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Submission title:	Feature Extraction for Quality Mod…
File name:	ICISPC.pdf
File size:	860.25K
Page count:	5
Word count:	3,466
Character count:	18,179
Submission date:	14-Jan-2019 06:30PM (UTC-0800)
Submission ID:	1064221841

2018 2nd International Conference on Imaging, Signal Processing and Communication

Feature Extraction for Quality Modeling of Malang Oranges on an Automatic Fruit Sorting System

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***Abstract*—This paper evaluated some of the machine vision techniques to extract fruits characteristic, which in this case is Malang oranges. Appropriate algorithms are developed and implemented to extract features from local fruit based on Indonesian National Standard (SNI 3165: 2009) which is concerning to oranges. The research is done by analyzing fruit images, extracting HSV parameters and extracting feature using contour detection, hull convex and RGB histogram. A sensing machine which is consists of a photo box with a camera and a conveyor has been developed. The detection process can be done in real-time with the help of boxes equipped with adequate lighting. Convex hull analysis can be used to determine the diameter that has a great effect on the citrus fruit classification. While the red-green ratio can be used to label citrus fruits so that it can be used on a gradation-based fruit sorting machine. The performance was evaluated in terms of measurement accuracy which is above 88%. The research has the potential to be improved with the addition of an artificial intelligence-based decision system.**

Keywords-contour detection; hull convex; RGB histogram; red-green ratio

I. INTRODUCTION

Tangerine or mandarin orange (Citrus reticulate) is one type of orange that has long been known and cultivated by people in Asia, especially in Indonesia. Besides being a commodity trading in the country, the fruit is also traded in the international market. Indonesia is one of the producers of orange which has big enough potency to fulfill consumer demand inside and outside the country. The center of tangerine production is now mostly found in East Java especially in Malang area. Given its natural resources, this area has the advantage to produce export-quality oranges. To improve the quality in order to compete in the domestic and international market, it is necessary to have a quality standard that can be applied by Indonesian farmers and acceptable by the international market. Indonesian National Standard (SNI 3165: 2009), concerning Tangerines is formulated by the Technical Committee 65-03 of the Ministry of Agriculture Republic of Indonesia as an effort to produce citrus which has the qualities according to market demand [1].

Currently, Indonesia is the second largest citrus importer country in ASEAN after Malaysia especially sweet oranges, with an average import volume per year reaching 25,408 tons or equivalent to US $ 17,464,186 per year. As for the type of tangerine, it reached about 100,813 tons per year with a value reaching US $ 80,569,300 [2]. Not surprisingly, many imported oranges are found in almost all supermarkets including small traders. What is very sad is that imported oranges are laid out and better placed than national oranges. It seems that consumers are also less fond of their own oranges products because the quality is still inferior to imported oranges. The tendency to increase the import of citrus varieties indicates the existence of certain market segments (consumers) who want the type and quality of prime fruit that cannot be fulfilled by domestic producers. To supply these needs, import policy is opened, mostly from Australia, China and Pakistan. Actually, the condition of the oranges is not fresher than local oranges because it has been stored in cold storage for 6 months - 1 year.

Increased import of oranges can actually be a market opportunity as well as national oranges development opportunities along with increasing consumer preferences for good quality fruits. Opportunities to develop oranges cannot be separated from the national potential, such as the number of oranges production centers, the high diversity of citrus genetic resources, the availability of high quality national orange varieties including seeds, technology, and local market itself. It means that the national oranges have the opportunity to replace the existence of imported oranges as long as the government, citrus agribusiness and entrepreneurs have a high commitment to support the development of this national program. Therefore, the Indonesian government launched a strategic step "Sustainable National Oranges Development Program" which is systematically arranged, comprehensively and involves several institutions including policy makers.

To support the national oranges development movement, there needs to be technology development in line with the increase of production capability. Post-harvest processing and packaging technology is needed to accelerate and synchronize processes that are currently still done conventionally with human assistance. The quality of oranges can be seen from the diameter, shape and also the color of the fruit skin [3]. The camera is used as a visual sensing to detect the characteristics of fruits. By equating the patterns that have been compiled in SNI 3165: 2009, a sensing system was created to model the fruit quality sorter

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