



**FAKULTI KEJURUTERAAN ELEKTRIK
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**FINAL YEAR PROJECT
INVESTIGATION OF MINI FOOD PROCESSING AUTOMATION**

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" I hereby declare that I have read through this report entitle "**Investigation of mini food processing automation**" and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Mechatronics Engineering"

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INVESTIGATION OF MINI FOOD PROCESSING AUTOMATION

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**A report submitted in partial fulfillment of the requirements for the degree
Of Bachelor of Mechatronics Engineering**

Faculty of Electrical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2018

“I declare that this report entitle” **Investigation of mini food processing automation**“ is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree”

Signature :

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DEDICATION

I would like to thank GOD who always blessed me with courage and perseverance to pursue my final year project without any problems. I would also like to thank my supervisor Dr. Ahmad Zaki Bin Haji Shukor, my family and my friends who supported me throughout this this research.

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Abstract

Food manufacturing industry is gaining its importance in terms of monitoring quality and quantity mainly. After processing certain types of food they are graded in terms of quality for further processes. As the food processing industry grows it demands more on automation or robotics to ease human effort. In this project it is not only an attempt to improve the production of tart shell but also to enhance the image processing technique by detecting color during the baking process through threshold after the conversion of Red, Green and Blue medium to Hue, Saturation, Value medium. The concept of pneumatic press was used to replace human from manually pressing the dough for the tart production analysis. This ensures the consistency of the shape of the tart for the analysis on the upcoming experiment. During the pressing process it requires the conveyor to be stationary with the mold platform so that the pressing process can run without any flaws. This is done via placing two ultrasonic sensors to detect the mold platform with appropriate distance in order to stop under the pneumatic cylinder for the pressing process. To run the whole program spontaneously a Raspberry Pi 2 is used to connect all the instruments such as power window motor, pneumatic cylinder and the ultrasonic sensors. Raspberry Pi 2 operates the system when it is programmed with the Python programming. Through this it can ease and improve the production of the tart shell instead of using the PLC which can be complicated in terms of connections and understanding. This may also save plenty of time in producing tart shell from human efforts such as the manual pressing of the dough. The perfect shape of a tart is identified by calculating the success rate of a perfect press and imperfect press to determine the number of circles formed in a tart after the pressing process.

Abstrak

Pembuatan makanan adalah salah satu industry yang penting dari segi pemantauan kualiti dan kuantiti. Selepas memproses makanan, ia dinilai dari segi kualiti untuk proses selanjutnya. Industri proses makanan semakin berkembang dan ia memerlukan lebih banyak mesin serta robotik untuk memudahkan kerja manusia. Oleh itu, teknologi automasi diamalkan untuk meningkatkan pengeluaran makanan dengan teknologi yang canggih. Tujuan kajian ini adalah untuk meningkatkan pengeluaran shell tart dan juga untuk meningkatkan teknik pemrosesan imej dengan mengesan warna semasa proses melalui penukaran warna dari medium RGB iaitu merah, hijau, biru ke medium HSV (hue, saturation dan value). Pneumatik, digunakan untuk menggantikan manusia daripada tekanan secara manual untuk analisis pengeluaran tart. Ini dapat memastikan konsistensi bentuk tart bagi analisis pada percubaan yang akan datang. Proses ini berjalan apabila penghantar bergerak dengan platform acuan supaya proses mendesak dapat berjalan secara spontan. Ini dilaksanakan melalui mengadakan dua sensor kedekatan untuk mengesan platform acuan dengan jarak yang sesuai untuk berhenti di bawah silinder pneumatik untuk proses tekanan. Untuk menjalankan keseluruhan program secara spontan Raspberry Pi 2 digunakan untuk menyambung semua instrumen seperti motor, silinder pneumatik dan sensor Ultrasonik. Raspberry Pi 2 fungsi apabila pengaturcaraan python diprogramkan ke dalam Raspberry Pi. Melalui ini ia dapat memudahkan dan meningkatkan pengeluaran shell tart dari menggunakan PLC yang rumit dan ini juga dapat menjimatkan banyak masa dalam menghasilkan shell tart serta bahagian menekan yang dilakukan melalui secara manual oleh manusia. Bentuk tart yang sempurna dapat melalui mengira kadar berjaya tekanan sempurna dan tekanan tidak sempurna untuk mengenalpasti nombor bulat yang berada di dalam sebuah tart selepas proses tekanan.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Automation and Robotics have changed manufacturing in almost every industrial sector throughout country and globally. Through this they have increased efficiency in bringing product consistency for the consumers. This is crucial in food manufacturing industry since the demand and the scope of the industry getting bigger. As the demand increases for the domestic environment, satisfaction in terms of food manufacturing in a factory is essential. For example, food and beverages, bakeries and many more are required by the consumers which increase the demand. Products that are high volume, long life and fixed automation can use either robots or combinations of simpler electromechanical devices. Through this, particular process can be done with ease such as food packaging, preparation of the ingredients, food monitoring and so on. If the products are regular in shape and organized, simple solutions will often serve. However, the solution of the robotics will be complicated if the product localization is poor with irregular shape. Without any doubt, that automation and robotics industry has an important role to play by providing improved technology machineries that has influence throughout the global for the food manufacturing industry. It ensures the region continue and meet the demands by providing high-quality and affordable food products for the consumers [1].

