Mango Quality Prediction Using Image Processing

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Abstract - **The project introduces an innovative and technology-driven solution to the agricultural sector by harnessing the power of image processing and machine learning. Mangoes, a popular tropical fruit, are renowned for their diversity in quality and ripeness levels. Ensuring consistent fruit quality is crucial for both producers and consumers. This project aims to address this challenge by developing a system that can predict mango quality attributes, such as ripeness and freshness, by analyzing images of the fruit. The system captures high-resolution images of mangoes and employs advanced image processing techniques to extract key features, including color, texture, and size. Machine learning algorithms are then utilized to analyze these features and predict the quality of each mango. The project leverages a comprehensive dataset of mango images, encompassing various quality attributes and ripeness stages, to train and validate the predictive models. The potential benefits of this project are multifaceted. Mango producers can benefit from improved quality control, reduced post-harvest losses, and enhanced supply chain management. Consumers gain access to consistently high-quality mangoes. Furthermore, the project contributes to the reduction of food waste and supports sustainable agriculture practices. The system's real-time capabilities can be integrated into various stages of the mango supply chain, from harvest to distribution. However, exemplifies the synergy between agriculture and technology, offering a practical and efficient solution to the challenge of quality prediction in the mango industry. It demonstrates the capacity of image processing and machine learning to enhance the agricultural value chain, ensuring that consumers can savor the highest quality mangoes while fostering sustainability and reducing food waste.**

Keywords: Mangoes, Quality Attributes, Agricultural, Convolutional Neural Network (CNN), Authentication, Deep Learning.

I. INTRODUCTION

Mangoes are a beloved tropical fruit renowned for their rich flavor and succulent sweetness. The quality of mangoes, characterized by attributes like ripeness and freshness, is of paramount importance to both producers and consumers. However, assessing mango quality can be a subjective and labor-intensive task, often leading to variations in the market. The project, introduces an advanced approach to address this challenge. Leveraging cutting-edge technologies, including image processing and machine learning, this initiative aims to provide an objective and efficient means of predicting mango quality. By capturing high-resolution images of mangoes and subjecting them to rigorous analysis, the system can assess key quality attributes.

The system's functionality extends to extracting relevant features from the images, such as color, texture, and size. These features are then analyzed by machine learning algorithms, which have been trained on a diverse dataset of mango images, encompassing a range of quality attributes and ripeness stages. The potential implications of this project are far-reaching. Mango producers stand to benefit from improved quality control, enabling them to reduce post-harvest losses and enhance supply chain management. Consumers, on the other hand, gain access to mangoes with consistent quality, ensuring a delightful and predictable eating experience.

Moreover, this project contributes to broader sustainability and efficiency in the agriculture sector. By reducing food waste and improving quality control, this project supports sustainable agriculture practices. The real-time capabilities of the system make it adaptable for integration at multiple points along the mango supply chain, from harvest to distribution.

This project underscores the synergy between agricultural practices and cutting-edge technology. By utilizing image processing and machine learning, it exemplifies how technology can enhance the quality of agricultural products and streamline the supply chain. As a result, consumers can look forward to savoring high-quality mangoes, while producers and the environment benefit from sustainable and efficient practices.

II. LITERATURE SURVEY

Recognizing the Ripeness of Bananas using Artificial Neural Network based on Histogram Approach (Saad, H.,

Ismail, A., Othmand, N., Jusoh, M., Naim, N. and Ahmad, N.) Above all else, the undertaking begins by gathering 3 arrangements of various bananas (unripe, ready and overripe). These pictures of the bananas are caught utilizing a webcam and are then resized to 352x288. The justification for doing so is because of the first picture being too large. By having an enormous picture, it will take much longer for the GPU to handle the pictures. From that point onward, the venture moves into the RGB part extraction stage to decide the variety force of the picture. A histogram is then plotted in view of the RGB esteem. To prepare the ANN model, the task utilizes a spread that includes in 3 phases (Feed-forward of information preparing design, Back-proliferation of blunder and Weight change). While preparing the model, the result is contrasted with target esteem with work out proper mistake. The mistake component will then, at that point, be dispersed back to the secret layer. After network is prepared, the application will just include with the feed-forward stage. To limit the squared mistake of the result, the angle descendent strategy will change its weight appropriately. At last, a GUI is made with the goal that the client can utilize the ANN model to distinguish readiness of banana.

