POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

AUTOMATIC SLICER MACHINE

NAMA	NO PENDAFTARAN
MUHAMMAD NUQMAN BIN RUHASMIDI	08DMP18F1035
MUHAMMAD ASRARI BIN MOHD YASIN	08DMP18F1029
DIVYASHINI A/P SUBBARAO	08DMP18F1008

JABATAN KEJURUTERAAN MEKANIKAL

JUN 2020

POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

AUTOMATIC SLICER MACHINE

NAMA	NO PENDAFTARAN
MUHAMMAD NUQMAN BIN RUHASMIDI	08DMP18F1035
MUHAMMAD ASRARI BIN MOHD YASIN	08DMP18F1029
DIVYASHINI A/P SUBBARAO	08DMP18F1008

Laporan ini dikemukakan kepada Jabatan Kejuruteraan Mekanikal sebagai memenuhi sebahagian syarat penganugerahan Diploma Kejuruteraan Mekanikal

JABATAN KEJURUTERAAN MEKANIKAL

JUN 2020

AKUAN KEASLIAN DAN HAK MILIK

TAJUK : AUTOMATIC SLICER MACHINE

SESI : JUNE 2020

1. Kami, **1. MUHAMMAD NUQMAN BIN RUHASMADI**
2. MUHAMMAD ASRARI BIN MOHD YASIN
3. DIVYASHINI A/P SUBBARAO

Adalah pelajar tahun akhir **Diploma Kejuruteraan Mekanikal, Jabatan Kejuruteraan Mekanikal, Politeknik Sultan Salahuddin Abdul Aziz Shah**, yang beralamat di **Persiaran Usahawan, 40150, Shah Alam, Selangor**. (selepas ini dirujuk sebagai 'Politeknik tersebut').

2. Kami mengakui bahawa projek 'Automatic Slicer Machine' dan harta intelek yang ada di dalamnya adalah hasil karya/reka cipta asli kami tanpa mengambil atau meniru mana-mana harga intelek daripada pihak-pihak lain.

3. Kami bersetuju melepaskan pemilikan harta intelek 'Automatic Slicer Machine'kepada 'Politeknik Sultan Salahuddin Abdul Aziz Shah bagi memenuhi keperluan untuk peanugerahan **Diploma Kejuruteraan Mekanikal** kepada kami.

Diperbuat dan dengan sebenar-benarnya diakui

Oleh yang tersebut;

a) MUHAMMAD NUQMAN BIN RUHASMADI	)	…….
(No. Kad Pengenalan: 000412-09-0015)	)	MUHAMMAD NUQMAN
b) MUHAMMAD ASRARI BIN MOHD YASIN	)	…….
(No. Kad Pengenalan: 000522-14-0837)	)	MUHAMMAD ASRARI
c) DIVYASHINI A/P SUBBARAO	)	…….
(No. Kad Pengenalan:001205-10-1118)	)	DIVYASHINI SUBBARAO
Di hadapan saya, AHMAD FAKARUDDIN BIN MOHD FAUZI (821127-08-6189)	)	…….
sebagai penyelia projek pada tarikh: 4/6/2019	)	AHMAD FAKARUDDIN BIN MOHD FAUZI

ACKNOWLEDGEMENT

We thank all of you who have given us the opportunity to complete my final year project. First, we want to thank PSA Mechanical Engineering Department for giving students an opportunity to exhibit their advanced technical skills and know-how through their final year project.

In addition, we express our heartfelt appreciation for our role as project supervisor to Mr. Ahmad Fakaruddin Bin Mohd Fauzi. During the consultations, he gave us good guidance and helpful advice.

In addition, the key role played by Lau Tai Wai, owner of Ampang welding shop who has helped us to welding on of our machine parts, is to be recognized with great appreciation. We are so thankful for the time and attention. Thank you to all for helping us to finalize our project directly and indirectly. Last but not least, we appreciate our parents ' financial support for the funding of the final project year.

ABSTRACT

Food preparation is an important part in food industry. One of it is cutting vegetables into a desired thickness. This innovation intends to encourage restaurant operators to speed up and simplifying the process of cutting vegetables. The study showed that majority of restaurant operators in Malaysia used manual vegetable cutting techniques which takes time to deliver the dish to their customers. Therefore, this study focuses on the design and development of automatic vegetable cutting machines. The key goal of this project is to ensure immediate turnaround time and maximize the amount of cut vegetables. Methods used involves problem statement, idea generation, machine design, project construction and modification. A sequence of checks will be carried out on the system to ensure that it follows the standards that have been set and running properly. The machine performance was evaluated in the cutting of non-leafy vegetables such as cucumber, potato, onion and brinjals into sizes at certain machine speeds. The parameters investigated were cutting performance and the throughput capacity. The findings of the study show that the unit can successfully cut root and tuber crops with slices ranging from 8 mm to 9 mm in thickness. Considerations for the design of the machine include: product resistance to cutting, moisture content, slice length, cutting speed, overall power requirement and power supply. As a conclusion, this project focuses on design and production of automatic vegetable slicer with a view to integrating design, science and technology to deliver goods that are usable and attractive for consumers.

