RIPE TOMATO DETECTION AND GRADING SYSTEM USING IMAGE PROCESSING TECHNIQUES

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Computer Engineering Technology (Computer System) with Honours.

by

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Date: 12 FEB 2021

APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Computer Engineering Technology (Computer System) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Pada masa ini kualiti makanan menjadi masalah besar dalam pertanian. Adalah sukar dan memakan banyak masa untuk mencari kualiti makanan terbaik oleh orang di pasaran secara manual. Kematangan buah yang tidak mencukupi juga menjadi masalah utama. Untuk sistem yang dicadangkan ini, sebiji tomato telah dijadikan produk yang akan diuji untuk kualiti makanan. Oleh itu, adalah perlu untuk mengenali corak yang sesuai untuk menentukan kematangan buahnya. Salah satu corak pengenalan gambar tomato adalah dengan menggunakan algoritma pengesanan warna. Projek ini menjelaskan teknik untuk mengesan permukaan kulit tomato secara automatik dalam gambar warna digital dan menentukan ukuran tomato berdasarkan gambar binary yang diperoleh. Sistem ini menerangkan proses dua langkah, yang pertama mengesan kawasan yang cenderung mengandungi kulit tomato dalam gambar berwarna, dan kemudian mengekstrak maklumat dari kawasan ini yang mungkin menunjukkan lokasi tomato dalam gambar. Gambar yang telah diproses mesti digunakan dalam peratusan nilai warna untuk mengelaskan kematangan tomato itu. Ukuran gambar tomato akan ditentukan untuk mendapatkan gred tomato. Perisian MATLAB dan kotak alat pemprosesan gambarnya telah digunakan dalam pemprosesan dan analisis gambar. Hasilnya, muka Pengguna Grafik (GUI) untuk pengesanan kematangan tomato dan penilaian sistem tomato dengan menggunakan MATLAB R2020b telah dimajukan. Untuk cadangan masa depan sistem ini dapat ditingkatkan dengan menambahkan banyak jenis sayur-sayuran dan buah-buahan yang lain.

ABSTRACT

Nowadays the food quality grading and classification is become a big issue in agriculture. It is difficult and consume too much time to manually find the best food quality by people in the market. Insufficient maturity of the fruit is the main problem too. For this proposed system, a tomato is used as the product to be tested for food quality. Therefore, it is necessary to recognize the appropriate pattern to determine the ripeness of the fruit. One of the recognition patterns of tomatoes image is by using color detection algorithm. This paper explained the technique for the automatic detection of skin surfaces of tomatoes in digital color images and determine the size of tomato based on the binary image. The system describes a two-step process, the first of which detects regions that are likely to contain tomato skin in color images, and then extracts information from these regions that might indicate the location of the tomato in the image. The image that has been processes must use in percentages value of color in order to classify the ripeness of tomatoes. The size of tomato image will be determined to get a grade of tomato. MATLAB software and its image processing toolbox is used in images processing and analysis. A Graphical User Interface (GUI) for ripeness tomato detection and grading system by using MATLAB R2020b is developed. For future recommendation, this system can be upgraded by adding other types of vegetables and fruits.

DEDICATION

I would like to dedicate this thesis to my beloved parents and my supervisor and co-supervisor for assisting me in completing this thesis. I also dedicate this work to each one of my fellow friends. May Allah bless them.

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First and foremost, all praise to Allah for His mercy that this thesis can be completed on time. I am thankful to my supervisor, Mr. Shamsul Fakhar bin Abd Gani for his advice and guidance from beginning until I can complete my project. To my beloved parents, I offer them my deepest gratitude for all their prayers and support. Lastly, I offer my regards and blessings to my housemate and classmate who always supported me in any aspects during the completion of this project.

Thank You

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LIST OF SYMBOLS

D, d	-	Diameter
F	-	Force
g	-	Gravity = 9.81 m/s
I	-	Moment of inertia
1	-	Length
m	-	Mass
N	-	Rotational velocity
P	-	Pressure
Q	-	Volumetric flow-rate
r	-	Radius
T	-	Torque
Re	-	Reynold number
V	-	Velocity
w	-	Angular velocity
x	-	Displacement
z	-	Height
q	-	Angle

LIST OF ABBREVIATIONS

GUI	Graphical User Interface
HSV	Hue, Saturation, Value
GLCM	Gray Level Concurrence Matrix

CHAPTER 1

INTRODUCTION

1.1 Background

Tomato is a famous grown fruit/vegetable, and is usually loved by consumers around the world thanks to its distinctive flavour, health-promoting properties and rich nutritional content. Engineering has been widely employed in variety of fields, like manufacturing equipment and industrial applications, control the traffic and agriculture. the rationale for agricultural automation is that the reduction of workforce; therefore, robotic harvesting has become popular within the automation of agriculture (Wu *et al.*, 2019).