Ripeness Classification of Bananas using an ANN (Mazen, F. and Nashat, A.) The proposed strategy for doing readiness/newness recognition for this article is by utilizing an ANN. Prior to preparing the ANN model, the article starts with the information assortment process. The dataset utilized comprises of 300 bananas with changing aging levels (unripe, ready and overripe). The pictures of bananas in the dataset are caught utilizing a Samsung Note 3 camera. Then, the pictures are then pre-handled prior to preparing and testing the ANN. From that point forward, a HSV model is utilized to depict the RGB shades of the banana pictures. Moreover, morphological sifting is finished on the banana pictures to upgrade them. Also, Otsu's technique is utilized to eliminate the foundation of the banana picture to build the exactness of the model. Subsequent to assessing the diary articles carrying out AI methods, we can reason that the articles above upholds involving ANN to perform characterization for organic product quality. This is on the grounds that ANN can perceive the comparative examples contained in the information pictures to order them.

On line detection defective apples using computer vision system combined with deep learning methods (Fan, S., Li, J., Zhang, Y., Tian, X., Wang, Q., He, X., Zhang, C. and Huang, W.) In view of a diary article composed by Fan et al. (2020), proposed a technique for utilizing a 4-path arranging framework to grade the nature of apples. In this 4-path arranging framework, a transport will be used to move and turn natural products uninhibitedly to guarantee that the whole surface of the organic product is caught however much

as could reasonably be expected by two cameras. Fundamentally, the picture of each natural product will be caught in 3 different direction by having them pivot around for each picture catch. This is so we can catch all of the "faces" of the natural product. Other than that, two straight lights are utilized to guarantee that the picture caught by the cameras are adequately brilliant. To increment exactness by shutting out stray light, the parts expressed beforehand are all positioned inside a light chamber.

An efficient approach to Fruit Classification and Grading using Deep CNN (Pande, A., Munot, M., Sreeemathy, R. and Bakare, R.) As per the diary article composed by Pande et al. (2019), a comparable strategy is proposed to do organic products quality reviewing. The technique is a mechanized framework to grade organic products by putting them on a transport line to assist with shipping the organic product while a camera catches pictures of them. From that point onward, the pictures caught will be shipped off Raspberry PI to pre-process them for the DCNN classifier to run on GPU. During the pre-handling stage, the foundation of the pictures is eliminated to counteract the "commotion" that contains undesirable highlights in the pictures. To do this, the splane of picture will be increased with the first picture to recover the locale of the picture that contains the organic product. Without eliminating these "clamor", the CNN model could become familiar with the unessential highlights contained behind the scenes in this manner making it less exact. This article expresses that Beginning V3 (design of CNN) is utilized to order leafy foods evaluating. Other than that, move learning is carried out to diminish the figuring power and the preparation information expected to do characterization. Move learning can do this by reusing a prepared model from one more related task on another model. To prepare the organization, the dataset is partitioned in a proportion of 60:20:20 by which 60 of the pictures are utilized to prepare the organization; 20 will be utilized to test the exactness of organization and the unused 20 will be utilized to get the last precision of organization.

Fruit Freshness Detection using CNN Approach (Harsh, A., Jha, K., Srivastava, S., Raj, A. and S, R.) Brutal, A. et al. (2020) proposed involving CNN to distinguish newness of natural products. CNN is a kind of ANN that is well versed in picture examination. CNN is used so the spatial connection between pixels can be saved. These pixels have numerical administrators that are stacked on top of one another to create the layers in the organization. In this article, the writers involved a two-track profound brain network as its design. This engineering contains two layers by which the main layer contains profound learning calculation and the subsequent layer contains associated layers to do grouping. This brain network has 4 layers of stowed away neurons.

Subsequent to checking on the diary articles that are utilizing Profound Learning strategies, it is found that all of the writing surveyed above upholds involving CNN for organic product newness grouping. The explanation being CNN is the most appropriate model for picture arrangement because of its high precision.

