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Identification of Papaya Fruit Ripening Process Using AI

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Abstract

Identifying the ripening process of papaya fruit using artificial intelligence involves employing machine learning algorithms to analyze various features such as color changes, texture alterations, and chemical compositions. This model is capable of analyzing visual cues to determine the stage of ripeness. The dataset compares images of papaya at various ripening stages, and our artificial intelligence (AI) model demonstrated high accuracy in classifying these stages. Employing machine learning algorithms and image processing techniques, this project discerns the ripening stages of papaya fruit, distinguishing between natural and artificial ripening through analysis of color and texture features. Leveraging convolution neural network (CNN) and You Only Look Once (YOLO) models, our approach conducts visual cues analysis to ascertain ripeness stages. Comparative analysis of papaya images at varying ripening stages enriches our database. Demonstrating high accuracy, our AI model proficiently identifies these phases. This study pioneers AI methodologies for papaya ripening process identification, employing image processing and machine learning algorithms. It innovatively utilizes AI approaches to distinguish between artificially and naturally ripened papaya fruit. The implementation of this AI-based solution holds significant potential for enhancing efficiency and precision in the agricultural industry, facilitating optimal harvesting and post-harvest management practices for papaya farmers, ultimately leading to improved crop quality and reduced waste. The methodology involves the collection of various features such as color, texture, and seeds using image processing and machine learning algorithms. A dataset comprising images of both artificially and naturally ripened papayas will be used to train and validate the AI model. The developed system will contribute to ensuring the quality and safety of papaya fruits in the supply chain, addressing concerns related to artificially ripened fruits. The project aims to contribute to food safety and quality assurance by providing a non-invasive and efficient means of identifying the ripening process of papayas. The project involves the development of a machine learning model trained on a dataset comprising images of papaya fruit at different ripening stages.

Keywords: Artificial intelligence (AI), convolution neural network (CNN) model, YOLO model, image preprocessing, computer vision, OpenCV library

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INTRODUCTION

Currently, fruits are ripened using chemicals that harm human health. It is important to identify fruit ripeness because it helps to improve human health. People feel concerned about the safety and quality of what they eat, so it is vital to know how fruits ripen. The objective of our project was to use AI to identify the papaya ripening process and specifically solve this issue.

Structure of papayas. natural ripening in a natural setting causes papayas to undergo a gradual

ripening process in the tree. As the fruit matures, it changes color from green to yellow and its texture becomes softer. The fruit releases ethylene gas during the natural ripening process, which is controlled by temperature, sunlight, and other variables. Naturally ripened papayas may exhibit uneven yellow or green patches. Artificially ripened papayas tended to have a uniform yellow-orange color, indicating uneven ripening. When identifying a naturally ripened papaya by texture, inspection for a slight flex to the touch is required, especially in the area surrounding the stem end. The skin should yield slightly when gently pressed; however, it should not be mushy. Furthermore, may shift in color from green to yellow-orange color as it ripens naturally.

Artificially ripened papayas often have a uniformly softened texture with firm areas because they are typically ripened using chemicals such as calcium and carbide, which can result in uneven ripening. The system provides a better intelligent fruit and ripening detection approach based on multitasking cascaded convolutional neural network (CNN). This approach has the potential to enable the highly accurate real-time operation of automated robots. This study proposes an effective CNN method for fruit and ripening detection. Fruit detection was accomplished by training the fruit data in the simulation. The precision of fruit identification can also be demonstrated by plotting it using a program called Matplotlib [1].

The process of sorting papaya fruit is a challenge that arises after harvest. The quality sorting process is still performed manually or conventionally by humans. It undoubtedly has flaws and restrictions that call for a sizable labor force, and opinions on the standard of papaya vary among people. Thus, an Artificial Neural Network (ANN) approach is suggested in this review to identify the standard of papaya fruit based on laboratory color and texture data [2].