This section is organized in six parts where motivation for this project continues after this introduction part. The third part emphasizes on the problem statement specifically on this project while the fourth part presents the objective of this project

to overcome the problem given. The fifth part introduces scope where the last section covers the overall view of the project.

1.2 Motivation

In this rising modern technology world, food industries demand are rising equally in making preserved foods and also quality monitoring to ease human effort in processing food products. Automation technology has impact on food processing in terms of high quantities, increased efficiencies and better quality products. Combination of modern technology, robotics, and pneumatic systems has shown dramatic improvement in food processing quality and quantity. However, with advanced automated industries, many highly efficient methods are implemented in food automation system such as food storing and inspection process [2].

Producing tart shell manually requires a lot of time, human effort and energy especially for subsidiary production. As mentioned, it will also increase the labor cost in the process of making the tart shell. One at a time the dough's are required to be pressed into its mold form manually by the operator. The shape of the mold should be unvarying in curve and must be managed by a capable person in order to sustain the identical shape and the thickness of the tart shell. Having said that, with the advanced robotic and machines in the production lines a new benchmark for quality improvement and fast production can be achieved. This is due to the manual application of food managing which has greater rate of error and might as well expose to contamination [3].

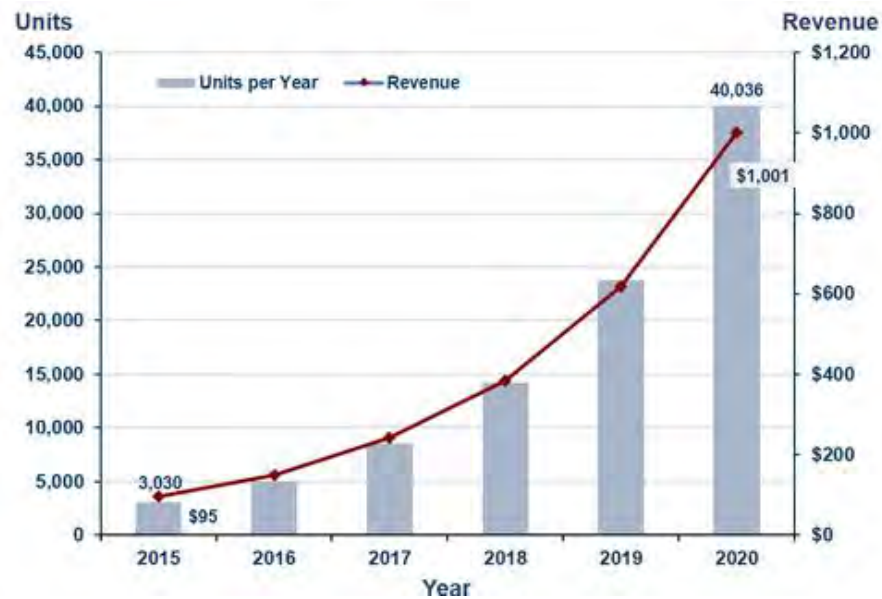


Fig 1.1: The expected robot sales by 2020 [5].

