



A STUDY ON NOVEL FRAMEWORK FOR DETECTING CHEMICALLY RIPENED MANGO FRUITS

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ABSTRACT

Computer vision systems are now commonly utilised for identifying, classifying, and grading various types of fruits. For mango fruit classification and maturity detection, existing research focuses on characteristics such as fruit size, colour, shape, and texture. Though much work is put into identifying, maturing, and detecting defects in mango using colour cues, there are few attempts made in the direction of identifying artificially ripened mango fruits. In contrast, just a few attempts have been made to delve deeper into the colour characteristics of the fruits. To address these challenges, this study provides a novel framework based on MPEG-7 colour descriptors for detecting fake ripening of mango fruit. The proposed scheme consists of three stages: first, image pre-processing, which includes masking, filtering, segmenting, and cropping; second, dominant colour extraction using dominant colour descriptors, which is then mapped with the help of clustering to identify the artificial ripening of mango fruit; and finally, dominant colour extraction using dominant colour descriptors, which is finally mapped with the help of clustering to identify the artificial ripening of mango fruit. Experiments were conducted on two separate datasets including four different varieties of mangoes, demonstrating the suggested method's robustness and efficiency in comparison to existing approaches.

KEYWORDS: Dominant Colours, Artificial Ripening, Computer Vision, Image Processing.

1. INTRODUCTION:

Known as "king of fruits" for its nutritional content, flavour, scent, and health benefits, mango is the national fruit of India. mangoes are produced in 2263 thousand hectares of land in India, where they produce roughly 19.687 million tonnes of fruit each year, resulting in an average of 8.7 MT/ha of fruit per hectare. As a tropical fruit, mango is one of the most widely consumed fruits in the world because of its rich, exotic flavour and delightful taste. Minerals, vitamins, fats, and proteins are all present in significant amounts (a total of 15.1 mg of vitamin C per 100 grammes). Mango's total sugar content is said to be between 10% and 17% sucrose, depending on the cultivar. Mango is a seasonal fruit that is often harvested in April, when the weather is hot and humid, and then allowed to fully ripen. A biological process known as maturation occurs over a long period of time and results in a fruit that is delicious, edible, and helpful. Most countries use artificial ripening chemicals to ripen mangoes, which is a highly nutritious fruit. Despite the fact that the PFA Act of 1955 forbids the use of calcium carbide, self-ish dealers continue to secretly employ this harmful chemical for a variety of reasons, including its low cost and ease of availability.

2. LITERATURE REVIEW:

For fruit sorting and recognition, colour features have been used in the literature to use colour characteristics for grading, defect identification, and maturation detection from the image. G Feng and C Qixin explain one such case of fruit sorting using an intelligent fruit categorization framework based on hue image processing. The fruit component of the image is segmented using the OHTA colour space, and blob abstraction is used to discover the fruit curve before calculating the hue percentage. For feature categorization, the HSI colour space was utilised, which has a number of disadvantages.

According to, part of the pod portion can be removed from the photograph to get the proper colour characteristic values for the fruit. KNN is used to classify the fruit based on the mean of the colour from the RGB components, as well as the fruit's size, area, circumference, and diameter. A major drawback of the method was the amount of time it took to calculate geometrical properties.

In, Li, Cao, and Guo presented a new approach for fruit classification based on the most prominent colour histogram match. Segmentation is done by using photos of fruits. In the OHTA colour space, an algorithm is proposed for extracting the image of the pod from the background. Color histogram matching is used to determine the hue of a given colour. Despite its excellent accuracy (up to 97.2%), the experiment struggles to match the time-sensitive demands of real-time software. There is another method for ranking fruits based on their colour, which is termed Direct Hue Plotting. The proposed method employs pre-selected standards to generate a unique set of colour space transition constants. One major problem to using a three-dimensional RGB hue space is that it is reduced to just a small set of colour guides. The proposed method estimates the date and maturity of the tomato, as well as the presence of surface flaws.