ABSTRAK

Penyediaan bahan makanan merupakan bahagian penting dalam industri makanan. Di antaranya ialah pemotongan sayur-sayuran mengikut ketebalan yang dikehendaki. Inovasi ini bertujuan untuk mendorong pengusaha restoran untuk mempercepat dan memudahkan proses pemotongan sayur. Kajian menunjukkan bahawa kebanyakan pengusaha restoran di Malaysia menggunakan teknik memotong sayur secara manual di mana ianya mengambil masa yang lama untuk menghantar makanan kepada pelanggan. Oleh itu, penyelidikan ini memberi tumpuan kepada rekabentuk dan pembangunan mesin pemotong sayur automatik. Matlamat utama projek adalah untuk memastikan masa pemotongan yang pantas dan memaksimakan kuantiti sayur yang telah dipotong. Metodologi yang digunakan melibatkan penyataan masalah, penghasilan idea, rekabentuk mesin, pembinaan dan pengubahsuaian projek. Beberapa siri pemeriksaan akan dilakukan pada sistem untuk memastikannya mengikut piawaian yang ditetapkan dan dapat beroperasi dengan baik. Prestasi mesin dinilai dengan memotong sayur-sayuran yang tidak berdaun seperti timun, kentang, bawang dan terung bagi beberapa ukuran pada kelajuan tertentu. Hasil kajian menunjukkan bahawa alat ini berjaya memotong sayur pada ketebalan antara 8 mm hingga 9 mm. Faktor pertimbangan rekabentuk mesin terdiri daripada rintangan terhadap pemotongan, kandungan air, panjang pemotongan, kelajuan pemotongan, keperluan kuasa keseluruhan dan bekalan kuasa. Kesimpulannya, projek ini memfokuskan kepada rekabentuk dan penghasilan mesin pemotong sayur automatik dengan mengintegrasikan rekabentuk, sains dan teknologi untuk menghasilkan produk yang berguna dan menarik.

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Research Background

People are still busy doing their job in this modern age. The progress made today makes it simpler, quicker and more productive to operate. Based on the research that has been carried out, the study shows that most restaurant operators in Malaysia still have manual techniques for cutting vegetables.

Nowadays, the restaurant industry has expanded rapidly due to consumer interest. Food business is one of the occupations that a lot of people in this generation are following. Of course, Malaysia, which consists of different races, has different types of food, not to mention different types of food, and has become a favourite of the people. So, the food business sector is the priority of the people.

Sadly, issues occur in the food industry when traders take a long time to supply their customers with food. This is because the method of food processing involves the preparation of ingredients, ingredient cutting and production. Furthermore, it takes a long time to cut ingredients because every food has its own preparation. It takes a long time for most people to cut onion. That is because onions produce a syn-propanetriol-S-oxide-gas-producing amino sulfoxide. The watery eyes are caused by that gas.

This study therefore focuses on the design and production of cutting machines for vegetables. The mechanism used to drive this machine needs to be set in order to design. A set of checks will be carried out on the system to ensure it meets and operates

correctly with the requirements. This system is manufactured to facilitate the processing of vegetables and to ensure consumer safety.

1.2 Problem Statement

Food preparation workers are employed in restaurants, hotels and other places where food is served. The processing of large amounts of vegetables and fruit takes time, despite the fact that many people enjoy the knifework. In the commercial food industry, quality is also essential. Human beings cannot reliably cut their vegetables for many hours because our steady hand could even fail. Human also causes injuries as a result of carelessness. This is why vegetable slicers are designed to solve this problem. The project aims to design and manufacture an automated vegetable cutting machine which reduces manpower in the production of food, improves the handling capacities for a large number of vegetables and improves safety characteristics to prevent users from experiencing injuries. Through using 'Automatic slicer machine,' vegetable cutting can be accelerated and the pressure on restaurant traders can be eased.

1.3 Research Objectives

The objectives to this research are:

i. Develop and design machines for vegetable cutting.
ii. Reduces the possibility of injury.
Save time and raise the quantity of food preparation cuts

1.4 Scope of Research

The scopes and limits to this research are:

I. Cut off non-blatt vegetables.
II. Dedicated to traders in restaurants

1.5 Significance of Research

Upon completion of the testing, the final design will be developed into an automatic slicer machine. Design and study for the project analysis will ensure that the mechanical parts of the system function accordingly. A good selection of materials in design will add up to a cost-effective machine. The most advantageous aspect of this research is the experience of computer drawing / assembly and during the development of the machine.

Summary of Chapter

The studies on its sources of ideas and inspirations were explained in this chapter. All the goals have been made out of all the statements of the issue. The purpose of this project, along with the importance, will be to evaluate the machine 's output in carrot, onion, and potato cutting by evaluating its cutting efficiency and throughput capability at different operating speeds.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, will be shown three evolution of cutting method. These three methods have its own advantages and disadvantages. Vegetables are defined as a herbaceous plant or part of a plant that is consumed in whole or in part (Welbaum, 2015). The production of world vegetables has increased over the years.

World production of vegetables from 1970 until 2009 (FAO, 2011). The rise was primarily due to prolonged technological development. Vegetables are grown on a large scale to accommodate supermarkets and some food industries, such as canning industries. The key challenge lies in reducing the size of the vegetable so that the consumer can comfortably eat it. For a long period of time, cutting and slicing have existed, and many techniques have been used to perform special tasks. Knives and other machines designed for such purposes were used in conventional methods. These approaches have been tiresome and time-consuming, especially in our busy lives.

Throughout the transformation of the modern age, digital computers have steadily become a crucial part of everyday human life. Automated computers have consistently saved much of the manual equivalents relative to their manual counterparts. The time for people to perform a certain task and this change has contributed dramatically to a more and more competitive and quicker way of doing things.

Automation was the key focal point of design in the late 90's (Tony, et al., 2014). Night and day, the engineering industry worked tremendously to bring about substantial changes to new automated goods. Kitchen appliances are a must for these commercial kitchen areas. Due to their utter quality, longevity and high reliability, modern kitchen equipment is in great need in the worldwide market. So, in this chapter, it will be explained about the evolution of cutting methods and comparison of models that have been designed by us.

