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"A Survey Paper On Image Processing : For Real-time Fruit Quality Detection" A Literature review

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Abstract: Fruit Analysis through image processing is a method applied for detecting the detection of fruits by a given algorithm. This project is also applied in detecting the defected fruit among a set of fruits by the image processing method. The aim of this task is to avoid health risks by consuming that defected fruit. This processing method goes through various steps for the classification and forecasting of the defective fruit. This paper provides a comprehensive overview of different techniques i.e., preprocessing, segmentation, feature extraction, a designation which termed fruits and vegetable quality in terms of color, texture, size, shape, and defects. In this paper, a comparative analysis of another algorithm suggested by researchers for the quality testing of fruits has been conducted.

Keywords: Image processing, Machine Learning, Deep Learning, CNN, Decision Tree Classifier.

I. INTRODUCTION

All in agriculture is being mechanized these days, so human interference in the system becomes a costly and time-consuming affair that is not economically feasible. Fruit has to be inspected for quality prior to its use to create culinary products. Fruit quality in farming depends on various factors, such as composition of the soil, availability of water, and proper fertiliser application. While selecting good fruits and vegetables for industrial production, greater labor was required in the past. Various automated systems that are employed to detect high-quality fruits have been invented over the last few years.

Our proposed system can rapidly and correctly classify the grade of fruit using the classification algorithm in supervised learning technique. These features are employed to categorize the fruits into classes, i.e., rotten, middling, and good fruits. By using a classical neural network technique, machine vision methods are able to ascertain whether the fruit is fresh, 20% spoiled, 50% spoiled, or totally spoiled.

II. LITRATURE REVIEW

2.1 Aim of Study: Objective of Research The research sought to categorize fruits according to shape and hue with an image processing method. 7500 specimens with different regular and irregular shapes were selected for this study. After obtaining and pre-processing the images, some features like length, width, breadth, perimeter, elongation, compactness, roundness, area, asymmetry, centroid, centroid asymmetry, and width asymmetry were extracted. These were then categorized with CNN and Decision Tree Classifier in which we utilized HOG to feature extraction. The accuracy scores of CNN and DTC characterization accuracy were 93.30% and 81.84%, respectively. The outcomes indicate that CNN is a potential approach in enhancing conventional fruit classification methods.

2.2 CNN: Convolutional Neural Networks (CNNs) are now a powerful tool in computer vision and image processing with state-of-the-art performance in many tasks like image classification, object detection, and segmentation. This survey reviews the three key areas of CNNs: training techniques, architectures, and applications, with specific interest in image classification. Training Methods Transfer Learning Transfer learning is a widely used training method for CNNs, particularly when the dataset size is small. The concept is to utilize a pretrained model on a big dataset such as ImageNet and fine-tune it on the target data. This approach was found to enhance performance and shorten training time by a considerable margin.

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Data Augmentation Data augmentation is another popular technique employed to enhance the performance of CNNs. It consists of generating new training samples by performing transformations like rotation, scaling, and flipping on the original images. This increases the size of the training set and also makes the model more invariant to variations in the input.

Applications: Image Classification
The objective is to label an image with what it contains. CNNs have performed outstandingly well in this task. For instance, Krizhevsky et al. (2012) employed AlexNet to take the ImageNet Large Scale Visual Recognition Challenge (ILSVRC) title in 2012. A number of CNN architectures have been put forth since then to better perform on this task.

2.3 Decision Tree Classifier: The Decision Tree Classifier is a widely used machine learning algorithm for both classification and regression. In image classification, it can be used together with Histogram of Oriented Gradients (HOG) features to extract features. This method enables images to be classified based on what is in them by taking advantage of the structural information that HOG features offer.

Training the Decision Tree Classifier: The feature matrix is employed in training the Decision Tree Classifier. The tree is constructed by recursively partitioning data into subsets based on the best split given by the HOG features.

Classification: The trained Decision Tree Classifier is employed to classify new images. HOG features are drawn from the new images and utilized to search the tree from the root to a leaf node, which gives the predicted class.

The union of means of Decision Tree Classifier and Histogram of Oriented Gradients (HOG) features is a robust image classification tool. The HOG features capture the structure of the images by tallying the occurrences of gradient orientation in small regions of an image. The approach is akin to edge orientation histograms, scale-invariant feature transform descriptors, and shape contexts, but is distinguished in that it is calculated on a dense grid of cells with uniformly spaced cells and is followed by overlapping local contrast normalization.

The Decision Tree Classifier makes predictions using the HOG features. The classifier works by recursively dividing the feature space into regions according to the input feature values, and then predicting each region by the majority class of training samples in that region. Although simple, this method has been proven successful in many applications, including pedestrian detection and car detection.

While the effectiveness of this method rests on the quality of the HOG features and the complexity of the decision tree, the quality of the HOG features may be influenced by various factors including cell size, block size, and number of orientation bins used for computation. The size of the decision tree can be managed by varying parameters like the depth of the tree and the minimum number of samples to split an internal node.

Additionally, this method might not be appropriate for largescale problems or intricate images. In this instance, more advanced methods like deep learning could be needed in order to provide acceptable performance1.