Fruit Ripeness Assertion Using Deep Learning

This research presents an assessment that Everyone's health is their priority in this pandemic-prone era, thus eating fruits of high quality is crucial to good health. Unfortunately, the accessibility of chemically ripened fruits by dangerous chemicals such as calcium carbide makes it quite difficult to obtain organically ripened fruits. A modern organization for chemical-ripening contamination detection is provided to address these problems. It uses both visible and infrared spectrometric fingerprints in two distinct stages [4].

Fruit Ripening is intimately associated with ethylene content in the fruit. The physical changes may be changes in color, size, texture, shape, etc. Identifying the ripening stage using changes in chemical properties requires the use of destructive methods of measurement but provides more accurate results, whereas changes in physical properties can be measured using non-destructive methods. However, the drawback of using changes in physical properties is that they provide less accurate measurements compared to changes in chemical properties. However, the advantage is that measuring changes in physical properties is easy and time-efficient compared to measuring changes in chemical properties [5].

Effective methods for image processing are involved in this study, and AI models such as CNN and You Only Look Once (YOLO) are used to ascertain the ripening process of papaya fruit. The AI model uses color and texture data to identify whether a papaya fruit is naturally or artificially ripened. In addition, it predicts the accuracy of the papaya fruit [6–9].

RESEARCH METHODOLOGY

Image Acquisition

Papaya fruit images were gathered from the dataset by a processionist. The AI system uses images acquired using image acquisition techniques such as computer vision to obtain photographs of papaya at different stages of ripening. It must be converted into a digital format. This transforms the RGB color channel into a Hue, Saturation, and Value (HSV) channel (Figure 1).

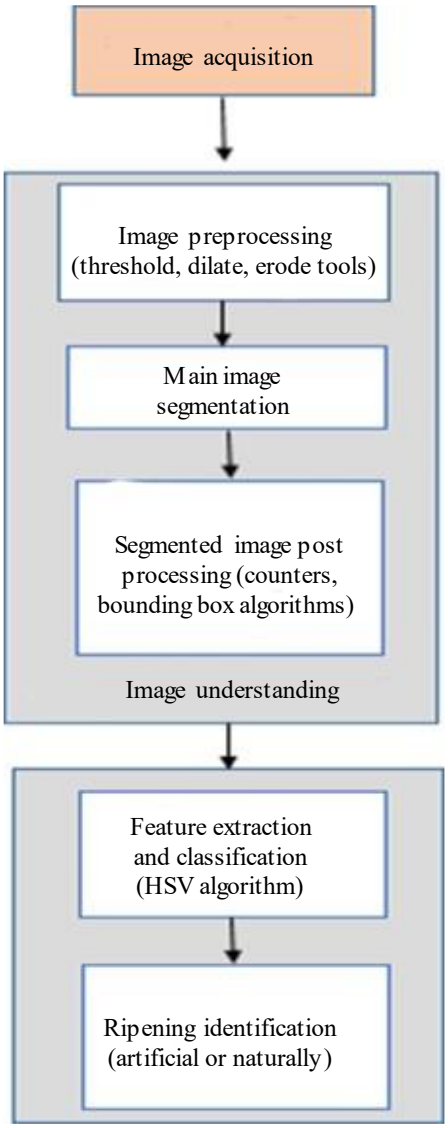

Figure 1. Architecture diagram obtain photographs of papaya at different stages of ripening.

Image Preprocessing

Following Acquisition, preprocessing techniques are utilized to improve the image quality, eliminate noise, and standardize the color. Threshold, dilation, and erosion image preparation techniques were used. A pre-algorithm, such as HSV, is used once the images have been processed to access color variations during ripening. Utilizing these characteristics, an AI classification model was trained to distinguish between artificial and natural ripening by inspecting color patterns. OpenCV software segments a region of interest, which entails transforming an image into intensity binary pixels. These categories are created beneficially for combining neighboring pixels, and improving their characteristics increases them. However, erosion shrinks regions, lowers noise, and focuses on regions that have been found [10–17].

Image Segmentation

Image segmentation is performed using bounding box algorithms and contours. To identify the papaya fruit ripening process using AI, contours, and bounding box algorithms are essential components of image segmentation. By sorting out specific regions of the images, these methods facilitate the examination of color shifts and other ability indicators. When utilized with AI models, they improve the accuracy of determining the various stages of papaya fruit ripening [18].