2.2 Evolution development of the cutting method.

2.2.1 Research of cutting

The manual method for cutting vegetables through the use of a knife. Throughout history, knives have been one of the most essential items for everyday use, both as an appliance for cooking and for providing food and shelter. Knives were made of stone during the Neolithic period. Later, over time, human history started to refine copper, bronze, and eventually iron goods on the content of knives. Therefore, in order to develop the technology of these knife items in order to become more advanced, the shape of the knife has been modified to become more specialised as different types of knives are available on the market.

2.2.2 Types of knives and usage

a) Chef's knife

Figure 2.1: Chef's Knife

'Chef's knife' is one of the most commonly used kitchen tools. The chef's knifes usually range from 8 to 10 inches in size to 14 inches in length. During the preparation of food, you can use the 'Chef's Knife' for most slicing, which will be the most effective tool. Good for: onions and carrots, cabbage, potatoes and meat.

b) Paring knife

Figure 2.2: Paring Knife

The paring knife is a thin, all-purpose knife with a straight edge suitable for fruit and vegetables peeling or 'paring', and other small or complicated work such as de-veining the shrimp, taking the jalapeno seeds away, 'skinning' or cutting small garnishes. Usually, paring knives are between 6 and 10 cm long. The use of a peeler is another way to peel fruit and vegetables. Do not use such a knife for rough vegetables because their light weight can cause injury. The best for: apricots, fruits, apples, onions, garlic, and fresh herbs.

c) Serrated Knife

Figure 2.3: Serrated Knife

Serrated knives with their pelleted, toothlike edge are suitable for cutting food, such as a loaf of crusty bread, with a rough outer and softer inner appearance. The principle behind a serrated knife is similar to that of a saw: The teeth of the blade catch and then rip as the knife smoothly slides through the food. Best for: Tomatoes, bread, citrus fruits, pies, quizzes, pizza.

d) Hand slicer

Figure 2.4: Hand Slicer

In order to improve productivity and keep pace with recent technical advances, the form of this product has made a good addition to cutting vegetables with solids with better yields. The products used for the creation of this hand slicer are of excellent quality, and the economy is indirectly compatible. The tool frame is made of stainless steel on the parts of the cutlery and cabinet. This strong vegetable cutter is considered to be more accurate and reliable than manual knife cutting. This can be seen from the test and the skill of the vegetable cutting tool.

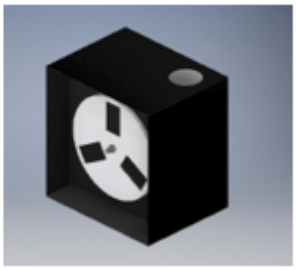
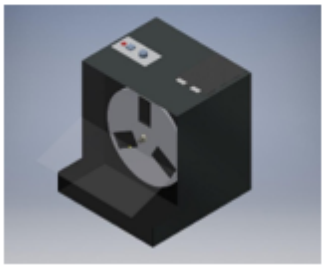
e) Vegetable cutting machine

Figure 2.5: Vegetable Cutting Machine

First, to get a taste of this modern flow with vegetable cutting machines, these solids can help make cuts of the same size. Compared to cutting using knives and tools as usual, vegetable cuts can differ in size and may be incorrect or unattractive. Large cuts may also be of various sizes since the majority of vegetable cuts are manual. Therefore, the use of this vegetable cutting tool will also help to render vegetable cutting in line with faster time, as this efficient automated vegetable cutting tool works continuously to save time. Indirectly, shortages in cutting times can lead to the use of this manual cutting tool cutting more soft vegetables and cutting strong vegetables with good results.

2.2.3 Comparison of models

Table 2.1: Comparison of Models

	Design A	Design B	Design C
			
Advantages	-cheap - Light -Easy to build -Use of batteries	- using electricity -has a tray	- motor speed can be changed -has a tray -has a door to prevent material from coming out -even cutting -Using direct current
Disadvantages	- Unable to change pace. -the unregulated output of materials -inconsistent cuts; -does not have security features;	- The content will come out -Can't change the speed -inconsistent cuts; -does not have security features;	- High costs -heavy
Parts	- motor -pvc pipe -blade of stainless steel -block timber -Plate of Stainless Steel	-motor -pvc pipe -stainless steel blade -block timber -stainless steel plate -wire	-motor -Pvc pipe -hinge -stainless steel blade -HDPE (high-density polyethylene plastic) block -stainless steel plate -Acrylic sheet

Summary of Chapter

To finish this chapter, it is important to present all studies of materials and methods in order to improve the understanding of this project. Every thesis and other projects relating to this cutting machine allows us to understand it fully. Especially for us.

After a lot of materials and methods were discussed and researches were done, the three projects have their own benefits and drawbacks as a result of the analysis. We have therefore explored the new slicer machine from all points of view. We have subsequently developed ideas that can support food traders and home use. Moreover, for our project, we have taken note of the advantages and disadvantages of the above items. The products above would be less used because of design flaws, materials used because of weaknesses in design, materials and the quality of products.

CHAPTER 3

METHODOLOGY

3.1 Introduction

Figure 3.1 displays the flow chart of the overall management of the project. The approach begins with the creation of a strategy outlining the resources, schedules and other measures required to achieve the objectives. Among team mates and supervisors, planning was carried out. The project was split into three sections: Questionnaires, Concept Design, Manufacturing and Assembly Process.

