CHILI GRADING SYSTEM USING ANN APPROACH

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DECLARATION

I acknowledge that this Bachelor's Degree Thesis is the result of my own efforts and work, except for quotations, excepts, equations references and summaries, each of which I have explained the source.

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ABSTRACT

New safe and quick methods for grading of fruits has become more potential and important to many areas. It is because the quality of fruit turns out to be an important factor for the consumer and it essential for marketing high uniform quality produce. At the present time, traditional grading methods still be use in Malaysia which is using the manual grading method that consumes more time. This problem can be solved if farmers change the way of method to the modern view which is using new technology that has been introduced by Federal Agricultural Marketing Authority (FAMA) and Ministry of Agriculture and Food Industries (MAFI). Recently, enterprises inclined to the grading system for increasing the working capacity and decreasing of working cost. The inconsistency associated with manual grading method is decrease when the grading system are used. The objective of study is to study the effectiveness of chili grading system. In this study, chili grading system by size and color texture using the image processing and artificial neural network techniques were studied. Not only that, in this research is to conduct a study to investigate the best method for chili grading. The assembled system has achieved research but it needs to be analyzed further.

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ABSTRAK

SISTEM PENGGREDAN CILI MENGGUNAKAN PENDEKATAN ANN

Kaedah baru yang selamat dan cepat untuk penggredan buah-buahan telah menjadi lebih berpotensi dan penting kepada banyak bidang. Ini kerana kualiti buah ternyata menjadi faktor penting bagi pengguna dan ia juga penting dalam memasarkan hasil berkualiti tinggi yang seragam. Pada masa kini, kaedah penggredan tradisional masih digunakan di Malaysia iaitu menggunakan kaedah penggredan secara manual yang memakan masa yang lebih lama. Masalah ini boleh diatasi sekiranya petani mengubah cara kaedah kepada pandangan moden iaitu menggunakan teknologi baharu yang telah diperkenalkan oleh Lembaga Pemasaran Pertanian Persekutuan (FAMA) dan Kementerian Pertanian dan Industri Makanan (MAFI). Baru-baru ini, perusahaan cenderung akan kepada sistem penggredan untuk meningkatkan kapasiti kerja dan mengurangkan kos kerja. Ketidak konsisten yang dikaitkan dengan kaedah penggredan manual berkurangan apabila sistem penggredan digunakan. Objektif kajian adalah untuk mengkaji keberkesanan sistem penggredan cili. Dalam kajian ini, sistem penggredan cili mengikut saiz dan tekstur warna menggunakan pemprosesan imej dan teknik artificial neural network telah dikaji. Bukan itu sahaja, dalam penyelidikan ini adalah untuk menjalankan kajian untuk menyiasat kaedah terbaik untuk penggredan cili. Sistem yang dipasang telah mencapai penyelidikan tetapi ia perlu dianalisis dengan lebih lanjut.

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LIST OF ABBREVIATIONS

FAMA - Federal Agricultural Marketing Authority

ANN - Artificial Neural Network

CNN - Convolutional Neural Network

IC - International Color Unit

ASTA - American Spice Trade Association

GUI - Graphic User Interface

MSE - Mean Square Error

UI - User Interface

ML - Machine Learning

CHAPTER 1

INTRODUCTION

1.1 Chapter Overview

This chapter elaborate the problems, the approach and the project objectives. The chapter will be including of problem statement, proposed approach, project objectives and conclusions.

1.2 Problem Statement

While the technology is enhancing, many results was shown by using so many method and techniques. In Malaysia agriculture is one of the main sources to our country development and trade with other countries. Especially for fruits, many business sites demand for the fruit export from our country not only that, the local too, but because of the lack of labourers the process of grading is taking time. In order to produce the best quality of fruit, the automated fruit grading is necessary for fruits grading while to solve the lack of labourers and time.

1.3 Proposed Approach

For the approach, the project focus on how accurate the process of the grading is. The grading itself will be conduct base on the color of the product, size and the level of the ripeness of product by using the artificial neural network approach. Meanwhile, the project is to analyzing the accuracy and the performance of the grading process and analyze what the best result from the sample of grading. Developing graphic user interface to see the process of the grading.