Segmented Image Post-processing

For image post-processing, the put text and draw rectangle techniques were used. This algorithm is probably a component of the localization and annotation of images used in the AI-based papaya ripening process identification. To visually mark or define specific regions in images of papaya fruit to identify areas related to natural or artificial ripening processes, this algorithm probably finds important features or regions in the images associated with the ripening process and annotates them with text labels [20].

Feature Extraction and Classification

Preprocessing color detection images for feature extraction, Once the images are obtained, color changes during ripening are examined using a pre-algorithm such as HSV. These characteristics can be used to train an AI classification model that enables it to distinguish between artificial and natural ripening based on color patterns.

CNN Model

Using images of papaya fruits at various stages of ripening, a model was trained to establish the ripening process of papaya fruit. The CNN model collected information from these images in the form of features. This was used to categorize the new images into various ripening stages. Usually, the procedure entails gathering a dataset of images of papaya fruit, classifying the images derived from their level of ripeness, dividing the dataset into training and testing sets, and then training the CNN model using the training set. After training, the model can be studied on a real dataset to assess how accurately it can identify the ripening stage of papaya fruit either naturally or artificially ripened [21–29].

YOLO Model

The method used to determine the ripening process of papaya fruit was similar to that of CNN. On the other hand, YOLO is an object detection method that takes advantage of using bounding boxes to localize several objects including papaya fruits that are detected in the image sequentially (Figures 2 and 3].

RESULT AND DISCUSSION

Objects including papaya fruits that are detected in the image sequentially

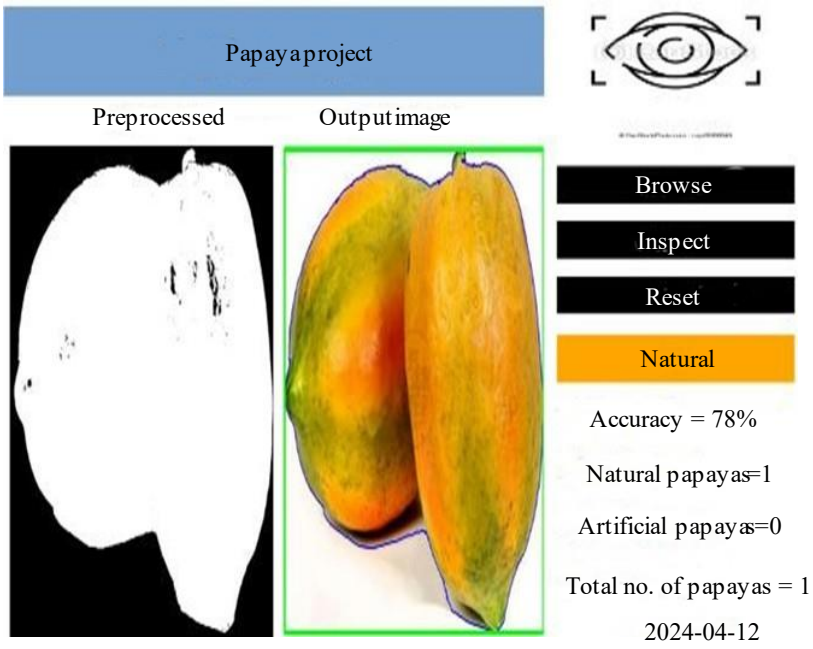

Figure 2. Natural ripened papaya.