3.2 Methodology chart

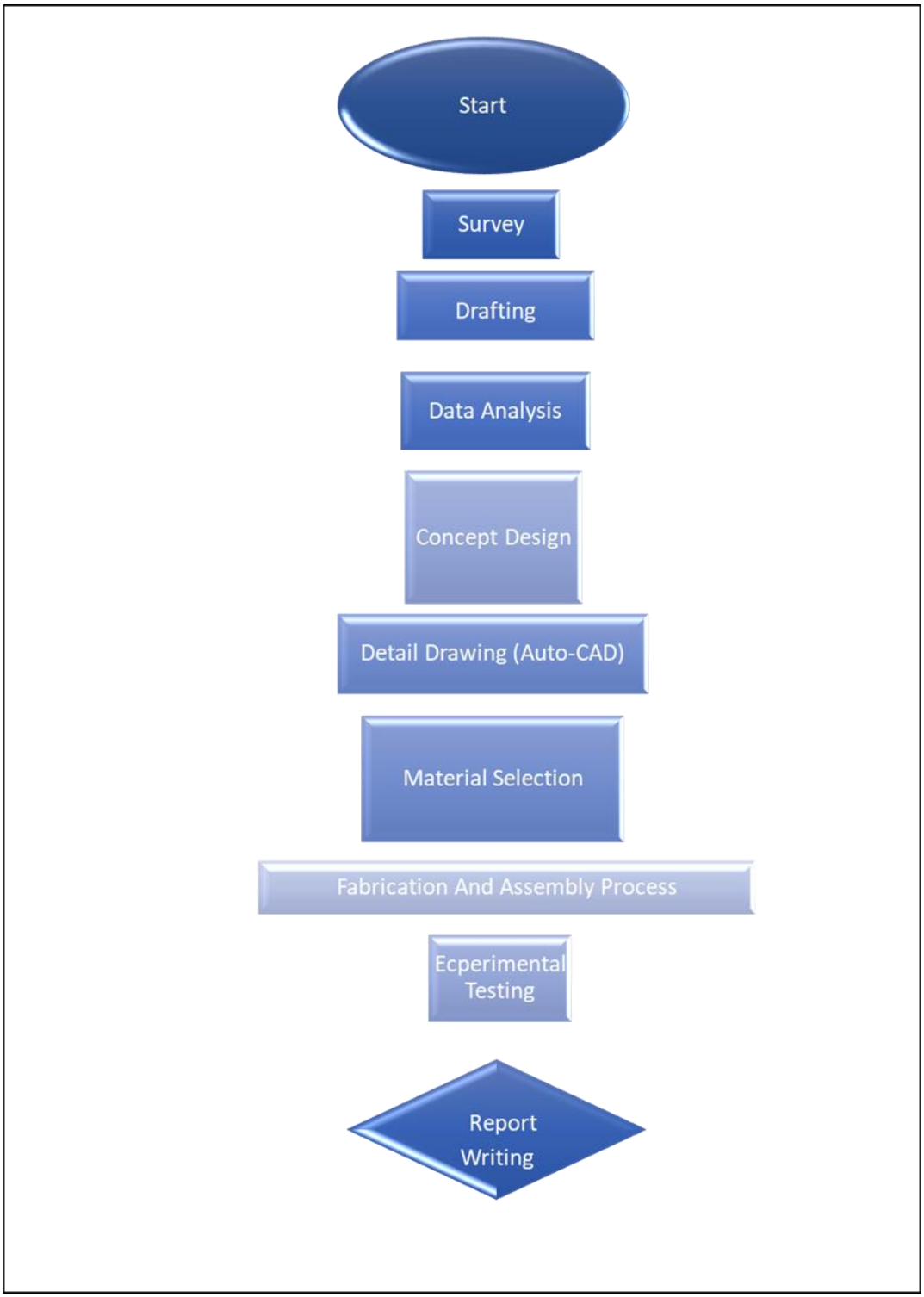
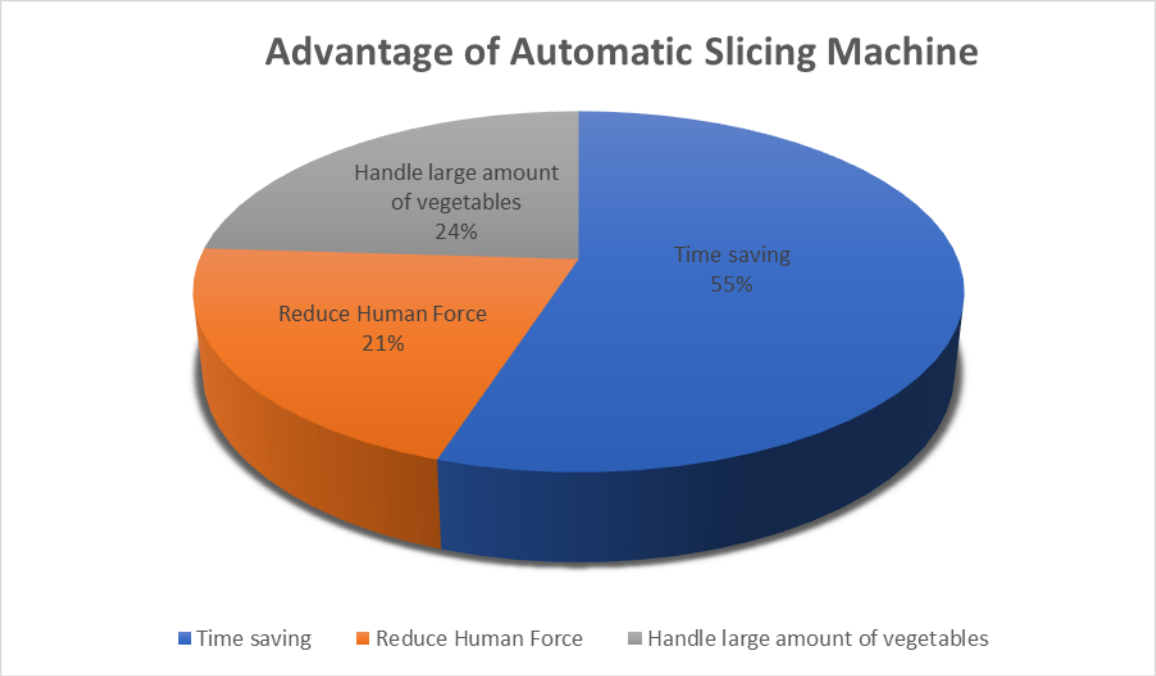


