resizing. To 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 . 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 flips, ± 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 overfitting and underfitting problems. In this work, the YOLOv7 deep learning model has been implemented in the Roboto environment and Torch framework. Hyperparameters to train the YOLOv7 model have been illustrated in Table 5. Dataset has been trained for ten epochs and 16 batch sizes and the training stops if the validation generalization loss does not improve. the 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 significantly 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.

CHAPTER 3

PROPOSED SYSTEM

CHAPTER 3

PROPOSED SYSTEM

OBJECTIVE OF PROPOSED MODEL

The proposed model for predicting diseases in pomegranate fruits using machine learning aims to achieve several key objectives. Firstly, it seeks to develop a highly accurate prediction system capable of effectively distinguishing between healthy and diseased fruits, enabling early detection of diseases such as bacterial blight or fungal infections. Secondly, the model aims to be scalable, adaptable to various agricultural settings, and capable of handling large volumes of data. Thirdly, it aims to provide a user-friendly interface accessible to farmers, facilitating easy input of fruit images and interpretation of prediction results. Additionally, the model strives to offer real-time monitoring capabilities, empowering farmers with timely updates on disease prevalence and management recommendations. Furthermore, the model aims for generalizability across different regions and seasons, ensuring its applicability under diverse environmental conditions. Through rigorous validation and continuous feedback integration, the proposed model seeks to become a valuable tool for enhancing crop health, productivity, and sustainability in pomegranate cultivation.

ALGORITMS USED FOR PROPOSED MODEL

Using a Convolutional Neural Network (CNN) for pomegranate fruit disease prediction involves several steps:

1. *Data Collection*: Gather a dataset of images of pomegranate fruits, with labels indicating whether they are healthy or diseased, and if diseased, which disease is present.
2. *Data Preprocessing*: Resize the images to a consistent size, normalize pixel values, and augment the dataset with techniques like rotation, flipping, and zooming to increase variability and improve model generalization.

3. *Model Architecture Design*: Design a CNN architecture suitable for image classification tasks. This typically involves alternating convolutional layers with activation functions like ReLU, followed by pooling layers to reduce spatial dimensions, and finally fully connected layers to perform classification.
4. *Training*: Split the dataset into training, validation, and test sets. Train the CNN model on the training data, using techniques like gradient descent and backpropagation to optimize the model parameters based on a chosen loss function.
5. *Hyperparameter Tuning*: Experiment with different hyperparameters such as learning rate, batch size, and architecture parameters to optimize model performance on the validation set.
6. *Evaluation*: Evaluate the trained model on the test set to assess its performance in terms of metrics like accuracy, precision, recall, and F1-score.
7. *Deployment*: Once satisfied with the model's performance, deploy it for real-world use, potentially integrating it into a software application or system for automated disease detection in pomegranate fruits.

Throughout this process, it's important to continuously monitor and refine the model to improve its accuracy and generalization capabilities. Additionally, interpretability and explainability of the model's predictions can be important considerations, especially in agricultural applications where stakeholders may need to understand the basis for the model's decisions.

DESIGNING

UML DIAGRAM

UML DIAGRAMS

The Unified Modeling Language allows the software engineer to express an analysis model using the modeling notation that is governed by a set of syntactic semantic and pragmatic rules.

A UML system is represented using five different views that describe the system from distinctly different perspective. Each view is defined by a set of diagram, which is as follows.

User Model View

This view represents the system from the users perspective. The analysis representation describes a usage scenario from the end-users perspective.

Structural Model view

In this model the data and functionality are arrived from inside the system. This model view models the static structures.

Behavioral Model View

It represents the dynamic of behavioral as parts of the system, depicting the interactions of collection between various structural elements described in the user model and structural model view.

Implementation Model View

In this the structural and behavioral as parts of the system are represented as they are to be built.

A. Class diagram:-

The class diagram is the main building block of object oriented modeling. It is used both for general conceptual modeling of the systematic of the application, and for detailed modeling translating the models into programming code. Class diagrams can also be used for data modeling. The classes in a class diagram represent both the main objects, interactions in the application and the classes to be programmed. A class with three sections, in the diagram, classes is represented with boxes which contain three parts:

The upper part holds the name of the class

The middle part contains the attributes of the class

The bottom part gives the methods or operations the class can take or undertake.

Class diagram:

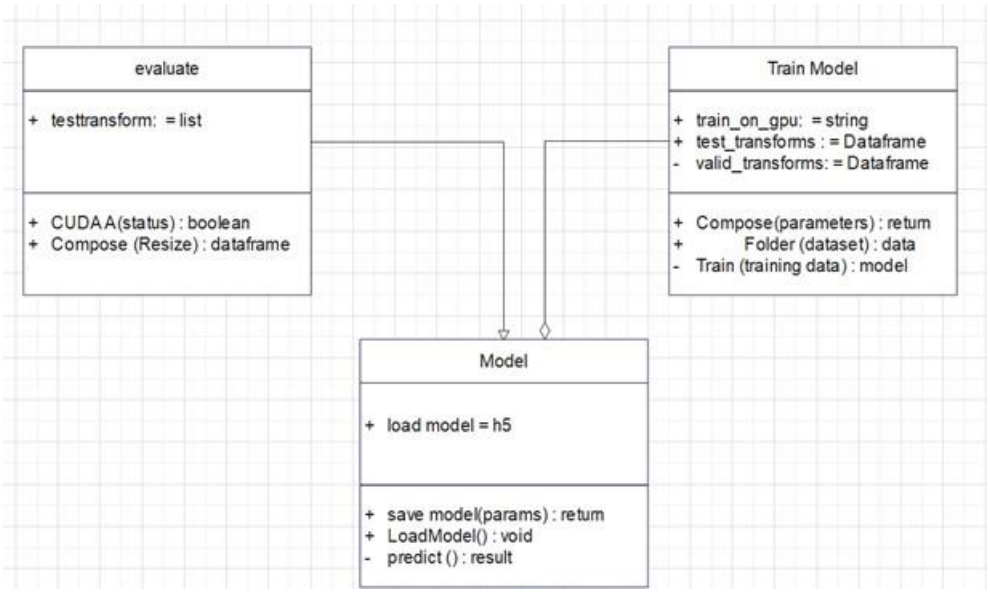


Fig 3.3.1.1: Class Diagram

B. Use case diagram:-

A use case diagram at its simplest is a representation of a user's interaction with the system and depicting the specifications of a use case. A use case diagram can portray the different types of users of a system and the various ways that they interact with the system. This type of diagram is typically used in conjunction with the textual use case and will often be accompanied by other types of diagrams as well.