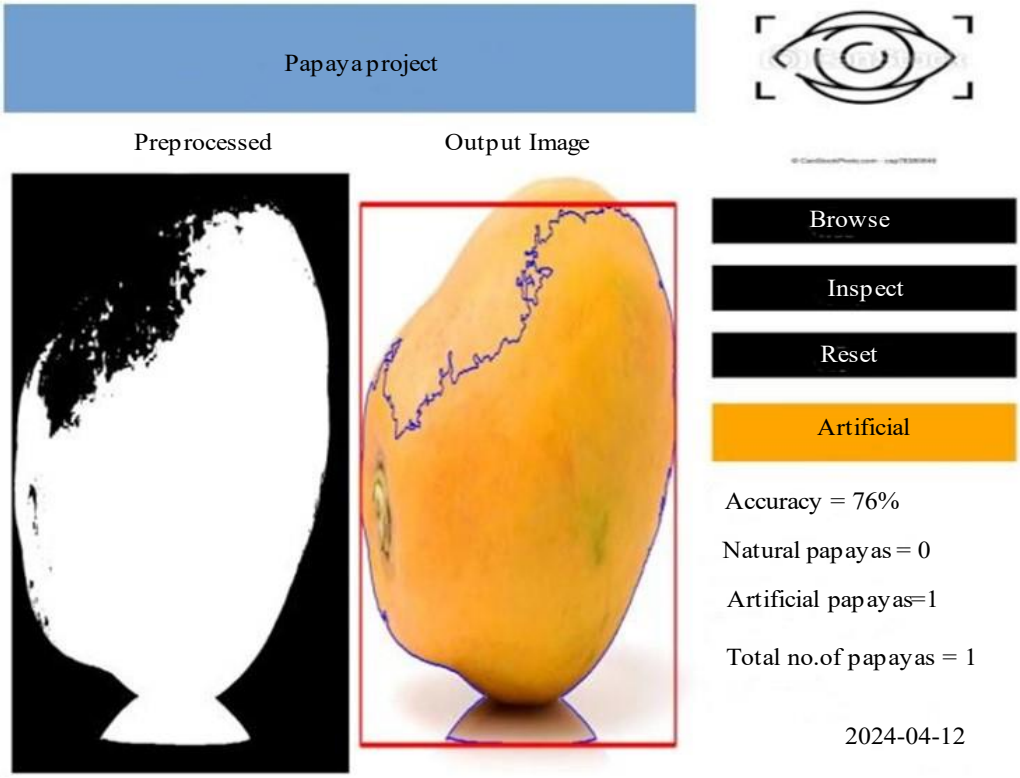

Figure 3. Papaya fruits that are detected in the image sequentially.