The figure 1.1 shows expected robotic sales by 2020, which is from the year of 2015. The graph is anticipated to be rose from the year of 2015 until 2020. In a recent survey, ABI estimation for the combined robots in the market will be more than 1 billion in upcoming 2020. The survey shows the market share for Asia Pacific (APAC) region that will increase from 19 percent to 57 percent, from the year of 2015 until 2020 [4]. This indicates the robot sales will be at peak in the coming year since the global is now advancing in both technologies and robotics. In a collaborative manner millions of industrial robots are being produced every single day.

Based on the descriptions above, robots can be enabled to do physical task over and over again where it will be hard for human to perform. Robots are combination of high tech parts which are integrated to perform a particular task capably in most of the repetitive working environments such that humans frequently will get exhausted.

1.2 Problem statement

Actions like pressing with pneumatic system are more consistent rather than manually press to spike up overall yield and reduce waste when it comes to use automation system in the food production. A rough calculation indicates that manufacturers enjoy roughly 3 percent yield improvement with the help of robots in situations like exact pressing and manual pressing [3]. When it comes to using pneumatic system the basic factor should be considered to design an automation food production system is identifying the suitable pressure to press the dough. Immoderate or inadequate pressure of the pneumatic system can influence the shape or the thickness of the tart shell. Apart from that, the platform which holds the mold also have to be sturdy and firm to acclimate the pressure from the pneumatic system while it is being pressed.

Having said that, a tart shell with the size about 450mm in diameter, it requires some skills to maintain its shape when it's done repetitively. By using the pneumatic system, it will improve the speed and the timing for pressing the tart shell into its mold [6]. Besides that the accuracy of the tart's shape can be influenced by the amount of dough that has been used. To have and maintain the correct amount it is essential to measure the mold's weight before it's filled in.

Other than that, to identify the appropriate shape and colors in certain conditions is essential for conducting this experiment. Identifying shapes in terms of maturity, shape defect, extra features and many more are considered in this aspect as well. Maturity indicates through color changing perspective, while shape defect is identified through feature extraction method. Problems that arise in machine vision are prone to physical or technical difficulties. There are certain variables considered in machine vision.

First and foremost, for image acquisition process resolution and the distance of the camera from the object of interest plays an important role, where the resolution and distance are connected indirectly. The higher the resolution of a camera, the larger the distance can be from the object of interest and vice versa. For a good quality picture a high resolution camera is required, hence to improve image quality through a short distance. In certain image acquisition process lighting plays an

important role to display the picture brighter so it can be viewed clearly for further steps. Fixing lighting in a closed chamber can result the image to be very bright and vice versa with a dim light. Adjusting light intensity according to the camera's distance and its resolution quality, it brings out good quality image as a result. In certain cases, position of the camera plays an important part as well to determine the appropriate angle of the image. In order to get an angular view of the image the camera should be tilted and adjusted to capture the image as per the requirement of the image needed. In some cases the camera will be placed uniformly towards the object to obtain direct image, where the angular motion doesn't require.

Throughout this research, improving the design of the conveyor system can escalate the tart process production. By doing so, it is provided with organization process to identify the exact shape via image processing technique.

1.4 Objectives:

1. To improve the automation system and the tart shell production.
2. To enhance image processing technique to reject or accept the accurate shape using edge detection and color detection.
3. To analyze the relationship between weight, shape, distance of the camera and its resolutions by using machine vision technique.

1.5 Scope

- The conveyor and pneumatic was operated using Raspberry Pi2 to improve the automation.
- OpenCV-Python will be utilized to integrate the image processing and all the operations in the Raspberry Pi in order to recognize the shape of the tart.
- With the size of 24mm of the dough and 44mm of the symmetry mold is utilized in this experiment.
- Additionally OpenCV-python used to detect the accurate shape and the color of the tart.
- The shape and the aspect of the tart shells are observed by the webcam after being pressed.
- The dough is weighed with electronic scale and placed manually for image processing and it will be taken back manually after the process to be placed on a tray, if accepted.
- The expected tart shell production by this automation machine is 50-100 pieces per hour.