An innate and stable fault identification and maturity unveiling framework employing image processing techniques has been proposed in. Based on photos of mango fruit alone, algorithms are developed to identify defects and maturity detection. The quality ratio of mango fruits is used to categorise them into two

types. The fruit is rotten if the quality ratio value exceeds the given ceiling value. Fruit tastes better if the quality-to-price ratio is lower than the predetermined ceiling value. Handling large amounts of data was a serious drawback.

The Dominant Color Descriptor (DCD) for MPEG-7 was proposed by L. Cieplinski in and provides an efficient representation of the typical colours in an image or image portion. Similarity searches in picture databases and image browsing using colour values, whether multiple or specific, are two of its primary use cases.. Instead of being stuck in the colour space, as is the case with traditional histogram descriptors, the delegate colours are derived from each individual image, allowing for a more exact and efficient colour depiction.

Because colour is a crucial artistic element for both human eye and computer processing, establishing a framework to detect naturally and artificially ripened mangoes relies heavily on DCD. Beyond the normative components of the specification, it provides an efficient extraction and matching technique.

Recently, Swati K and Vijay W in proposed an artificial ripening detection approach using MATLAB. Grey level co-occurrence matrices are then utilised to measure and detect pixel intensity fluctuation using the process of segmentation and spatial domain feature extraction. Using mango photos as input, S Maheswaran et al. developed a system that can detect artificially ripened fruits by comparing their histogram feature values to those of naturally ripened fruits. This technique makes advantage of Android-powered cellphones.

3. MOTIVATION AND CONTRIBUTIONS:

Color-based detection of mango fruit maturity and defects has garnered great attention, but not artificial ripening. Mangoes that have been artificially ripened appear darker in colour. This study presents a new computer vision-based method for distinguishing organic from artificially ripened mangoes. This study uses DFI and an algorithm to classify naturally and artificially ripened mangos.

4. PROPOSED FRAMEWORK:

Fig. 1 shows image pre-processing, dominant colour extraction, and feature extraction. Preprocessing images includes masking, filtering, segmentation, and cropping. In section 4.1, a DFI is created for each image taken, identifying the dominant colours. In the third stage, cluster comparison determines whether an image's ripeness is natural or fake.

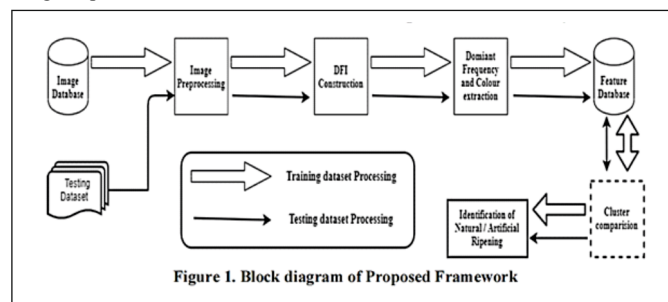


Figure 1. Block diagram of Proposed Framework

The DFI's structure will determine the image's prominent frequencies. From the improved version of the technique, exact dominating colours in terms of RGB values will be generated. This is an iterative process that yields primary, secondary, and tertiary dominant colours.

5. RESULTS AND DISCUSSION:

5.1. Experimental Setup:

A dataset of mango fruit pictures is developed for both training and testing purposes. 60 mangoes altogether, four varieties: Alphonso, Badam, Mallika, and Neelam. An artificially ripened batch of mangoes is left to ripen naturally while the natural batch is left to ripen. The photographs of the mangos were taken with a Canon Powershot. Fig.2 displays some sample mango images taken from various angles (vertical/horizontal, top/side/front). About 950 fruit photographs are prepared for the training and testing datasets. The NRM and ARM data sets are labelled separately. The framework was built on an Intel 4th generation i5 CPU running at 1.7GHz, 64bit Windows OS, 8GB RAM, and MATLAB version 9.



Figure 2. Sample snapshots of mango images (vertical / horizontal axis, top / side / front views.)

5.2 Experimental Results and Discussions:

A sample image's dominant colour feature values are analysed to determine if it is naturally or artificially ripened (section 4.1). 3. Primary, Secondary, and Tertiary Dominant Colour Variations in NRM and ARM Fruit Photos from the Training Dataset Natural ripened fruit has a dominant colour of 140-205, while fake ripened fruit has a dominant colour of 210-245. The secondary and tertiary dominant colours in both natural and artificial pictures vary greatly.