III. PROPOSED SYSTEM

The proposed system for the project is a pioneering solution that combines advanced technologies to predict mango quality attributes objectively and efficiently. By harnessing the capabilities of image processing and machine learning, this system aims to revolutionize the way mango quality is assessed. It begins by capturing high-resolution images of mangoes, which are then subjected to rigorous analysis. Cutting-edge image processing techniques are utilized to extract critical features like color, texture, and size from these images. Subsequently, machine learning models come into play, analyzing these features to predict the quality of each mango. To ensure the models' accuracy, a diverse dataset of mango images encompassing various quality attributes and ripeness stages is employed for training and validation.

The potential applications of this system are wide-ranging. Mango producers stand to benefit significantly as they gain improved quality control, reduced post-harvest losses, and better supply chain management. Consumers, on the other hand, can look forward to enjoying mangoes with consistent quality, resulting in a delightful and predictable eating experience. Moreover, the system contributes to sustainability in the agriculture sector by reducing food waste and enhancing quality control practices. Its real-time capabilities make it adaptable for integration at various points along the mango supply chain, from harvest to distribution.

Figure 1: Proposed Methodology

The information is utilized as preparing information and a piece of it is utilized as test information. The following stage to perform is include extraction, it is a dimensionality decrease interaction, and it determines information utilizing the mark pictures which can be utilized for handling and train the brain organization. Highlight Extraction means to diminish the quantity of elements in a dataset by making new elements from the current ones. In highlight extraction the rich elements of the mark are separated and changed over into ascribes for preparing the model. It will fundamentally take the mango pictures and creates information like points, curve, and circular segment length, and so forth of the mango pictures. This information is utilized to prepare our CNN model. We then train the CNN model, the information from include extraction is utilized to prepare the CNN model, the prepared CNN model will emphasize over every one of the information from the mango quality extricated during the element extraction process and the model will pick up utilizing the highlights during the preparation cycle. In the following stage the prepared model is utilized to foresee the mango limit which addresses the legitimacy of the mango dataset. The mango quality edge goes from 0 to 1, which addresses the genuineness of the mangos. On the off chance that the mango quality edge is higher than a given number say 0.5, then the certainty of the CNN that the mango quality is half. The mango quality edge is utilized as the making a decision about models for the credibility of the picture.

IV. RESULTS AND DISCUSSIONS

It can be inferred from the results that the validation test of the Plant Leaf Disease Detection using CNN was considered legitimate that the system is a valuable tool for detecting plant leaf disease.

The whole process is divided into three stages:

1. Input pictures are first made by a device or transferred to our web application by clients.
2. Segmentation pre-handling incorporates the course of picture division, picture improvement and variety space transformation. In the first place, the computerized picture of the picture is upgraded with a channel. Then, at that point, convert each picture into a cluster. Involving the logical name for Binarizes Sicknesses, each picture name is changed over completely to a parallel field.
3. CNN classifiers are prepared to distinguish illnesses in each plant class. Level 2 outcomes are utilized to hit up a classifier, which is prepared to group different sicknesses in that plant. On the off chance that not present, the leaves are named "sound".
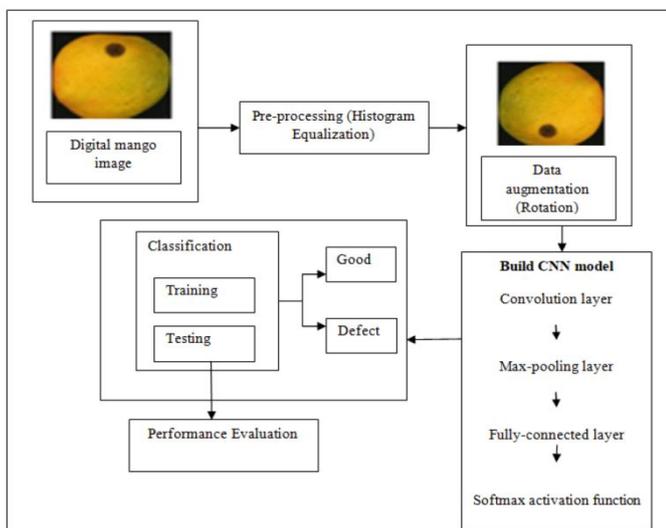
When we provide the system with input, we need new light for the system to function at its best. 90% of the data were utilized for training, and 10% were used for testing. More data might be used for testing and training, which would improve the accuracy and output of the system.