Figure 3.1: Methodology Chart

3.3 Survey

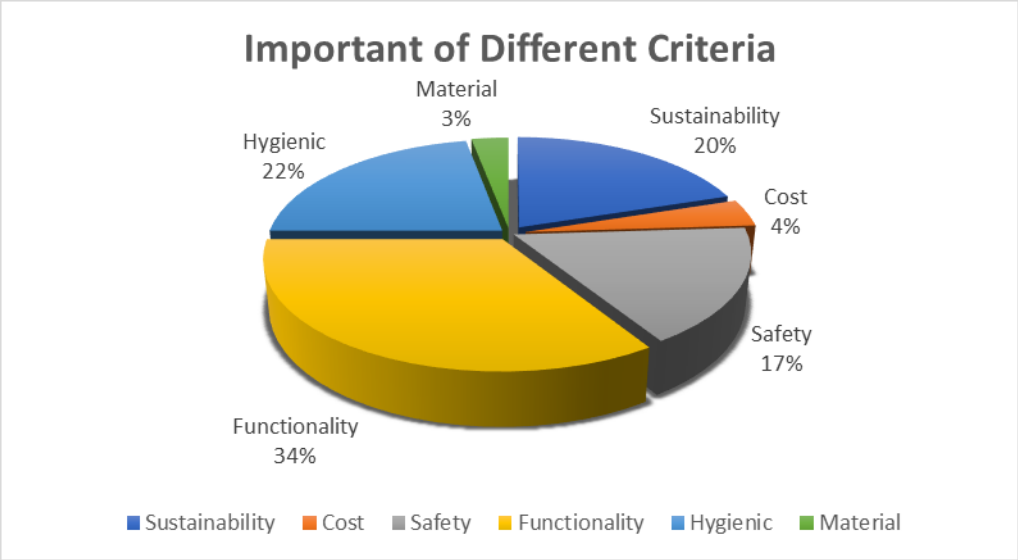
A survey was conducted to 40 participants to identify the specifications of the automatic slicing machine.

Table 3.1: Advantages of Automatic Slicing Machine



According to the data obtained from the survey, we found that 21 out of 40 respondents think that an automatic slicing machine can reduce the time consume for food preparation. 24% and 21 % of respondents believe that an automatic slicing machine can handle large amount of vegetable and reduce human force respectively.

Table 3.2: Important of different criteria



The purpose of asking this question is to know the most important criteria for an automatic slicer machine. From the results of the survey done, we found that most important criteria for an automatic slicing machine is the functionality of the machine. As we know from the respondents, 22% of respondent agree that hygienic is very important criteria to an automatic slicing machine. Some of them consider sustainability and safety as the important criteria which are 20% and 17% respectively. 4% of respondents thinks that selling price of the machine whereas another 3% of respondent thinks that the built-up material of the machine is the most important criteria. Logically, the criteria such as price, functionality, material and sustainability are closely related to each other's. A better functionality slicing machine will results in a higher selling price. For example, an automatic slicing machine allows user to perform slicing vegetables uniformly. Furthermore, material selection can be related with sustainability. For an automatic slicing machine, the cutter material that has been choose is stainless steel knife rather than alloy steel. Alloy steel is lighter in weight compare to stainless steel but the corrosion resistance of stainless steel is higher compare to alloy steel. Thus, the strength of stainless steel is higher which provide a higher factor of safety compare to stainless steel. The stainless-steel knife also resistant to fire and heat, and retains its strength even under high temperatures rather than alloy steel.

3.4 Conceptual design

3.4.1 Model 1

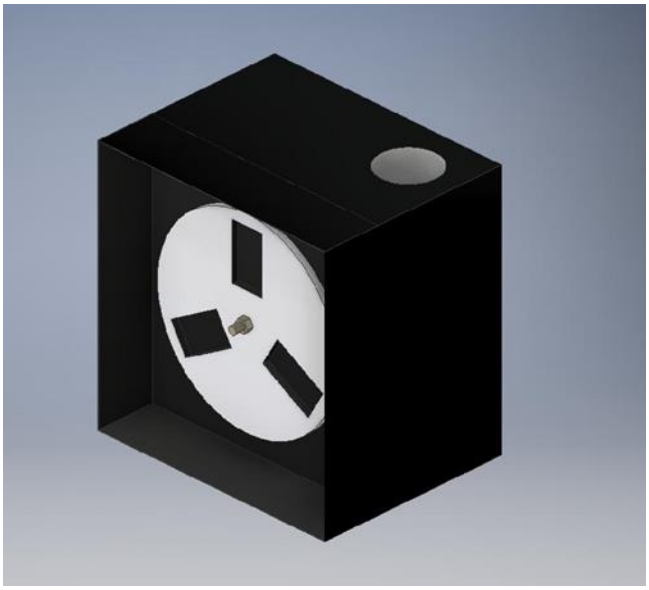


Figure 3.2: Model 1 of an Automatic Slicer Machine

Figure 3.2 shows the first conceptual design of our automatic slicing machine using Autodesk Inventor applications. This model using a minimalist concept which is the design is focus to keep the automatic slicing machine looks simple but functionable and high quality. This design produces more disadvantages than advantages. For example, this design not include the front cover which will cause the vegetables fly over and makes situation uncontrollable after the vegetables were slice. This design also lacks of hygiene features because at the "drop in "zone for vegetables not covered with acrylic which will cause any bacteria easily pop in and will cause food poisoning. Other than that, this model is lightweight, easy to carry and can modify the place of an automatic slicing machine from time to time. The housing size for this model also small because of the minimalist concept. The measurement we use is Width1.5ft, Length 1ft, and Height 1ft.