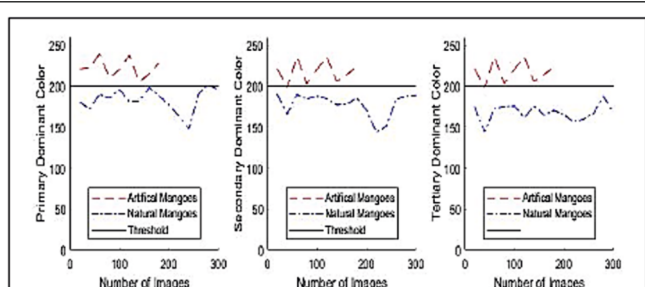


Figure 3. Primary, Secondary and Tertiary Dominant colour variations of training dataset including NRM and ARM images.

Color variations of natural and artificially ripened fruits are seen in Table 2. 183 for naturally ripened fruit and 222 for artificially ripened fruit. As you can see, the other two main colours have significant variance.

Table 2. Primary, Secondary and Tertiary Dominant colour values of training dataset.

	Primary Dominant Colour					Secondary Dominant Colour					Tertiary Dominant colour				
	Min	Mean	Max	AVG	SD	Min	Mean	Max	AVG	SD	Min	Mean	Max	AVG	SD
NRM	66	183	248	0.24	0.05	69	178	240	0.17	0.03	64	168	224	0.13	0.02
ARM	123	222	255	0.18	0.04	110	217	255	0.15	0.03	123	211	255	0.11	0.01

Fig. 4 depicts the testing dataset's differences between fruit images in primary, secondary, and tertiary dominating colours. On average, natural ripeness is 150-200, while artificial ripeness is 205-225. The NRM and ARM photographs have distinct secondary and tertiary colours. The readings for naturally matured and artificially matured mangoes, respectively, fall below and over the threshold line.

As shown in Table 3, the natural and artificially ripened mango fruits have a minimum, mean, maximum, average, and standard deviation. Compared to artificially ripened mango, organically ripened mango has a mean dominant colour of 154. These two datasets have very different mean values. Secondary and tertiary dominant colours' mean, average, and standard deviation vary greatly between tables.

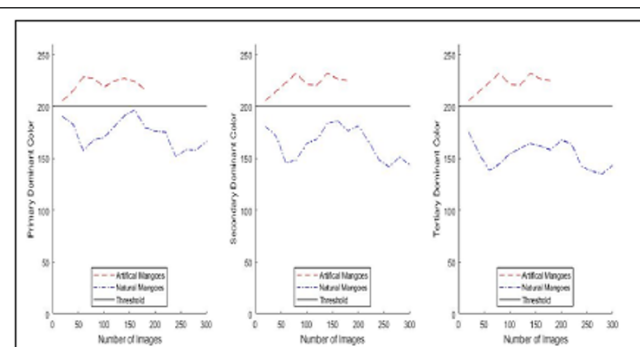


Figure 4. Primary, Secondary and Tertiary Dominant colour variations of testing dataset including NRM and ARM images.

Table 3. Primary, Secondary and Tertiary Dominant colour values of testing dataset.

	Primary Dominant Colour					Secondary Dominant Colour					Tertiary Dominant colour				
	Min	Mean	Max	AVG	SD	Min	Mean	Max	AVG	SD	Min	Mean	Max	AVG	SD
NRM	71	154	224	0.23	0.05	64	166	215	0.13	0.02	73	175	215	0.12	0.02
ARM	123	214	255	0.21	0.04	180	225	254	0.11	0.01	193	225	251	0.12	0.02

It uses a formula to calculate each color's normalised distance (1). For main, secondary, and tertiary dominant colours, the training dataset gave normalised distance values. For ripeness, the major prevailing colour is more likely to be greater in normalised value for natural and lower for artificial, the study found.