1.4 Project Objectives

I. To conduct a study to investigate the best method for chili grading system.

II. To implement the grading system by using Artificial Neural Network technique into the prototype.

III. To evaluate the effectiveness and performance of the system on the chili grading system.

1.5 Conclusions

The conclusions are the ANN approach are proposed to be the best method and solution for the grading system. As for the result, accuracy and precision for the grading high unexpected.

CHAPTER 2

LITERATURE REVIEW

2.1 CHAPTER OVERVIEW

This chapter elaborate the techniques, existing machine and data, and comparisons between existing algorithm. The chapter will be including of area of concern, relevantliterature, comparisons of existing machine and comparisons of existing data and algorithm.

2.2 AREA OF CONCERN

Grading system play as an important role in agriculture and business because of the quality of a product that are dominant to the consumer and it is an essential for marketing that monotonous to the high-quality product. From the prolonged year the grading system has been establish to and upgraded to fulfil the demand of the fruits and vegetable processing.

Most of the agriculture product are nearly graded manually, that is so expensive and time consuming for the processing and the labors shortage may affecting the job for grading. Meanwhile, a grading system that is both cost-effective and reliable can be done using an automated grading system.

2.3 OVERALL TREND

Many journals and article have been reviewed and referred that regarding to my project topic which is the chili grading system using ANN approach. From the reviewed, there are several methods for grading system to grade fruits and vegetables. The most important method for grading the product is using the image processing method that is snapping and capturing the image of the product by using a high-end camera.

2.4 RELEVANT LITERATURE

In this section will describe the relevant literature that has been selected for researchcontent, two literatures have been selected as references which is the Azis et al. (2001), Dasharathraj et el.(2020) and K.Akila et el.(2019).

The GLCM matrix produced a number of derivative values, including contrast, energy, entropy, correlation, and homogeneity. The GLM stand for gray level co-occurrence matrix.

2.4.1 Computer visions

In journal of Dasharathraj et el.(2020) conducted their research in schematic computer vision for post-harvest quality grading of dry chilies. The researches have stated that any food product must be graded for quality before it can be sold. Visual and olfactory elements are both used to determine the quality of food products. Quality grading is largely concerned with the classification of food products based on a variety of quality characteristics. This concept is to ensure that each of the quality parameter values is graded using well-defined threshold limits. Therefore, the dried chili must be graded before posted to the market or anywhere to make sure the product is good.

As for the research process go on, a chili image is taken with the Thermal Camera, and the Alpha value is calculated. Based on the allowable value of Alpha, the chili is either accepted or refused. A nondestructive moisture study of chili quality can be performed using a thermal camera.