3.4.2 Model 2

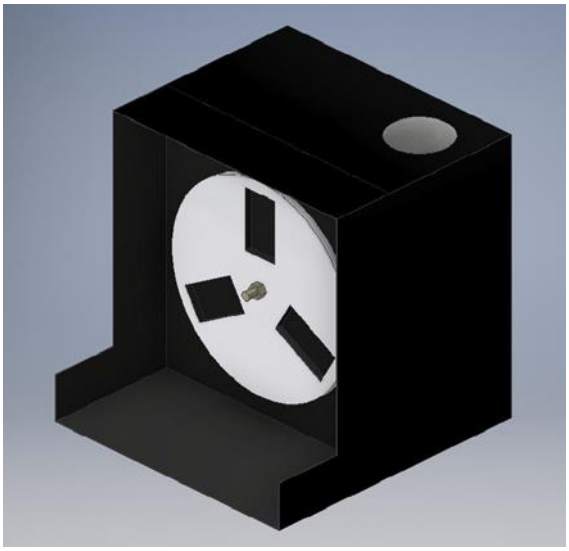


Figure 3.3: Model 2 of an Automatic Slicer Machine

Figure 3.3 shows the second conceptual design of our automatic slicer machine using Autodesk Inventor applications. This model is upgrade version of the first model. This model concept is focusing on safety first. The first thing of this new upgrade version is front cover. The front cover operates as two functions which is it assure user safety that can lead to injury from the knife at the HDPE block when it spins. The second function of front cover is to act as a shield for the vegetables to not fly over after the knife has slice it. Other than that, this version of model equips DIY special tray which can ease the user to gather all the vegetables after the slicing operation done. The tray will be a removable. The purpose of locating the removable special DIY tray is to ease the cleaning process. The tray material is high quality acrylic and the colour code is black. Black colour has been chosen to keep the minimalist idea of our first model. Other than that, the upgrade not include the hygiene factor because of the main focus only on safety for the user. The housing for this model we has upgrade to Length 2ft, Width 2.15ft and Height 2ft.

3.4.3 Model 3

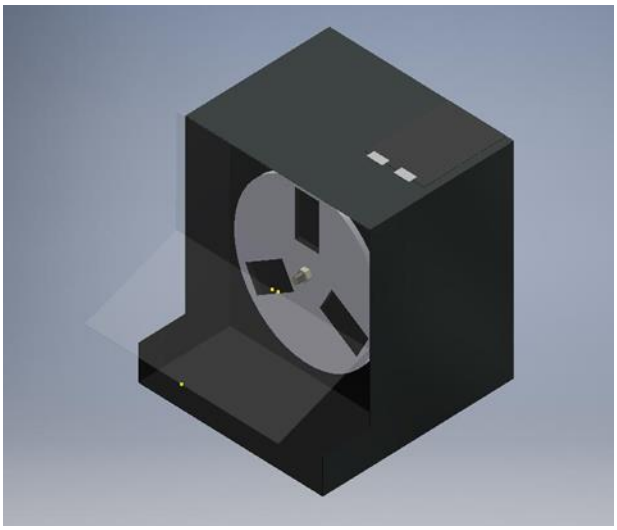


Figure 3.4: Model 3 of an Automatic Slicer Machine

Figure 3.4 shows the third conceptual design of our automatic slicer machine using Autodesk Inventor applications. This concept focusing on hygiene and user satisfied. We upgrade several functions such as half of the front cover can be open. The functions is to let the user can clean the HDPE block and special DIY tray in an uncomplicated way. Other than that, “drop in” zone for vegetables has equip the cover. The material used for the cover is soft acrylic. The drop-in zone covers used door concept. The cover equips hinges so that it can be open and close easily. The main functions to equip the cover is to protect the vegetables drop in zone from any bacteria that can pop in at it. The problematic of this model is the main switch is difficult to reach. It located inside of the housing. The colour and size of this model is the same with second conceptual design.

3.4.4 Model 4

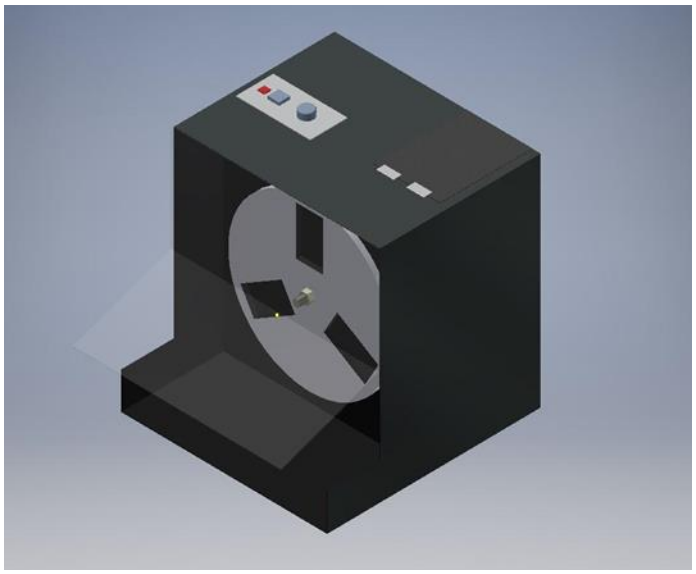
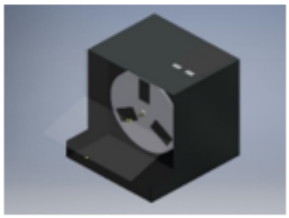
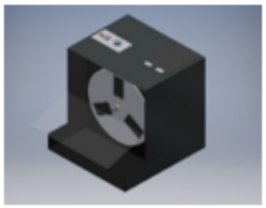