Use case diagram:

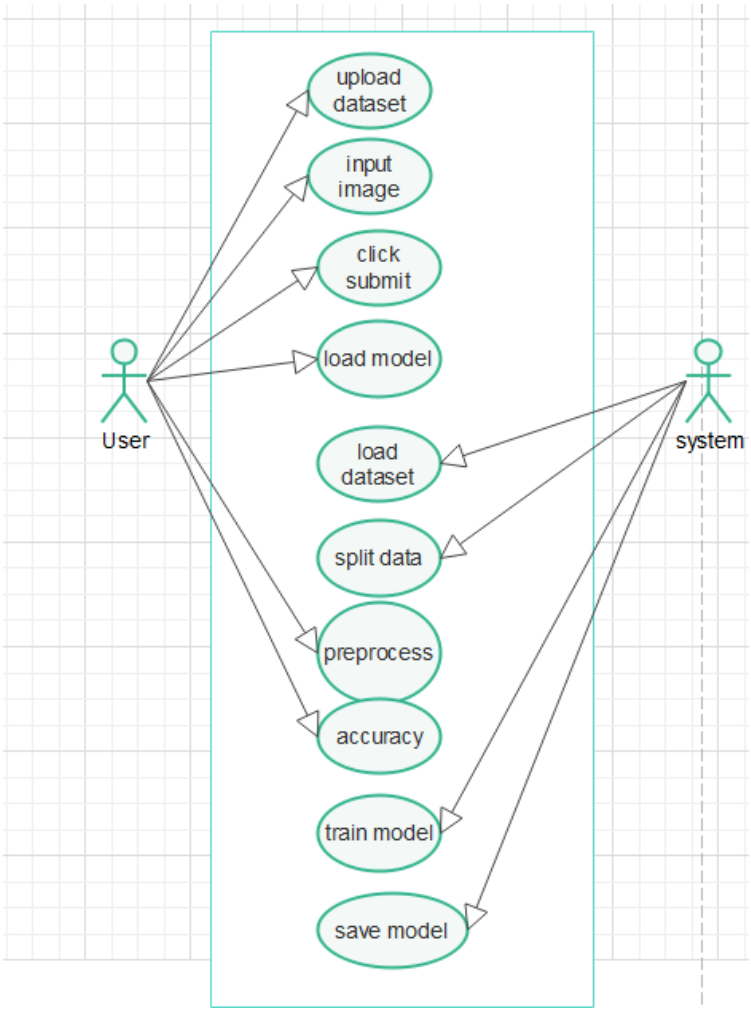


Fig 3.3.1.2: Use case Diagram

C. Sequence Diagram:

A sequence diagram is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Sequence diagrams are typically associated with use case realizations in the Logical View of the system under development. Sequence diagrams are sometimes called event diagrams, event scenarios, and timing diagrams.

Sequence diagram:

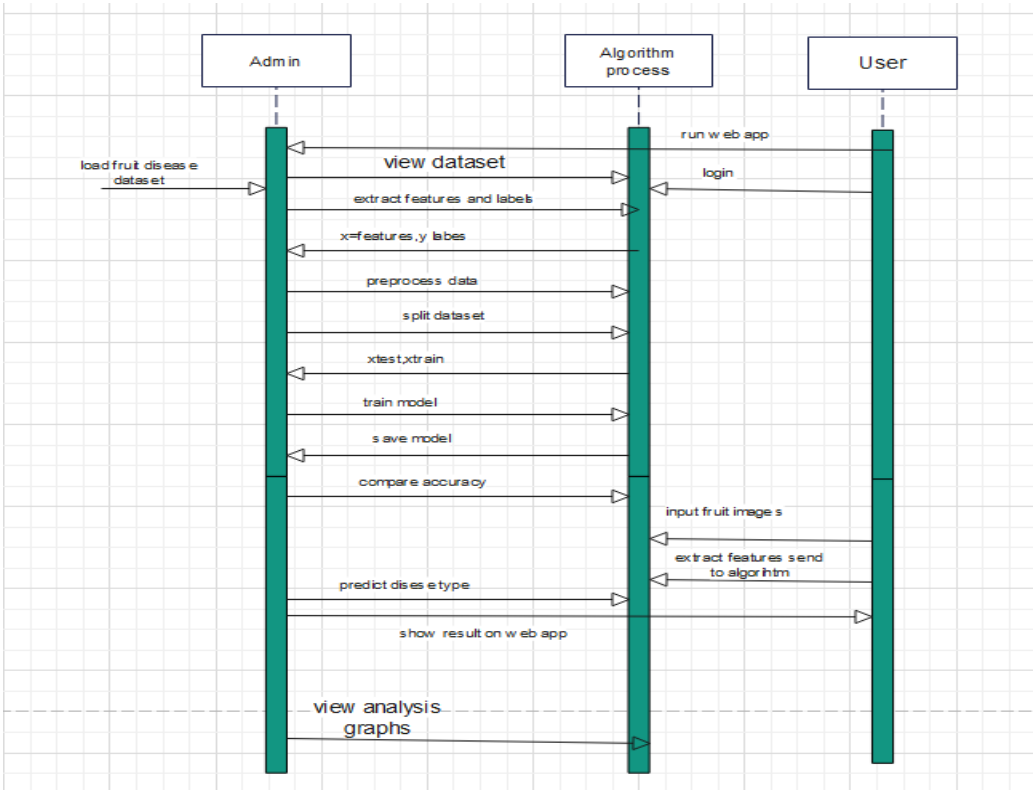


Fig 3.3.1.3: Sequence Diagram

D. Activity diagram:

Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows the overall flow of control.

Activity diagram:

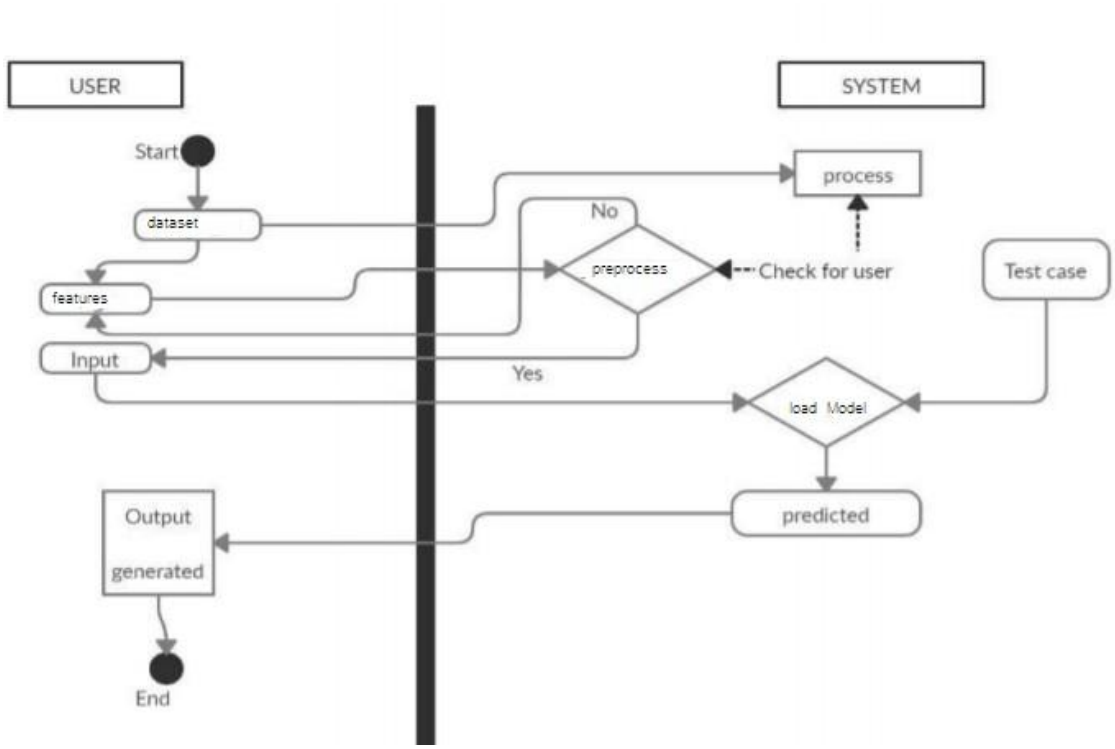


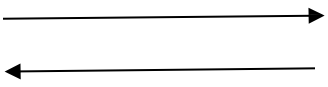
Fig 3.3.1.7: Activity Diagram

E. DATA FLOW DIAGRAMS

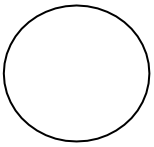
Data Flow Diagram can also be termed as bubble chart. It is a pictorial or graphical form, which can be applied to represent the input data to a system and multiple functions carried out on the data and the generated output by the system.

A graphical tool accustomed describe and analyze the instant of knowledge through a system manual or automatic together with the method, stores of knowledge, and delays within the system. The transformation of knowledge from input to output, through processes, is also delineate logically and severally of the physical elements related to the system. The DFD is also known as a data flow graph or a bubble chart.The BasicNotation used to create a DFD's are as follows:

- **Dataflow:**

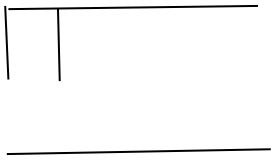


- **Process:**

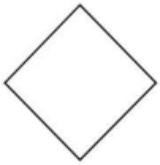


- **Source:**

- **Data Store:**



- **Rhombus**: decision



UML DIAGRAMS

The Unified Modeling Language allows the software engineer to express an analysis model using the modeling notation that is governed by a set of syntactic semantic and pragmatic rules.

A UML system is represented using five different views that describe the system from distinctly different perspective. Each view is defined by a set of diagram, which is as follows.

User Model View

This view represents the system from the users perspective. The analysis representation describes a usage scenario from the end-users perspective.

Structural Model view

In this model the data and functionality are arrived from inside the system. This model view models the static structures.

Behavioral Model View

It represents the dynamic of behavioral as parts of the system, depicting the interactions of collection between various structural elements described in the user model and structural model view.

Implementation Model View

In this the structural and behavioral as parts of the system are represented as they are to be built.

STEPWISE IMPLEMENTATION AND TESTING AND CODE

Implementation and Testing:

Implementation is one of the most important tasks in project is the phase in which one has to be cautions because all the efforts undertaken during the project will be very interactive. Implementation is the most crucial stage in achieving successful system and giving the users confidence that the new system is workable and effective. Each program is tested individually at the time of development using the sample data and has verified that these programs link together in the way specified in the program specification. The computer system and its environment are tested to the satisfaction of the user.

Implementation

The implementation phase is less creative than system design. It is primarily concerned with user training, and file conversion. The system may be requiring extensive user training. The initial parameters of the system should be modifies as a result of a programming. A simple operating procedure is provided so that the user can understand the different functions clearly and quickly. The different reports can be obtained either on the inkjet or dot matrix printer, which is available at the disposal of the user.

The proposed system is very easy to implement. In general implementation is used to mean the process of converting a new or revised system design into an operational one.

Testing

Testing is the process where the test data is prepared and is used for testing the modules individually and later the validation given for the fields. Then the system testing takes place which makes sure that all components of the system property functions as a unit. The test data should be chosen such that it passed through all possible condition. Actually testing is the state of implementation which aimed at ensuring that the system works accurately and efficiently before the actual operation commence. The following is the description of the testing strategies, which were carried out during the testing period.

System Testing

Testing has become an integral part of any system or project especially in the field of information technology. The importance of testing is a method of justifying, if one is ready to move further, be it to be check if one is capable to with stand the rigors of a particular situation cannot be underplayed and that is why testing before development is so critical. When the software is developed before it is given to user to use the software must be tested whether it is solving the purpose for which it is developed. This testing involves various types through which one can ensure the software is reliable. The program was tested logically and pattern of execution of the program for a set of data are repeated. Thus the code was exhaustively checked for all possible correct data and the outcomes were also checked.

Module Testing

To locate errors, each module is tested individually. This enables us to detect error and correct it without affecting any other modules. Whenever the program is not satisfying the required function, it must be corrected to get the required result. Thus all the modules are individually tested from bottom up starting with the smallest and lowest modules and proceeding to the next level. Each module in the system is tested separately. For example the job classification module is tested separately. This module is tested with different job and its approximate execution time and the result of the test is compared with the results that are prepared manually. Each module in the system is tested separately. In this system the resource classification and job scheduling modules are tested separately and their corresponding results are obtained which reduces the process waiting time.

Integration Testing

After the module testing, the integration testing is applied. When linking the modules there may be chance for errors to occur, these errors are corrected by using this testing. In this system all modules are connected and tested. The testing results are very correct. Thus the mapping of jobs with resources is done correctly by the system

Acceptance Testing

When that user fined no major problems with its accuracy, the system passers through a final acceptance test. This test confirms that the system needs the original goals, objectives and requirements established during analysis without actual execution which elimination wastage of time and money acceptance tests on the shoulders of users and management, it is finally acceptable and ready for the operation.

