MACHINE VISION

INNOVATIVE ASSIGNMENT

Fruit Surface Defect Inspection

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ABSTRACT :

Inspection of fruit surface defects is critical in ensuring the quality of agricultural produce. This study looks at how machine vision and machine learning approaches can be used to detect and diagnose defects in fruit surfaces. The studied research explores the use of various technologies, such as deep learning, to improve the accuracy and efficiency of fruit defect detection systems. These developments have the potential to transform the quality control process in the fruit business, resulting in higher product quality and less waste.

LITERATURE REVIEW:

Paper 1:

In [1] , 110 images as a dataset are taken which represents the various defects in citrus fruit. Black spots, powdery mildew, cancker and wind scar are most common defects in citrus fruit.

The proposed method is composed of four primary steps:

1) Preprocessing
2) Identification of defects using K-means clustering,
3) Feature selection, and
4) Classification.

The entire process is divided into a training phase and a testing phase, as depicted in Figures 1.

In the training phase, various images are subjected to preprocessing. A training model is constructed to process the input data samples using an algorithm, and the processed output is correlated with the sample output to create a trained model. Subsequently, the trained model is applied to the test images, which also undergo preprocessing, followed by mid-level processing. The mid-level process takes the image as input and extracts the features. Each image in the training set has been labeled and stored in a label vector. The features extracted from the test data are compared with the features of the trained model, and the corresponding defect is assigned from the labeled vector. This label determines the category of the test image, which is classified according to its disease class. The end result is displayed along with all the feature values , as well as the name and image of the identified fruit defect.