As indicated by (FAOSTAT, 2019), Global creation of tomatoes added up to 170.8 million tons, with China as the main manufacturer representing in excess of 31 percent of absolute creation. The post-collect system is basic in huge scope creation since tomatoes are fragile foods grown from the ground transitory plant. The figure 1.1 underneath shows the insights of creation/yield amounts of tomatoes in world.

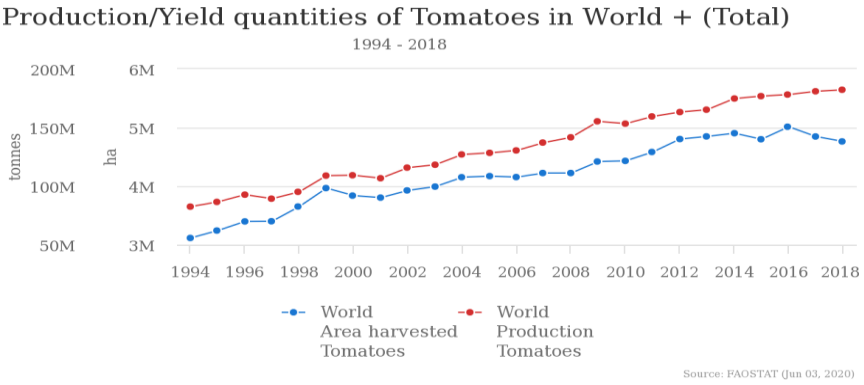

Figure 1.1: Production/Yield quantities of Tomatoes in World + (Total) from 1994 to 2018

EU (2011) guidelines identifying with handled products of the soil, the base necessity is that tomatoes ought to show up is new, flawless, liberated from weakening, liberated from breaks and liberated from harm and should be in an acceptable condition at goal. The acknowledgment of these attributes subsequently assists with clinging to the concurred advertise norms. A few compound and physical parameters influence the consistency of the leafy foods utilized for arranging and evaluating tomatoes subsequent to collecting, for example, size (huge and little), roundabout or oval shape, blemishes and readiness or shading (Ireri *et al.*, 2019).

Furnished with picture preparing methods, machine vision systems permit fast, simple and modest distinguishing proof of value parameters (size, shading, development and deformities). These strategies are non-damaging and PC driven, which will permit to perform simpler and high achievement levels contrast with manual or visual quality controls. Notwithstanding the solidness, surface, development estimation with non-ruinous strategies, there is an expanding enthusiasm for size and shape assurance (Uluisik, Yildiz and Ozdemir, 2018).

Computer vision and picture handling strategies have been found progressively valuable in the natural item industry, particularly for applications in quality assessment and imperfection arranging applications. The natural product created in the homestead is arranged by cost, and afterward moved to various standard markets at various detachments. Tomato is the world's biggest harvest and known as a protected food both due to its one of a kind nutritive worth and furthermore due to its wide spread creation (Arakeri and Lakshmana, 2016).

1.2 Problem Statement

Tomato creation is related with high work costs. Simultaneously, late manual work brings about corruption and inappropriate taking care of during culling may influence the vehicle and protection of tomatoes (Wu *et al.*, 2019).

Various chemical and physical parameters affect the quality of the fruit and Tomatoes were used for sorting and grading during post-harvest Such as size (large and small), circular or oblong shape, flaws and Readiness or colour (Ireri *et al.*, 2019).

The issue in natural product advertising is their market quality with lacking development, now and then they 're over-aged and spoiled, once in a while they're unripe. This turns into an issue especially for natural products/vegetables that have been sent or are to be traded to a removed area. This issue additionally happens because of deficient gathering time; when collected, the condition of readiness of the natural products isn't satisfactory or even overripe. (Taofik *et al.*, 2018).

1.3 Objectives

The goals for this project are shown below:

1) To identify the ripeness of tomatoes using computer vision system. (Hu *et al.*, 2019)
2) To analyze the performance of the developed system.