SOURCE CODE:

DATABASE CODE:

```
import os
import MySQLdb
from flask import Flask, session, url_for, redirect, render_template, request, abort, flash
from database import db_connect,user_reg,user_loginact,user_upload,user_viewimages
from database import db_connect,v_image,image_info
from database import db_connect
from werkzeug.utils import secure_filename
import random, uuid


app = Flask(_name_)
app.secret_key = os.urandom(24)


@app.route("/")
def FUN_root():
    return render_template("index.html")

@app.route("/index.html")
def logout():
    return render_template("index.html")

@app.route("/register.html")
def reg():
    return render_template("register.html")
```

```
@app.route("/login.html")
def login():
    data = {
        'p_images': get_pwd_imgs(),
        }
    return render_template('login.html', context=data)



@app.route("/upload.html")
def up():
    return render_template("upload.html")

@app.route("/viewdata.html")
def up1():
    return render_template("viewdata.html")

def get_pwd_imgs():
    # These images are just to confuse the attacker
    N=6
    images = random.sample(range(1, 39), N * N)
    print(images)
    p_images = []
    for i in range(0, N * N, N):
        p_images.append(images[i:i+N])
    print(p_images)
    return p_images
```

```
#----------register----------
---
@app.route("/regact", methods = ['GET','POST'])
def registeract():
  if request.method == 'POST':
    id="0"
    status =
user_reg(id,request.form['username'],request.form['password'],request.form['email'],req
uest.form['mobile'],request.form['address'])
    if status == 1:
     return render_template("login.html",m1="sucess")
    else:
     return render_template("register.html",m1="failed")
#----------Login----------
@app.route("/loginact", methods=['GET', 'POST'])
def useract():
   if request.method == 'POST':
      status = user_loginact(request.form['username'], request.form['password'])
      print(status)
      if status == 1:
         session['username'] = request.form['username']
         return render_template("userhome.html", m1="sucess")
      else:
         return render_template("login.html", m1="Login Failed")

   else:
      data = {
```

```
 'p_images': get_pwd_imgs(),
        }
        return render_template(request, 'login.html', context=data)



#-----------------------Upload Image-----------------------
@app.route("/upload", methods = ['GET','POST'])
def upload():
   if request.method == 'POST':
      id="0"
      status = user_upload(id,request.form['name'],request.form['image'])
      if status == 1:
       return render_template("upload.html",m1="sucess")
      else:
       return render_template("upload.html",m2="failed")
#-----------------------View Images-----------------------
@app.route("/viewimage.html")
def viewimages():
    data = user_viewimages(session['username'])


    print(data)
    return render_template("viewimage.html",user = data)


#-----------------------Track-----------------------
@app.route("/track")
def track():
    name = request.args.get('name')
```

```
 iname = request.args.get('iname')
    print("sdfdffsfsfdfaffdfdfsfsf")
    print(name)
    print(iname)
    data = image_info(iname)
    print("ddddddddddddddddddddddddddddd")
    print(data)
    data = v_image(data)
    print("ddddddddddddddddddddddddddddd")
    print(data)
    return
render_template("viewdata.html",m1="sucess",users=data,im=iname,au='augment.png',
gh='graph.png')


#..... Update Item .....
if _name_ == "_main_":
    app.run(debug=True, host='127.0.0.1', port=5000,use_reloader=False)
```

APP SOURCE CODE

```
import sqlite3
import hashlib
import datetime
import MySQLdb
from flask import session
from datetime import datetime
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.applications import VGG16
from tensorflow.keras.layers import AveragePooling2D
from tensorflow.keras.layers import Dropout
from tensorflow.keras.layers import Flatten
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import  Input
from tensorflow.keras.models import Model
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.utils import to_categorical
from sklearn.preprocessing import LabelBinarizer
from sklearn.model_selection import train_test_split
from sklearn.metrics import classification_report
from sklearn.metrics import confusion_matrix
from imutils import paths
import matplotlib.pyplot as plt
import numpy as np
import argparse
import cv2
import os
```

```
from tensorflow.keras.preprocessing import image
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
from tensorflow.keras.preprocessing.image import load_img, img_to_array
from PIL import Image
import os

import cv2
import pandas as pd

import os




def db_connect():
    _conn = MySQLdb.connect(host="localhost", user="root",
                            passwd="root", db="fdb")
    c = _conn.cursor()

    return c, _conn

#-----------------------------register-------------------------------------
--
def user_reg(id,username, password, email, mobile, address,):
    try:
```

```
  c, conn = db_connect()
        print(id,username, password, email,
              mobile, address)
        j = c.execute("insert into register (id,username,password,email,mobile,address)
values ('"+id+"','"+username +
                    "','"+password+"','"+email+"','"+mobile+"','"+address+"')")
        conn.commit()
        conn.close()
        print(j)
        return j
    except Exception as e:
        print(e)
        return(str(e))
#-----------------------------Login-----------------------------
def user_loginact(username, password):
    try:
        c, conn = db_connect()
        j = c.execute("select * from register where username='" +
                    username+"' and password='"+password+"'")
        data = c.fetchall()
        print(data)
        for a in data:
          session['uname'] = a[0]


        c.fetchall()
        conn.close()
        return j
    except Exception as e:
```

```
  return(str(e))
#.....Upload Image.....
def user_upload(id,name, image):
    try:
        c, conn = db_connect()
        print(name,image)
        username = session['username']
        j = c.execute("insert into upload (id,name,image,username) values ('"+id+"','"+name+"','"+image +"','"+username +"')")
        conn.commit()
        conn.close()
        print(j)
        return j
    except Exception as e:
        print(e)
        return(str(e))

#.....View Images.....
def user_viewimages(username):
    c, conn = db_connect()
    c.execute("select * from upload where  username='"+username +"'")
    result = c.fetchall()
    conn.close()
    print("result")
    return result

#.....Track.....
```

```
def v_image(name):
    c, conn = db_connect()



    c.execute("Select * From images where name='"+name+"'")
    result = c.fetchall()
    conn.close()
    print("result")
    return result
#-----------------------------------Update Items-----------------------------------
-

def image_info(image_path):
    classes = {4:"bacterial blight",5:"borer",6:"cercospora",7:"healthy"}

    img_width, img_height = 224,224

    # load the model we saved
    model = load_model('fruit.h5')
    # predicting images
    image = load_img(image_path,target_size=(224,224))
    image = img_to_array(image)
    image = image/255
    image = np.expand_dims(image,axis=0)
    result = np.argmax(model.predict(image))
    print(result)
```

```
    path="static/img/"
    prediction = classes[result]
    print(prediction)

  return prediction

  if _name_ == "_main_":
      print(db_connect())
```

MODEL ARCHITECTURE:

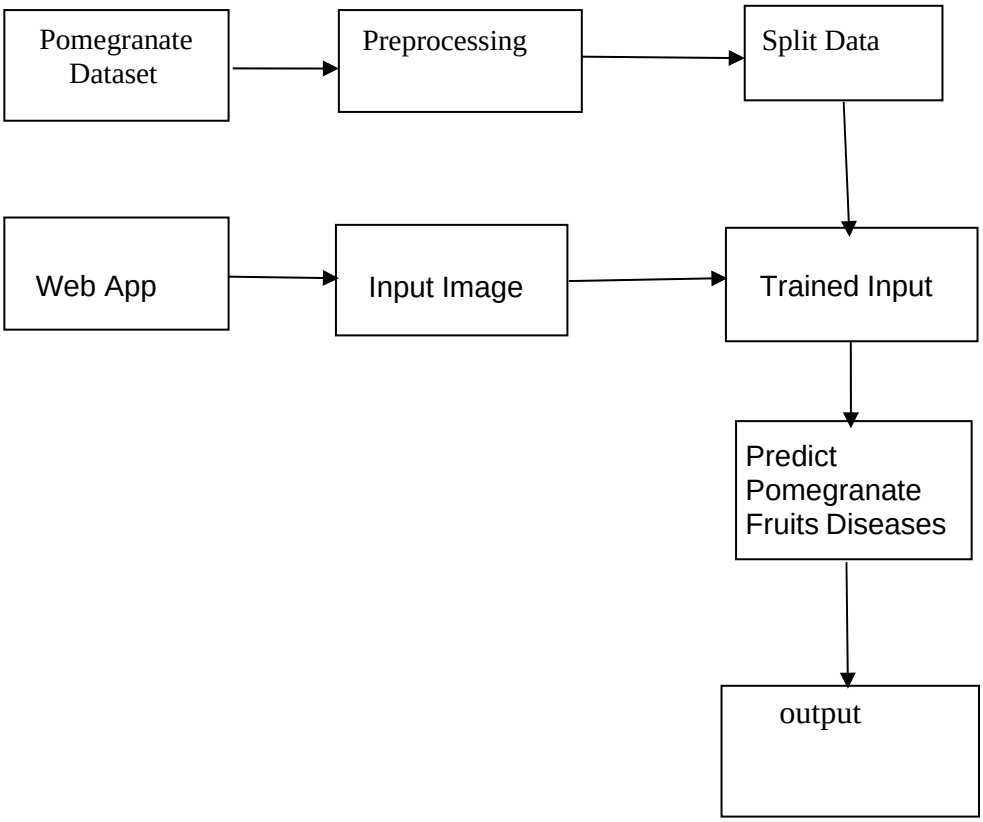


Fig: 3.5.1: Model Architecture

3.6 SYSTEM REQUIREMENT:

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(min)
- Programming Language - Python
- Development Kit - Anaconda
- IDE Dataset - Pomegranate and Apple fruit dataset
- Front End - Html, CSS,
- Framework - flask

CHAPTER 4
RESULTS AND DISCUSSION

CHAPTER 4

RESULTS AND DISCUSSION

4.1 OUTPUT SCREENS:

Home page is the main web page of a website. It may also refer to the start page shown in a web browser when the application first opens.

Fig 4.1.1: Home page

Select the Input image from dataset. Drag and drop to uploadthe dataset we click the button named Upload. The dataset isuploaded successfully.

Fig 4.1.2: Select The Input Image

When the dataset is uploaded successfully, we view images and track then go to click to predict. It verifies the Pictures &predict the diseases.