Then, the R-Value of RGB value is extracted from the 2D-Digital image of the chili that has passed the moisture content test. The IC (International Color Units)/ASTA (American Spice Trade Association) value is calculated in the same way. If the IC value is less than the specified IC value, it is sent to the rejected lot; otherwise, it is processed further. As the figure below show how the process is.
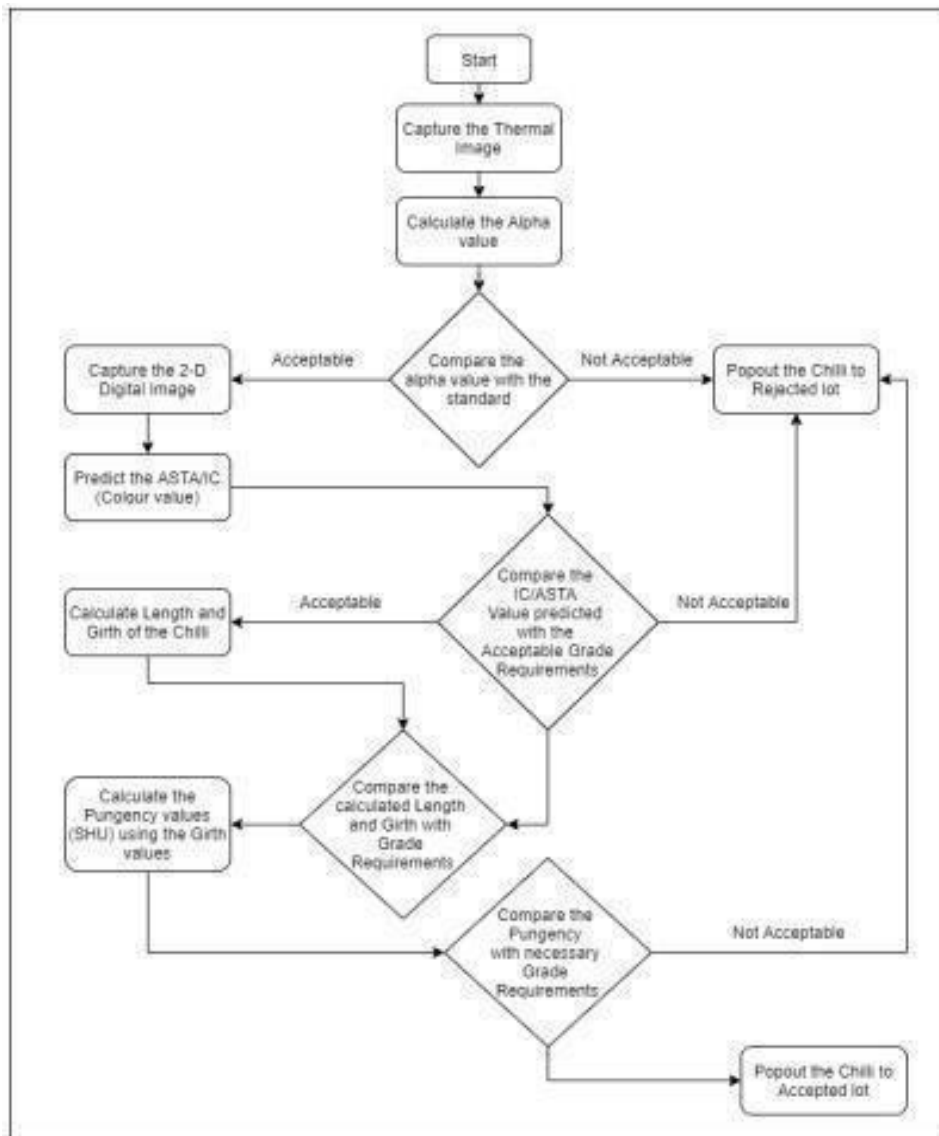
Figure 2.1: system architecture of computer vision source:

Dasharathraj et al.(2020)

The morphological aspects of chilis that meet the IC value requirements are retrieved using one of the methods given by Dasharathraj et al. If the Chili does not meet the requisite grade, it is sent to the rejected lot.

The Thickness of the Chili is used to evaluate the Chili based on Pungency once it passes the Morphological grade test. The chili is sent to the rejected lot if it does not meet the requisite Pungency grade; else, it is sent to the accepted lot. If a chili passes all of the tests, it has been rated on morphology, moisture, color, and pungency.

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2.4.2 Sorting techniques

The article of K.Akila et el.(2019) that have conducted in their research which is the mechatronics system design for automated chili segregation. In the research, the sorting system is a method of classifying chilis according to their maturity. The photos of the incoming chilis are captured by the camera unit mounted on the conveyor belt system and sent to the PC, which processes them using the Open CV software in a Python environment. The python program running on the PC will transmit commands to Arduino that are detailed in the Conveyor setup, which will sort the chilies using a servo as the actuation tool, based on the ripeness of chili algorithm as the sorting'ssub- components.

The images of the chilies that are communicated via the belt are captured using a camera. The camera in their system is a Logitech C310 Webcam with the following characteristics.

Table 2.1: Logitech C310 specifications

s.NO	PARTICULARS	RANGES
1	RESOLUTIONS	1280 X 720
2	FRAME RATE	30 FPS
3	INTERFACE CONNECTIVITY	USB 2.0
4	PIXELS	5MP

This camera unit was used to communicate the images of the chilis captured on the conveyor belt to the computer through the USB 2.0 connector, where they would be processed. The system runs on a DELL XPS 15 (2010) with an Intel i5 2430m (2nd Gen) processor, NVIDIA GT 525M GPU, and 6GB RAM. The PC is equipped with a Windows 10 professional operating system. These system requirements are sufficient to operate our applications. The photos from the Logitech camera are received by this computer through USB 2.0, processed by the python application running on it, and necessary commands are transmitted to the Arduino Nano via a serial connection port (USB).