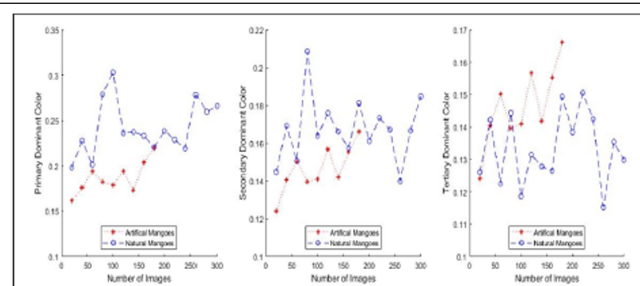


Figure 5. Distance graphs of primary, secondary and tertiary dominant colours for NRM and ARM of training dataset.

Fig.6 shows the normalised distance graphs for the dominant primary, secondary, and tertiary hues. On a normalised distance scale, NRM's major dominating colour is 0.19-0.27, while that of ARM is 0.21-3.

To determine if an image has been naturally or artificially ripened, a cluster of the primary colours' mean values will be employed. Fig. 7 compares natural and artificially ripened photographs. On cluster 4, NRM images are detected, while ARM images are found. Only a few photographs will fall into both clusters for testing. The identical cluster mapping can be observed in the training dataset.

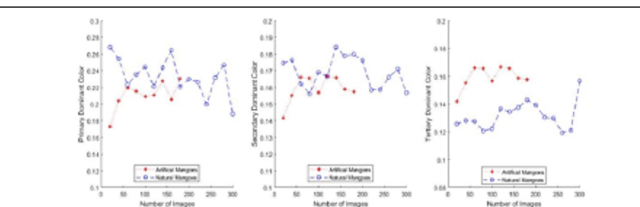


Figure 6. Normalized distance values of primary, secondary and tertiary dominant colours for NRM and ARM images of testing dataset are specified.

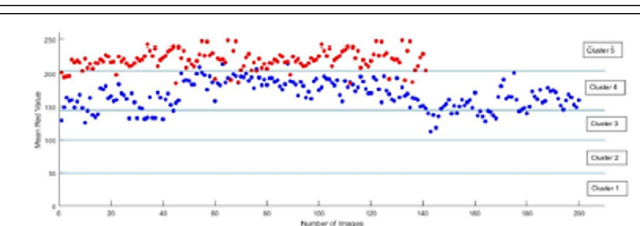


Figure 7. Cluster mapping for NRM and ARM images of testing datasets.

The recommended technique can produce outstanding results (85.17 percent precise). Figure 8 shows a screenshot of the GUI for a specific test image. For the intended outcome, the user must first select an image from a saved dataset. Cropped and masked images created for an input image are included in the output. Now a sample image can be classified as naturally ripened or artificially ripened.

matlabcentral/fileexchange/28164-color-frequency-image.MATLABCentral File Exchange.

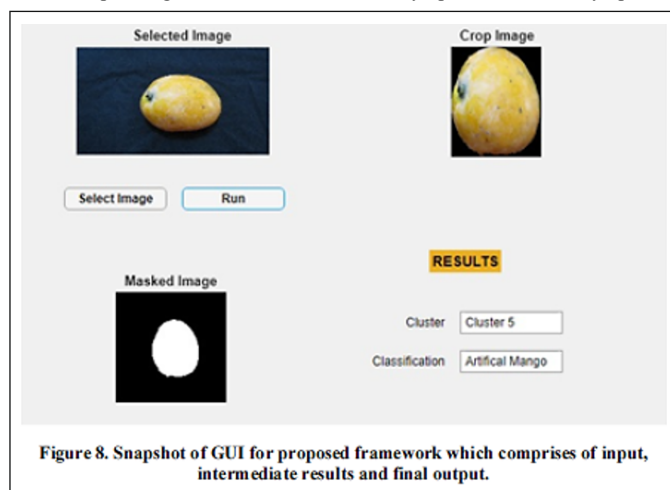


Figure 8. Snapshot of GUI for proposed framework which comprises of input, intermediate results and final output.

6. CONCLUSION:

It is critical to know whether mangoes are naturally or artificially ripened because they are one of India's most beloved climatic fruits. An artificially ripened mango can be identified by looking for strong colour traits defined in MPEG-7. This is the primary subject of the proposed article. This can be widened to include different types of mangos.

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