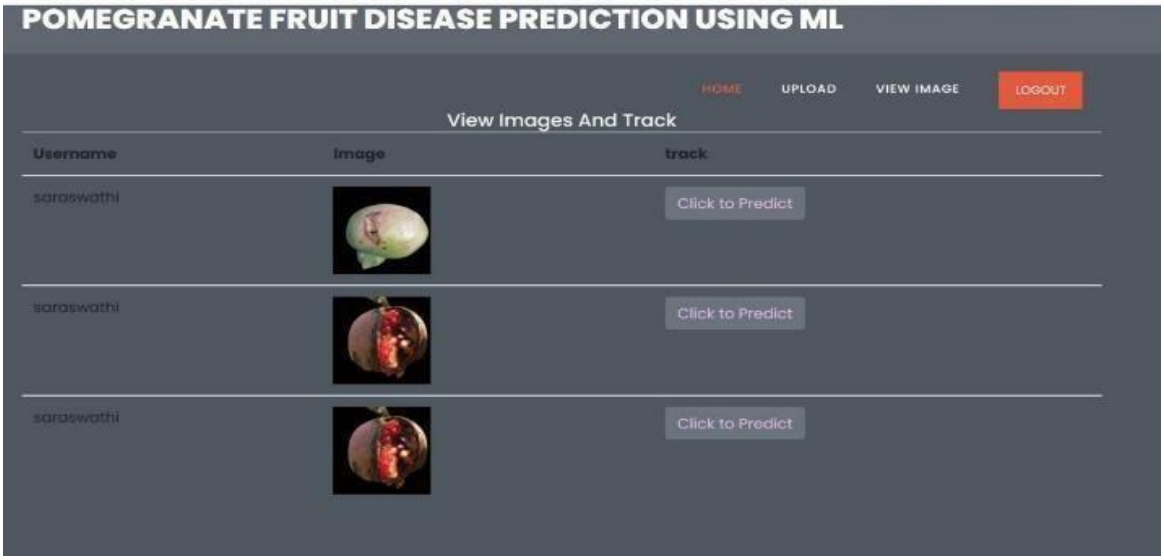


Fig 4.1.3: Predict disease

After predict the disease. It will display the result whichdisease is predicte

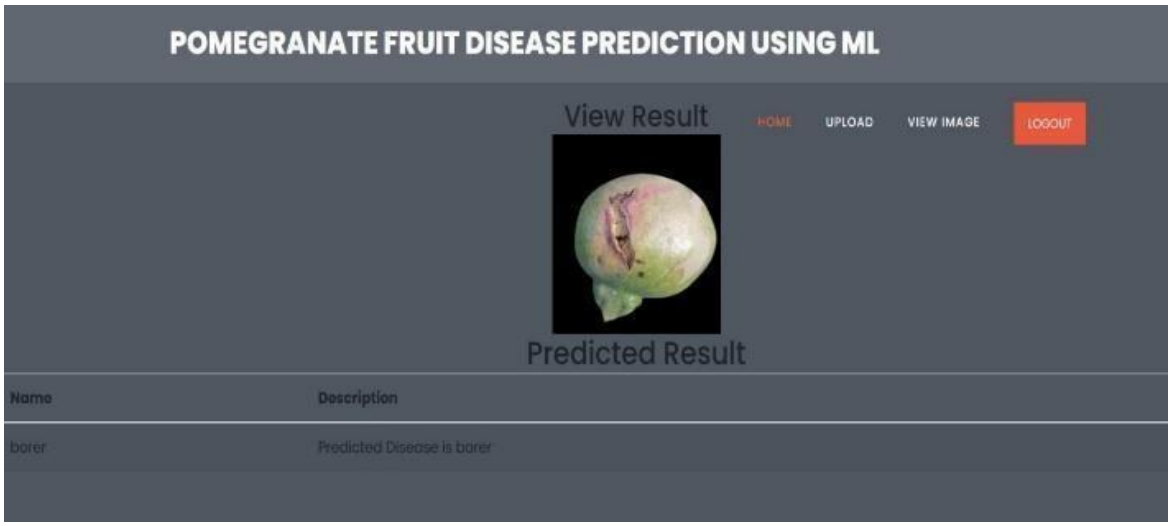


Fig 4.1.4: Predicted Result

Fig 4.1.5: Unhealthy Pomegranate fruit

Fig 4.15: healthy Pomegranate fruit

CHAPTER 5
CONCLUSION

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CONCLUSION

CONCLUSION

The implementation of Pomegranate and Pomegranate fruit disease detection using machine learning, specifically the CNN algorithm, along with a Flask web application, has shown promising results. The system focuses on detecting three diseases: borer, cercosporin, and bacterial blight, as well as classifying healthy fruits. By utilizing the CNN algorithm, the model can extract meaningful features from Pomegranate and Pomegranate fruit images, allowing it to distinguish between healthy fruits and those affected by specific diseases. The use of CNNs is particularly effective in image classification tasks due to their ability to capture spatial dependencies and hierarchical patterns within the data. The Flask web application provides a user-friendly interface for accessing the disease detection system. Users can upload images of Pomegranate and Pomegranate fruits and receive immediate results indicating whether the fruits are healthy or affected by any of the specified diseases. This approach offers several advantages over traditional manual classification methods. It reduces labor intensity, saves time, and improves overall efficiency. Additionally, by automating the process, it minimizes the risk of misclassification and helps prevent the spread of diseases to healthy fruits, thus preserving productivity. To further enhance the system, continuous data collection and augmentation can be performed to increase the diversity and size of the dataset. This would improve the model's ability to generalize and classify fruits accurately. Additionally, regular updates and maintenance of the system can incorporate new disease patterns or add new diseases for detection as required. Overall, the integration of machine learning, specifically the CNN algorithm, and a Flask web application for Pomegranate and Pomegranate fruit disease detection provides a valuable tool for farmers and agricultural stakeholders. It streamlines the classification process, aids in disease prevention, and ultimately contributes to improved crop yield and quality.

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GITHUB LINK

Ramya-txt/pomegranate-fruit-disease-prediction-using-machine-learning-(github.com)

RESEARCH PAPERS AND CERTIFICATIONS

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Pomegranate Fruit Disease Prediction Using Machine Learning

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Abstract: ***Pomegranate may be a broadly developed planting within Indian. This Profoundly useful natural product is contaminated by numerous bugs and illnesses which cause extraordinary temperate misfortunes. Distinctive Shapes of the pathogens maladies within leaves, Stems and of natural products are show. A few of the maladies that influence pomegranate natural products are anthracnose, heart decay and bacterial curse. There's a require for malady control procedures to incorporate opportune activity on the created infections. Hence, there's a require for shrewdly and self-learning acknowledgment frameworks to identify these illnesses within given Time. This think about is pointing to classifying of pomegranate natural products in twice classes ordinary and unusual utilizing CNN&LSTM procedure. This investigate work utilizes with cross breed CNN&LSTM procedure to distinguish four sort of maladies show within the pomegranate natural products and classifying all of them within 4 different classes. The comes about gotten utilizing CNN&LSTM are at that point optimized utilizing dragonfly calculation. The highlights like color, surface and shape of the natural products are gathered & bolstered into the half breed CNN&LSTM. The datasets with the classifier is understood like an exceed expectations record which is at first pre-processes utilizing outline diminish procedure and dimensionality carried utilizing foremost component investigation and Discriminant investigation.***

Keywords: Pomegranate Fruit diseases, classification, convolutional neural network, deep learning, disease detection, image processing.

a. INTRODUCTOIN

Pomegranate may be a natural product that develops with a terribly tall abdicate in numerous countries of Asian nations,and one in each once as in preeminent benefits picking up natural product inside the advertise. Be that as it may, since ofvarious condition, the plants are tainted by various illnesses that crush the whole trim, coming about in a awfully moo itemsurrender. So, the work proposes a picture prepare and neuralnetwork techniques to address the foremost common issues with phytopathology, i.e., the discovery & classifying towellness. Pomegranate natural product is additionally creditedto the reality that. takes off are influenced by illness caused by plants and climate. These illnesses are like curse microorganisms, plant spots, seed spoil, and leaf spots. The framework employments a few pictures for coaching, a few for testing capacities, and so on.

b. RELATED WORK

A. Early detecting of the pomegranates disease Utilizing ML

[1] Pomegranate is an unimaginably built-up characteristic item within Asia country with a tall advantage. Whereas, because of the dynamically discussing of conditioning as assortments with temperature, precipitation too as relative stickiness pomegranates trees will be corrupted by different diseases which closes in diminish of the gathering. Alter sicknesses will disclosed within of its starting activities using the assist and help of the expected Systems with utilizing secured up mark illustrate & sensing orchestrate, it can also be as willing to offer cautions with in farmers & in this way the capable. The pomegranate characteristic item and clears out are laid moo with different sicknesses exasperated using the plants vitality, microbes and so as with climate situation. This illnesses consolidate bacterial excoriate, normal item spot, common item rots and leaves spot

B. Identifying of Diseases in Pomegranate Leaves & Fruit

[2] Display paper is an endeavor to consequently review the malady on the pomegranate plant clears out. This inventive method would be a boon to numerous and would having some sample of preferences over the conventional strategy of evaluating. There had been a ocean alter within the mentality and the exertion put down by the agrarian industry by adjusting to thecurrent patterns and advances. One such illustration is the utilization of information data, communication innovation in framing which in the long run contributes to Accuracy Agribusiness. Directly, plant pathologists take after a monotonous method that primarily depends on

exposed eye forecast and an illness scoring scale with reviewing of diseases in pomegranate. Manual evaluating isn't asit were time devouring but too does not provide exact comesabout. Subsequently the current paper proposes a picture processing methodology to bargain as being one in the most issues of plant pathology i.e., illness evaluating. The comes about are demonstrated to be exact and palatable in differentiate to manual grading and ideally take a solid leap forward in setting up itself within the market as one such of the foremost effective and compelling handle. The proposed framework is additionally an effective module that recognizes the Bacterial curse malady on pomegranate plant. At to begin with, the captured pictures are prepared forupgrade. At that point picture division will be carry out inducetarget districts on the takes off and natural products. Afterword, in the event that the unhealthy spots on leaf is bordered by yellow edge.