The proposed system operates through the following steps:

- Image Capture: High-resolution images of mangoes are captured using a camera or other image-capturing devices. These images serve as the input data for quality assessment.
- Image Preprocessing: The captured images undergo preprocessing to enhance their quality and standardize features. This step may involve tasks like resizing, noise reduction, and color correction to ensure consistency.
- Feature Extraction: Image processing techniques are employed to extract essential features from the images. This includes characteristics like color, texture, and size, which are critical in assessing mango quality.
- Machine Learning Models: The system employs machine learning algorithms to analyze the extracted features and predict mango quality attributes. These algorithms have been trained on a diverse dataset of mango images that cover a range of quality attributes and ripeness stages.
- Quality Assessment: The machine learning models provide objective assessments of mango quality attributes, such as ripeness and freshness, based on the analyzed features. The assessments are based on data-driven patterns rather than subjective human judgment.
- Real-time Application: The system's capabilities may be integrated at various points along the mango supply chain, from harvest to distribution. This allows for real-time quality assessment and decision-making to enhance efficiency and consistency.
- Reporting and Visualization: Quality assessment results can be presented through user-friendly interfaces, providing producers and consumers with access to mango quality information in a comprehensible format.
- Sustainability and Efficiency: By offering consistent quality assessment, the system contributes to reducing post-harvest losses and supports sustainable agricultural practices.

The system's ability to predict mango quality attributes objectively and efficiently benefits producers and consumers by ensuring consistent quality control and reducing food waste. It offers a data-driven approach to mango quality assessment, fostering sustainability and enhancing the overall mango supply chain.
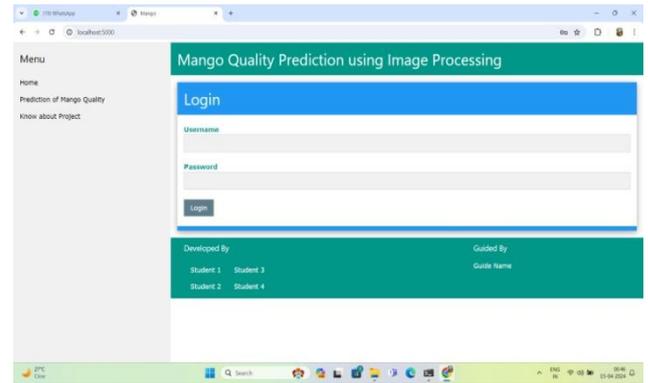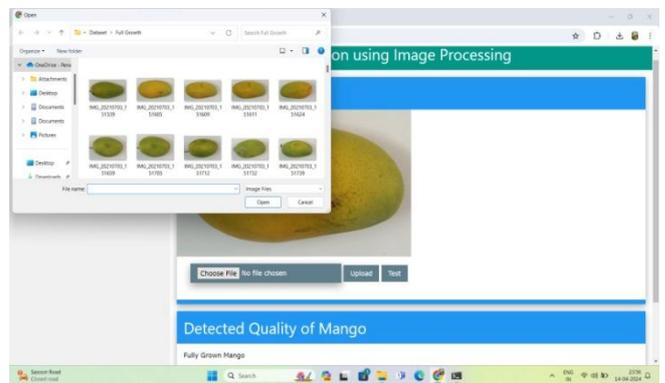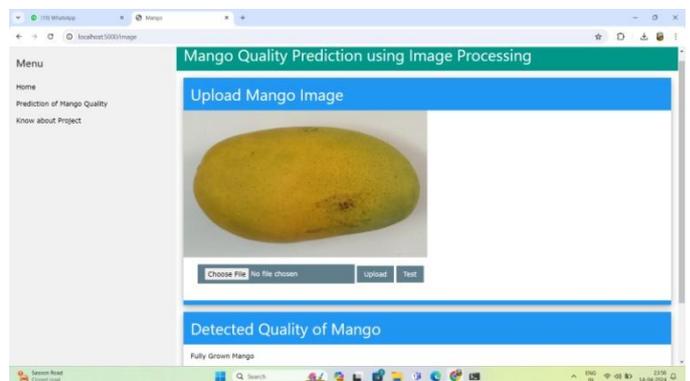