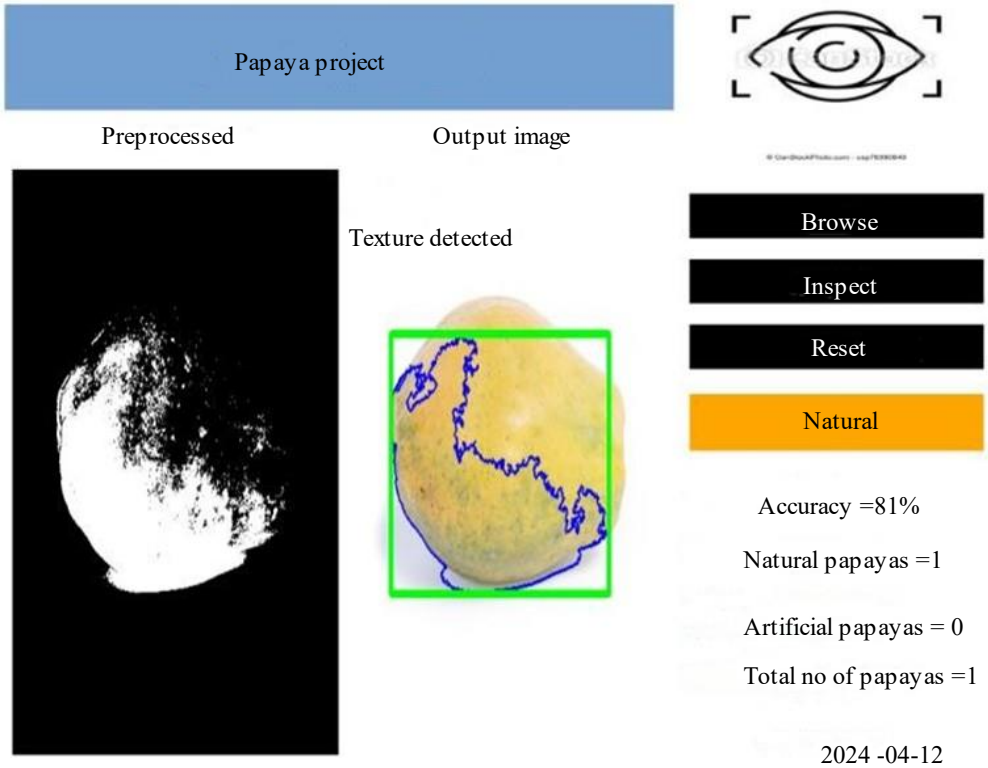

Figure 4. Texture detected papaya.

The YOLO model analyzed the papaya fruit's natural ripening phase with the best accuracy of 97% better than the CNN model (Figures 4, 5).

In the artificial ripening process of papaya fruit, the CNN model outperformed the YOLO model with an accuracy of 95%.

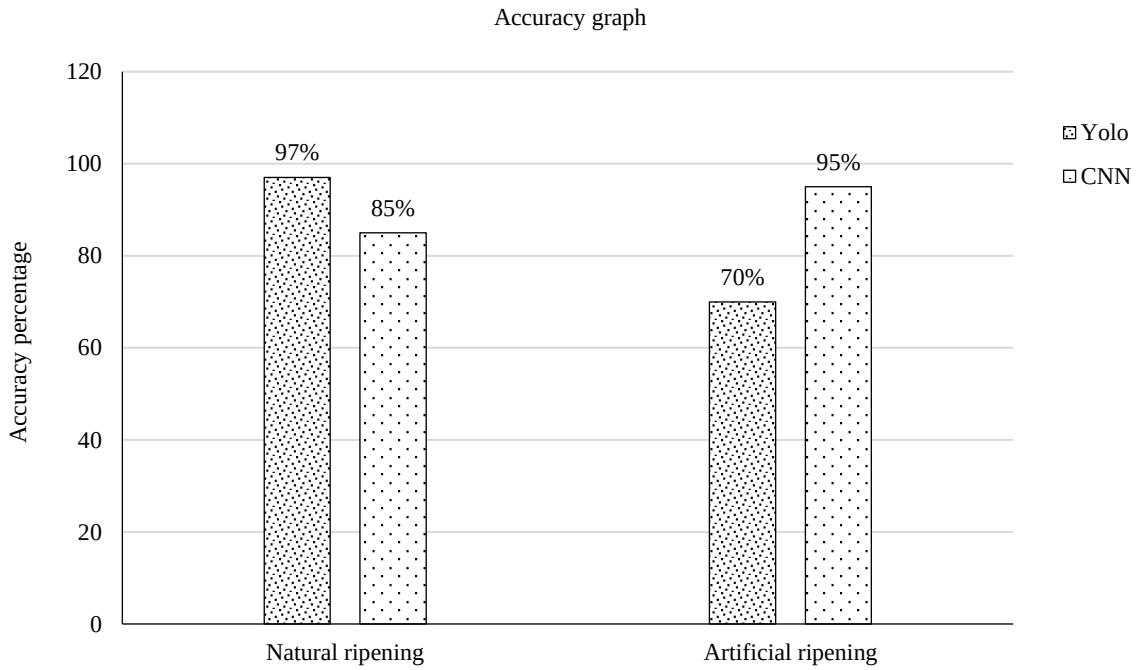

Figure 5. Accuracy graph.

CONCLUSION

Developing a comprehensive and reliable AI system for detecting papaya ripening by implementing these models. In addition to ensuring quality assessments, this method provides consumers with the information they need to choose the fruits they buy carefully.

Using AI models, such as CNN and YOLO, to distinguish between the stages of papaya fruit ripening is successful in accurately predicting the ripeness of the fruit. The YOLO model recognizes papayas that are naturally ripened, with a higher level of accuracy (97%). The CNN model predicted the artificial ripening stage of papaya fruit with an accuracy of 95%. It can more accurately determine whether papaya ripening occurs naturally or artificially using machine learning algorithms and image processing techniques.

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