The Arduino Nano, which was previously used in the conveyor setup, is utilized again in this sorting system to receive commands from the PC via COM port or to control the servo motor during the sorting process. The servomotor is installed at the leading end of the chilis exit and rotates to toss the ripe chilis out of the conveyor line. The Arduino provides control for the servo motors in the form of pulse width modulation, which allows the motors to rotate at precise angles. This precise servo control aids in the separation of ripe and green chilis in the conveyor setup at the other end.

Table 2.2: Difference of techniques

Techniques	Advantages	Disadvantages
DIGITAL IMAGE PROCESSING	Most use techniques in all machine and system, the method is easy to understand. the accuracy to capture an image is high	The way to snap the images of product is manually, it takes time to process.
COMPUTER VISIONS	By using the alpha method, the alpha value, the process may go to smooth accordingly.	But since it a vegetable such as chili sometime it has same color and size even the system can't recognize is it a different chili or not.
SORTING TECHNIQUES	Can Be done in manually and auto.	As for the component pixels, 5MP is already fall behind because if we follow the flow, 13MP or higher is the most suitable pixels to use even by using a phone now.

2.5 COMPARISONS OF EXISTING MACHINE

There is a lot of technology that exist for fruits grading or even vegetable. Here is the overview of some grading technology for related research:

2.5.1 Review of existing machines

Table 2.3: Difference of existing machine

	AB -128-S1 chili grading machine	Chili Pepper Processing Machine
Camera and display	-Full color CCD camera, 2048 pixel (high resolutions) - real time display (actual material image), the material image can be seen from controlling surface.	advanced image acquisitions, RGB full color camera, 162 million pixels 4K Toshiba CCD camera, subtlest defects as 0.01 mm^2 can be sorted out
Sorting	Tri-color CCD color sorter	30 initiative memorizations sorting programs, sorting accuracy >-99.99%
control	-Private computer control system	-Remote control (IoT), high speed transmission system using ethernet and wireless data transfer. one- key operations automation switchover and adjustments, LENOVO tablet detachable tablet. multifunctional sorter (can sort lot of product such as rice, corn, beans, seeds, peanuts and more)
accuracy	-Advance high accuracy valve and nozzle -800 ~1000 shots per second	-High speed electromagnetic ejector -2 billion times pressure
price	$11,899 USD	$8,800 USD ~ $12,800 USD

As can see at the table above Chili Pepper Processing Machine, is the great and best technology for chili grading because using new base control which is IoT method. Now a days, IoT is everything, for agriculture it is a recommendation to using it to get better and faster result for product grading. Beyond that it has 4K CCD camera that will give more and better clear chili image it just like people can see how detail the image is. Even the price is expensive but between two technology here the expensive is much better because of the air pressure for ejected is much accurate.

2.6 COMPARISONS OF EXISTING DATA AND ALGORITHMS

2.6.1 Artificial Neural Networks

In the article of A. Azis et el. (2001) has two steps of development which is training step and validating step. The training is to determine the ANNs structure and the validating step is to measure the levels of the ANNs accuracy of the quality classifications systems. In this study, a toolkit and MATLAB program were used to construct and construct the classification system. A dataset is the set of data used for training and validating the classification system

The dried chili served as the basis for this quality grading system. The training to testing data ratio was 80:20, resulting in 150 training samples and 36 testing data samples. There were three quality classes and a defect category in the sample (the black and green dried chilis). The UNECE Standard was used to classify the quality of the product. UNECE is stand for united economic commissions for Europe, it an organization that promoting a pan-European economic to all over world.

When the process begun, the sample data was extracted and put in a Microsoft Excel spreadsheet file, although it was still dispersed. The data was then filtered using control data to exclude samples that were out of boundaries (upper and low limits). Three quality classes and a rejected class were assigned to the 150 training samples.

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