Figure 2: Home Page

Figure 3: Upload Data

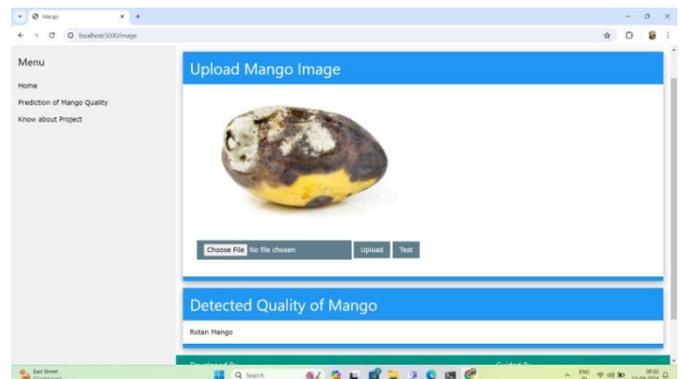

Figure 4: Result

Figure 5: Result

Figure 6: Result

V. CONCLUSION

This project offers a groundbreaking solution to the longstanding challenge of assessing and predicting mango quality. By leveraging the combined power of image processing and machine learning, this system transforms the way we evaluate mangoes, introducing objectivity, consistency, and efficiency into the process.

The project addresses not only the subjective nature of quality assessments but also the significant post-harvest losses incurred due to incorrect handling and distribution. The system's ability to provide objective and data-driven quality assessments offers a substantial advantage to both mango producers and consumers.

For producers, the system streamlines quality control practices, allowing for the cultivation and distribution of mangoes with consistent quality attributes. It reduces post-harvest losses, optimizes storage, and supports sustainability in agriculture. Producers can now make informed decisions in real-time, from harvesting to distribution.

Consumers, on the other hand, can anticipate an enhanced eating experience. The ability to select mangoes with desired ripeness and freshness provides predictability and satisfaction. Additionally, the potential for scalability means that the benefits of this system can extend beyond mangoes to other agricultural products.

In a world where sustainability and efficiency in agriculture are paramount, this project sets a significant precedent. It not only transforms the mango industry but also showcases the potential of technology to revolutionize the assessment of agricultural products. It is a testament to how innovation can reduce food waste, enhance the consumer experience, and promote sustainable practices.

In sum, the project offers a bright future for mango producers and consumers. It harmonizes technology and agriculture to create a more predictable, efficient, and sustainable approach to mango quality assessment, setting a precedent for similar applications in the field.

REFERENCES

[1] Dameshwari Sahu, Ravindra Manohar Potdar. Defect Identification and Maturity Detection of Mango Fruits Using Image Analysis. American Journal of Artificial Intelligence. Vol. 1, No. 1, 2017, pp. 5-14.doi:10.11648/j.ajai.20170101.12.

[2] Nandi, Chandra & Tudu, Bipan & Koley, Chiranjib. (2014). A Machine Vision-Based Maturity Prediction System for Sorting of Harvested Mangoes. Instrumentation and Measurement, IEEE Transactions on. 63. 1722-1730. 10.1109/TIM.2014.2299527.

[3] Ganiron Jr, Tomas. (2014). Size Properties of Mangoes using Image Analysis. International Journal of Bio-Science and Bio-Technology. 6. 31-42. 10.14257/ijbsbt.2014.6.2.03.

[4] S. Poorani and P. G. Brindha, "Automatic detection of pomegranate fruits using K-mean clustering," Int. J. Adv. Res. Sci. Eng., vol. 3, no. 8, pp. 198–202, 2014.

[5] V. Pham and B. Lee, "An image segmentation approach for fruit defect detection using k-means clustering and graph-based algorithm," Vietnam J. Comput. Sci., vol. 2, no. 1, pp. 25–33, 2015.

[6] A.Rocha, D. C. Hauagge, J. Wainer, and S. Goldenstein, "Automatic fruit and vegetable classification from images," Comput. Electron. Agric., vol. 70, no. 1, pp. 96–104, 2010.

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