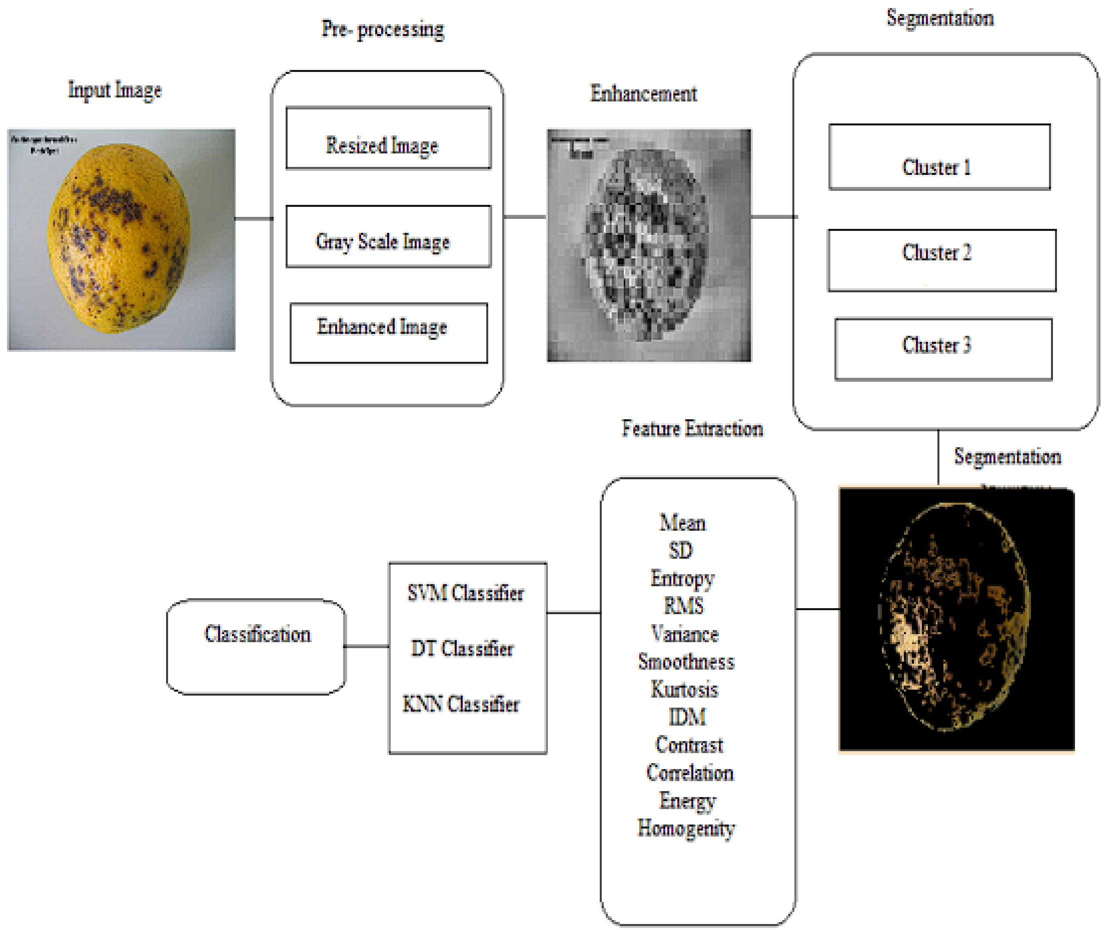


Fig.1 : Proposed Methodology [1]

In this study, computer vision systems were employed to detect four types of defects in citrus fruits: powdery mildew, black spot, canker, and scab. The process involved image resizing, conversion to grayscale, and enhancement using histogram equalization. Thirteen features were extracted from the images and used with three different classifiers: Support Vector Machine (SVM), Decision Tree, and K-Nearest Neighbors (KNN).

SVM demonstrated the best performance, achieving high accuracy for all defect types, with the highest being 98.18% for powdery mildew. Decision Tree had an average accuracy of 90% for all defect types, while KNN showed an accuracy of approximately 83%. SVM also showed better precision, recall, and F-measure compared to the other classifiers.

The study used a dataset of 240 images, distributed among different defect types. To improve the research, future work could consider expanding the dataset and exploring the use of additional classifiers.

Paper 2:

In [2], the researchers aimed to create a more effective way to identify defects on the skin of fruits, which is crucial for consumers when they pick out fruits in stores. The challenge is to ensure that only high-quality fruits are packaged and delivered to the end customers. To address this, they designed a specialized camera system.

This camera system was set up on conveyor belts where oranges moved swiftly. To capture high-quality images of the oranges, they used techniques like high-speed electronic shutters and proper lighting to prevent underexposure. These clear images were then used to train a computer program to recognize fruit defects.

To determine defects, the system focused on the colors in the images. They found specific color information that worked well in distinguishing healthy fruit skin from defective skin. They also reduced the complexity of these color features to make the process faster and less prone to errors.

They used a machine learning algo "Support Vector Machine" to learn from the color information and identify the fruit defects accurately. This approach proved highly effective in detecting skin defects on the oranges during testing.

They trained SVM model using 650 images in which 300 images were bad skin. 50 more bad skin images are used for testing purposes. SVM model are able to detect 59 defects from a total 61 defects.