Figure 3.5: Model 4 of an Automatic Slicer Machine

Figure 3.5 shows the fourth conceptual design of our automatic slicer machine using Autodesk Inventor applications. This concept is upgrade version of model 1, model 2 and model 3. This model counter all the disadvantages of all the three model before. This model concept has safety requirements, hygiene and most importantly eco-friendly. The switch problem in model 3 has been solve in this model. Switch of this model has been put at the top of the housing. The top position of the housing has been chosen to put the switch because we want to make the user access the switch easily. Other than that, “drop in” zone for vegetables has equip the cover. The cover equips hinges so that it can be open and close easily. The main functions to equip the cover is to protect the vegetables drop in zone from any bacteria that can pop in at it. The front cover operates as two functions which is it assure user safety that can lead to any injury from the knife at the HDPE block when it spins. The second function of front cover is to act as a shield for the vegetables to not fly over after the knife has slice it. Lastly, the tray will be a removable. The purpose of locating the removable special DIY tray is to ease the cleaning process. Measurement of this model is (Length 2ft, Width 2.15ft and Height 2ft.). Colour of this model is black which is minimalist colour

3.5 Evaluation

Table 3.3: Evaluation criteria

Model	Criteria					
	Safety	Cost	Material	Appearance	Function	Hygienic
Model 1 	X	✓	X	X	✓	X
Model 2 	✓	✓	X	X	✓	X
Model 3 	✓	X	X	✓	✓	✓
Model 4 	✓	X	✓	✓	✓	✓

Based on the Table 3.3, Model 4 is the best model which takes consideration on the safety, material, appearance, functionality, and hygienic. It also meets the data analysis from the survey which shows that most of the participants selected functionality as the most important criteria for an automatic slicer machine. Thus, Model 4 has been selected as the final solution idea.

3.6 Material Selection

3.6.1 Slotted Angle

Figure 3.6: Slotted angle and Slotted angle assemble using bolt and nut

The selection of a material for a housing part is one of the most important decision. We use the slotted angle as the housing part because we tend to the quality, eco-friendly and convenient. The material of the slotted angle is made from steel. Steel is an alloy of iron and carbon containing less than 2% carbon and 1% manganese and small amounts of silicon, phosphorus, sulphur and oxygen. The structural of steel is typically 50 ski material indicating that the steel has a yield stress of 50,000 pounds per square inch in both compression and tension. The material are very durable and hardly damaged. Other than that, the structural steel is made of 88% recycled product which is fully recyclable in the future and can be reused without further processing. The steel material also simply can be modified using the grinder machine if the measurement did not meet what it requires. The steel of the slotted angle is lightweight which will be convenient to handle. The slotted angle also easy to modified and assemble using the Bolt and Nut. Furthermore, this slotted angle has various type of design and colour which is helpful to attract the consumer.

3.6.2 Acrylic Sheet

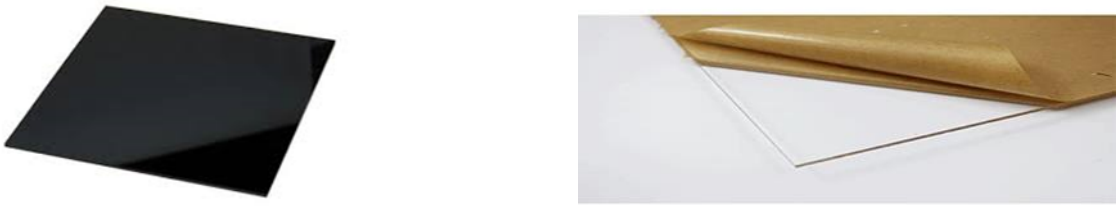


Figure 3.7: Transparent and black acrylic sheet

Acrylic sheet is the cover for the whole housing, cover for the “drop in” zone, tray for the vegetables after slicing operation has been done, and cover for the block HDPE knife slicer. Other than that, acrylic sheet function is as a shield for the user from block HDPE knife slicer when it operating. Acrylic sheet is made from synthetic polymer of methacrylate. We choose acrylic sheet because the acrylic sheet is high impact resistance, high optical clarity, innate weatherability and UV resistance, excellent dimensional stability, lightweight, and excellent chemical resistance. We used 6 acrylic sheets. First, transparent type, front cover (2ft x 2ft). Right and left we use black colour (2ft x 2.5ft for both right and left). For tray at the bottom side, we use black colour (2ft x 2.5ft) and at the top we also use black colour of acrylic sheet (2ft x 2.5ft). Lastly, at the back side, we used black colour acrylic sheet (2ft x 2ft). We assemble the acrylic sheet with slotted angle using bolt and nut.

3.6.3 Elbow pipe

Figure 3.8: PVC elbow pipe

The next material we appoint to use is PVC elbow pipe. PVC stands for polyvinyl chloride. The PVC elbow pipe are made from thermoplastic polymer. The density of the PVC pipe is 1.1–1.35g/cm3 and the Yield strength is 31- 60 psi, 10 – 24.8 MPa. The function of PVC elbow pipe is as “drop in” zone for vegetables before it slices. The 90 degrees PVC pipe has been chosen to let the vegetables smoothly slice. 90 degrees function in this slicing method is to let the vegetables reach the HDPE block slicer with fast speed that will help reduce the time of slicing. We assemble the PVC elbow pipe using the hot glue-gun to the acrylic sheet. The type of PVC pipe has strength, durability, easy to use and low cost.