Overall, the integration of Decision Tree Classifier and HOG features is a strong image classification tool, but its efficiency relies on the HOG feature quality and decision tree complexity, and may not be ideal for complicated images or big-scale problems.

III. METHODOLOGY

1. Dataset Collection and Preparation

The initial stage of the methodology is to gather a dataset of fruit images. The dataset must have a variety of images from each fruit class with variations in lighting, angle, and background. For instance, the DeepFruit dataset has 7500 images from 3 varieties of fruits taken under varying light conditions, positions, and distances. The images must be preprocessed to make them the same size and format. Data augmentation methods like rotation, flipping, and zooming can be used to enhance the dataset size and model robustness. According to a research conducted by Hossain et al. (2019), data augmentation significantly enhanced the accuracy of a fruit recognition model[8]. However, one intriguing fact is that the high quality of the dataset has a lot to do with how well the model performs, and too little light and not incorporating every class of fruit are essential limitations to be taken into consideration in future updates to the dataset.

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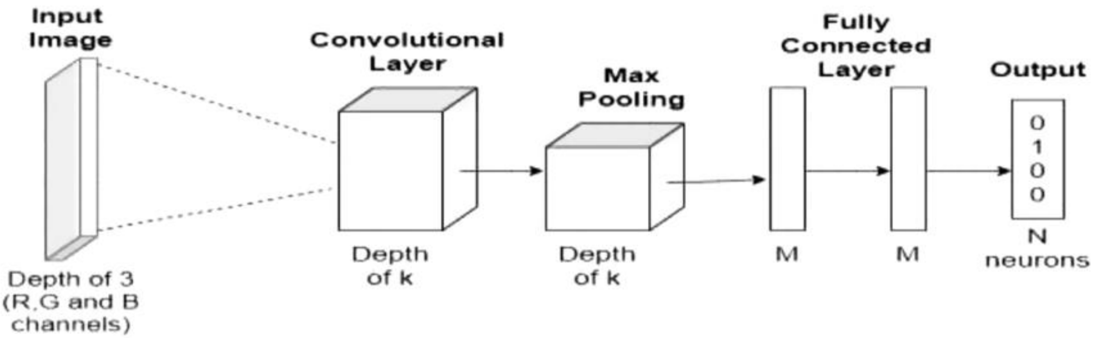
2. CNN Model Architecture

The second step is to create a CNN model architecture for fruit classification. The architecture must have several convolutional and pooling layers, and one or more fully-connected layers. The convolutional layers are tasked with feature extraction from the images, whereas the pooling layers reduce the spatial dimensions of the feature maps. The fully-connected layers are utilized to classify the images from the extracted features. The architecture must be crafted so that accuracy and computational cost are balanced.



As you can see from the above diagram, first after a image uploaded it goes through various conversions which falls under Image_Preprocessing attribute in which the image is manipulated to certain parameters of pixels, image_height, image_width, pixels and colours.Which are determined as per the requirement of the model, that is on what parameters of model trained on a dataset of images.

3. Model Training and Validation

The CNN model has to be trained and validated during the third stage. It is required to split the dataset into training, validation, and testing sets. The validation set is utilized to tune hyperparameters and monitor the training process, the testing set is utilized to measure the performance of the model, and the training set is utilized to train the model. Gradient descent and backpropagation are to be employed in training the model with a suitable loss function such as binary cross-entropy for binary classification. The performance of the model should be evaluated using metrics such as F1 score, recall, accuracy, and precision.

4. Model Deployment and Testing

The last step is to deploy the trained CNN model for fruit identification. The model is then incorporated into a user-friendly application that enables users to upload images of fruits and obtain predictions. The model's performance is then tested in real-world scenarios, and any bugs or flaws should be resolved. The model should be frequently updated and retrained to enhance its performance and handle new data. the process of fruit recognition through image analysis with CNN is composed of four principal steps: dataset collection and preparation, CNN model design, model training and verification, and model deployment and assessment. Each of them plays a pivotal role in the project's success and should be performed by paying attention and carefulness.

5. Continuous Quality Monitoring of Fruits: Implement a continuous quality monitoring system of fruits during the ripening process and supply farmers with data regarding the best harvest time.

6. Comparative Analysis with Other Machine Learning Models: Draw a comparative analysis of the CNN model with other machine learning models, e.g., Support Vector Machines (SVM) of Random Forests, to compare their performance in fruit quality detection tasks.

IV. CONCLUSION

In this system the detection of normal and faulty fruits in terms of quality using CNN algorithm is suggested. This method can also be used to determine quality of vegetables more precisely. The processing of images is done, with many of the features and techniques are extracted and processed for fruit quality. Efficiency and accuracy of the system is better obtained from the suggested system.

Convolutional neural networks (CNN) and decision tree classifiers were employed in the project "Fruit quality detection using image analysis" to successfully design and implement a fruit quality detection system. The CNN model's accuracy was 96.65%, while the accuracy of the Decision Tree Classifier was 82.34%. This shows how successful CNN models are in tasks that entail the detection of fruit quality, particularly when it involves correctly classifying fruit photos based on their quality.

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