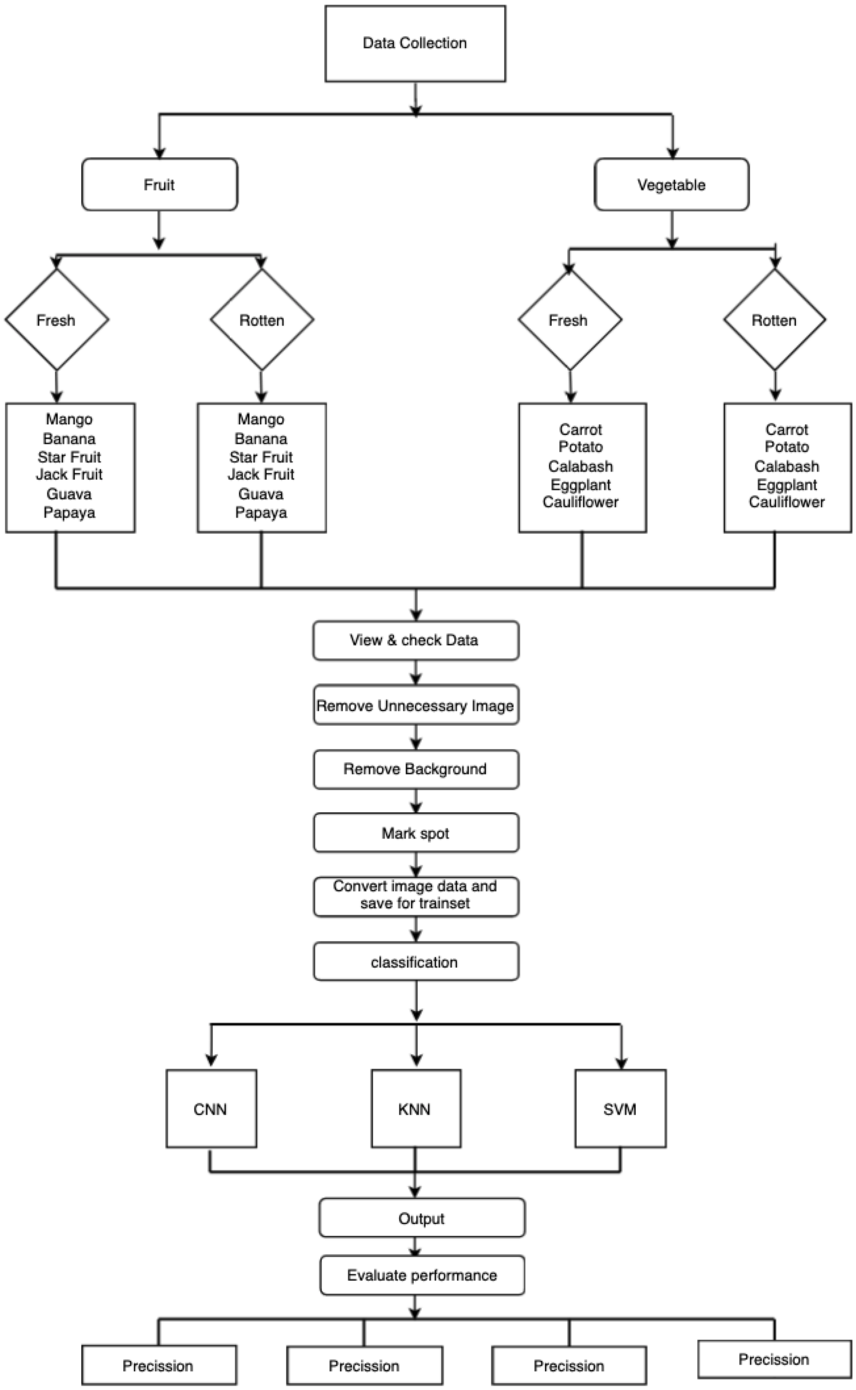
The authors believe that their method could be of great help to packinghouses, ensuring that only top-quality fruit is packaged and sent to consumers. They also mentioned that future improvements could make the system even more efficient, possibly extending its use to identify different types of fruit defects. This could allow producers to separate seriously damaged fruit from those with minor flaws, ensuring that customers receive only the best quality fruit.

Paper 3:

In [3] The reviewed research uses machine vision and machine learning to detect and classify defects in fruits and vegetables, which is a critical problem in the agriculture economy. The major aim is to reduce the amount of time and effort required to hand sort fresh and rotting products. According to the authors, agriculture is essential to any country’s economy, and the article emphasizes the importance of using automated systems in the context of the country's agricultural sector.

To solve the research problem, the paper uses a systematic methodology. This includes collecting data, preparing it, and classifying images with a Convolutional Neural Network (CNN) model. The use of widely available datasets from Google and Kaggle for both fresh and rotten fruits and vegetables ensures that the dataset is diverse. Image background reduction, spot detection, and image data conversion for the training dataset are all part of data preprocessing.

The Below image explains the whole methodology of this paper :



The authors explain the creation of an Android app that allows users to capture or select photos of fruits and vegetables for analysis. This program communicates with a REST API service to deliver fresh and rotting produce accuracy percentages. The paper describes the application's user interface and process, which improves user-friendliness.

Validation accuracy of CNN is 78%,58% for SVM and 56% for KNN.

CONCLUSION:

The research findings collectively highlight the potential of computer vision and machine learning in automating the detection of defects in fruits and vegetables.These methods offer high accuracy and efficiency, making them valuable tools for ensuring product quality. The future of this research field may involve expanding datasets, exploring additional classifiers, and improving usability, further benefiting the agriculture industry and consumers alike.

REFERENCES :

1. Identification of Citrus Fruit Defect using Computer Vision System
2. Detection of Fruit Skin Defects Using Machine Vision System
3. Bangladeshi Fresh-Rotten Fruit & Vegetable Detection Using Deep Learning Deployment in Effective Application