C. Pomegranate Fruits disease detecting with using Image Processing Technique

[3] The horticulture plant infections are dependable for rancher financial misfortunes. These infections influence on plant root, natural product, leaf, and stem. Finding early stage of infection location makes a difference the agriculturist to progress efficiency. Within the conventional framework agribusiness specialists and experts in agriculturist can identify the plant illness at lower precision which causes misfortunes to ranchers. Right now a few analysts are proposing delicate computing and master frameworks to recognize plant illnesses. Plant illness distinguishing proof by visual way is less accurate because a few maladies don't having noticing different effects or a few of the illnesses show up as well late at thetime of gathering. The present day innovation in farming division can significantly made strides the agribusiness generation and supportability. This project gives a audit for natural product illness discovery strategies of pomegranate plants. This consider incorporates preprocessing, division, include removal and classification methods for pomegranate natural product infections discovery frameworks. This project is used too states the comparisons and impediments of existing naturalproduct illness discovery strategies.

c. METHODS AND EXPERMENTAL DTAILS

A. Methodology

The methodology of our project is within the current founder deep model is proposed that's based on profound highlightsextricated utilizing CNN and CNN organize. The profound highlights are extricated from completely associated layers. The extricated profound highlights are sent as an initial value input in the cnn layer. After CNN layer a completely associated layer, aSoftMax layer and a classification layer utilized that would sort the pictures to typical and unusual which are representedwith course names and 1 separately. Within the current consider we extricated profound highlights by tests to work through some time recently upgrading the profound organize parameters. It can be watched from different investigates carried on to distinguish plant or natural product illnesses utilizing profound learning, CNN approach has demonstratedto deliver compelling precision results the display think about portrays the precision gotten from machine-based models to divide pomegranate as 2 different classes ordinary and unusual. Solid natural products are alluded to asordinary and ailing natural products are alluded to as ordinaryand ailing natural products are alluded to as irregular. The information is collected bywatching the vital highlights of natural products that quicklyexhibits the quality of natural product and is recorded. Illnessforecast within the natural product is associated to numerouscomponents such as weight of the natural product, number ofthe marks on top of the pomegranate, natural product shape, the plant stand and defoliation in the tree. The classification of the pomegranate natural products is carried out by a classifier show that was prepared on the preparing information toanticipate the course name of modern testing information. The oddity that our show work gives is include extraction assignment is done utilizing CNN demonstrate is combined with CNN to classify natural products which is significantly progressing the Accurate value in the classifications.

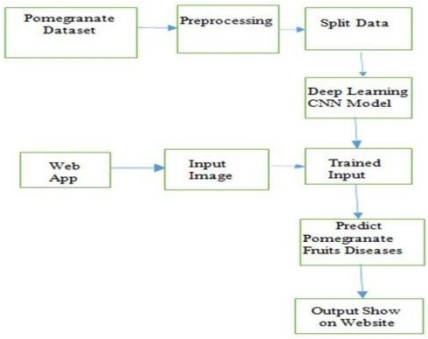

FIG 1: Architecture Model

1) *Pomegranate Dataset:* Attain a dataset containing pictures concerning the pomegranates Fruits with labels for various diseases or conditions.
2) *Web App:* Formulate a web application framework where users have the capability to upload images for analysis; disturbingly.
3) *Preprocessing:* Cleansing and preparing the dataset involves resizing images, normalization, and other transformations to possibly ready them for model training.
4) *Split Data:* Fragmentize the dataset into training, validation, and test sets, ensuring an accurate evaluation of the model's performance.
5) *Deep Learning CNN Model:* Conceptualize and render a Convolutional Neural Networks (CNN) model befitting for tasks in image classification; model's training needs to rely on the preprocessed dataset wholeheartedly.
6) *Input Image:* Permit users to upload images depicting pomegranate fruits via the web app interface; inconceivably.
7) *Trained Input:* Convey the uploaded images through the trained model as the CNN for the prophecy of diseases; momentously.
8) *Predict Pomegranate Fruit Disease:* Employ the CNN model upon the prophetic powers to reveal the manifest disease or condition within the pomegranate fruit, depending exclusively on the input image; in a strange turn of events.
9) *Output Show on Website:* Showcase the prophecy results on the website interface, demonstrating the discovered disease as well as also with various same kind of info or suggestions.

d. RESULTS AND DISCUSSION

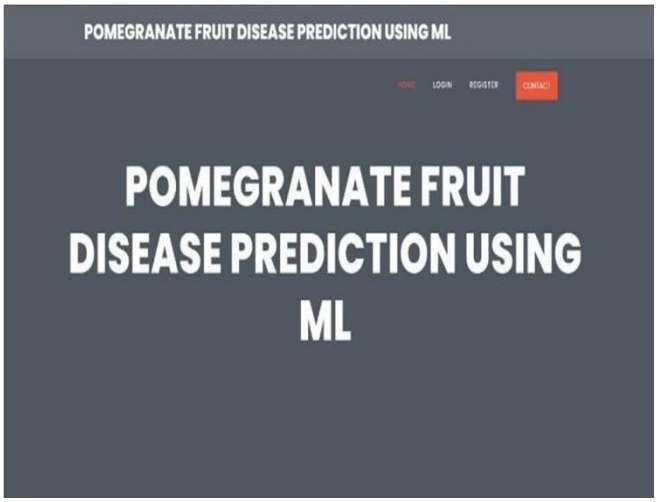

Fig 2: Home page

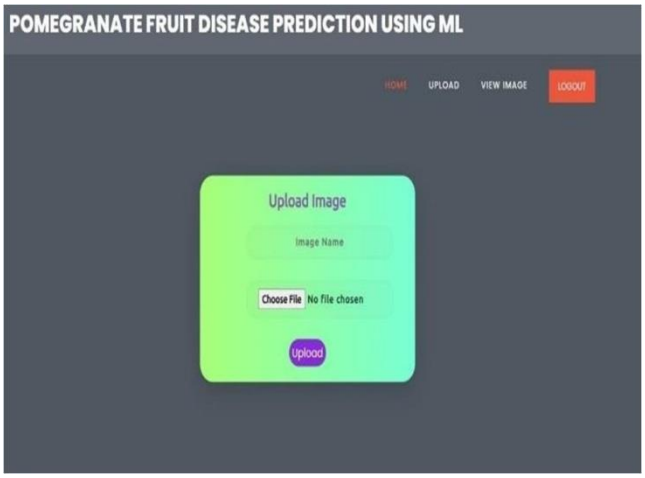

Fig 3: Select The Input Image

Home page is the main web page of a website. It may also refer to the start page shown in a web browser when the application first opens. Select the Input image from dataset. Drag and drop to uploadthe dataset we click the button named Upload. The dataset is uploaded successfully.

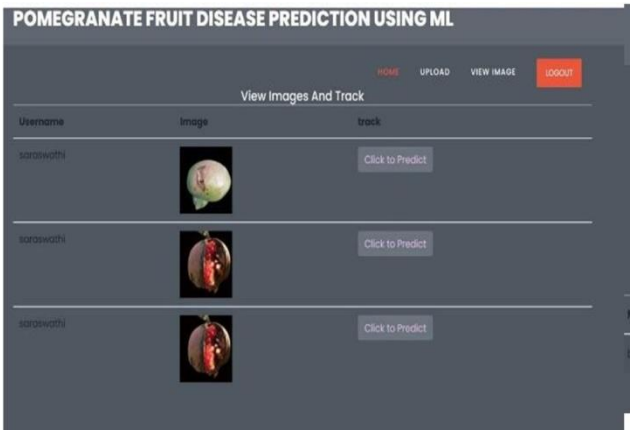

Fig 4: Predict Disease

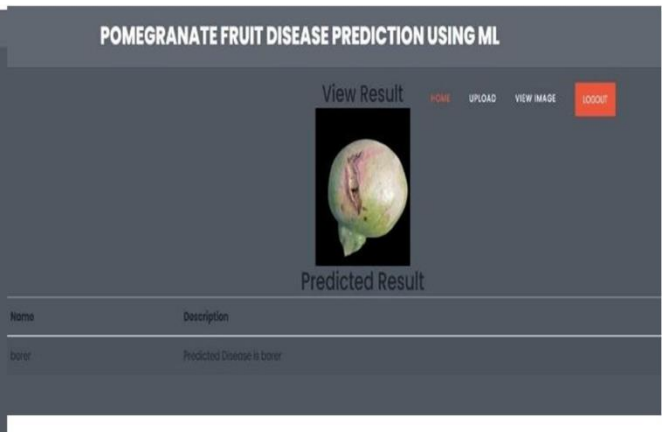

Fig 5: Predicted Result

When the dataset is uploaded successfully, we view images and track then go to click to predict. It verifies the Pictures & predict the diseases. After predict the disease. It will display the result whichdisease is predicted.

e. CONCLUSION

The Utilization of pomegranate and pomegranate normal itemsickness find utilizing machine stallion, especially the CNN calculation, at the side a carafe web application, has showed up promising comes approximately. The system centres on theacknowledgment of three illnesses: borer, and bacterial revile,also classifying sound natural products. By utilizing theCNN calculation, the illustrate can remove imperative highlights from pomegranate and pomegranate common item picture, allowing it to recognize between strong characteristic items and those affected by specific infections. The utilize of CNNs is particularly fruitful in picture classification assignments due to their capacity to capture

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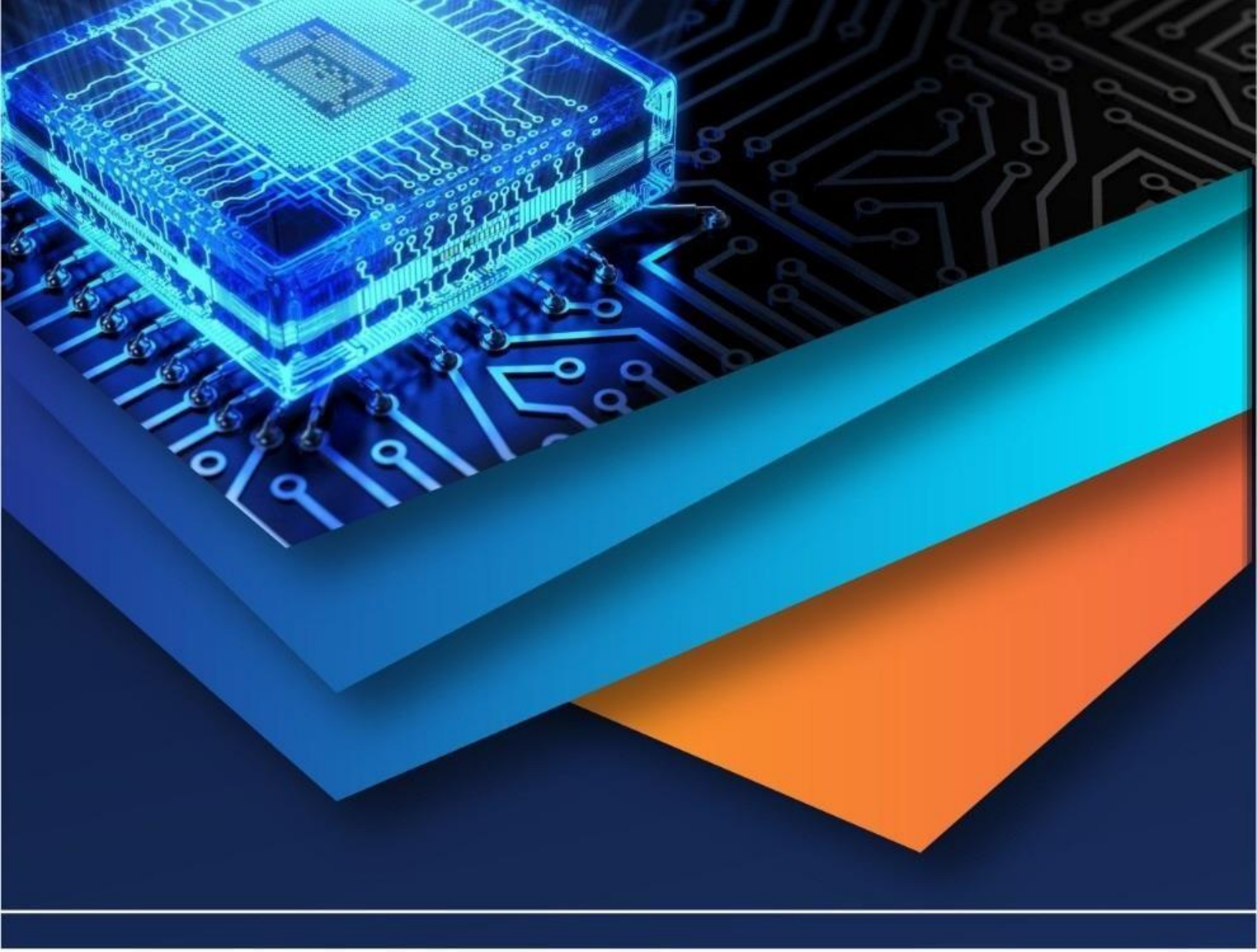

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