3.6.4 Rotary Dimmer

Figure 3.9: Rotary dimmer

Dimmers devices are connected to the motor and used to adjust the speed of the motor. This function are to obtain the uniformity of vegetables when it slice. We adjust the wire by link the dimmer wire to the motor wire. This theory knowledge we gain from the YouTube applications and we transform it into our project. Types of rotary dimmer switch has been chosen as our material selection. This dimmer switch is energy savings when use the dimmer at a lower level than the fixture's maximum output.

3.6.5 DC Motor (Kaprino)

Figure 3.10: DC Motor Kaprino

DC Motor devices that has been decided to be use as main engine to move the automatic slicer machine. D.C. motors serve the function of converting electrical energy into mechanical energy. D.C. motors are powered from direct current (D.C.). The speed of a D.C. motor is controlled by varying the armature winding's current. DC motor has higher starting torque, quick starting and stopping, reversing, variable speeds with voltage input and they are easier and cheaper to control than AC. This DC motor even though it uses direct current, we manage to control the current using the theory of dimmer. The motor was assembling at the slotted angle using bolt and nut.

3.6.6 Round block HDPE

Figure 3.11: Round block HDPE

We use round shape of HDPE block to attach the knife blade. The round shape has been decided because it has the best spin time than other shape. High Density Poly Ethylene (HDPE) is a thermoplastic polymer made from petroleum. The material has outstanding tensile strength and large strength to density ratio. Other than that, HDPE plastic has a high-impact resistance, eco-friendly and cost effective. HDPE material is the greatest material for our automatic slicer machine because it is corrosion resistance. HDPE also long-lasting material and weather resistant that has no issue to clean after the slicing operation has been settled. Round HDPE block were assembling at the motor rod and lock it with nut.

3.6.7 Santoku Knife

Figure 3.12: Santoku knife

The selection of a material for a knife blade is one of the most influential judgment. We have compared various of knife and Santoku knife has the most advantages for our project. Santoku knife is originated in Japan. The material of Santoku blade is stainless steel. Its blade is typically between 13 and 20 cm (5 and 8 in) long, and has a flat edge and a sheepsfoot blade that curves down an angle approaching 60 degrees at the point. The blade of Santoku is thinner than other knife and allows for more refined slicing. Santoku knife best use for slicing, chopping or dicing fruits, vegetables and nuts. The blade of Santoku were placed at the HDPE block at 60 degrees. We use 3 blades of Santoku to limit the the time of slicer. The blade assembles at the HDPE block using 3mm bolt and nut for solid it.

3.7 Machine Details

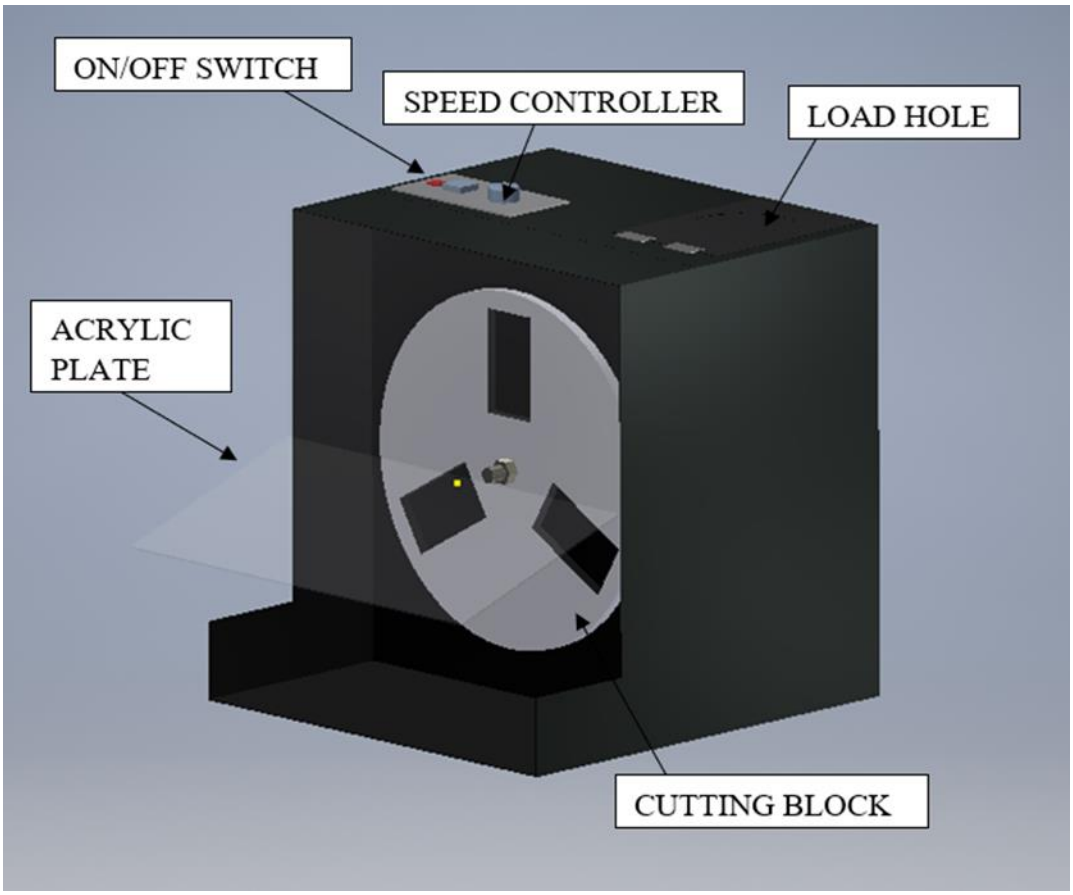
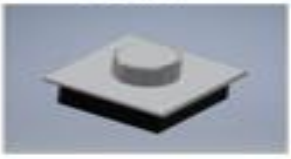
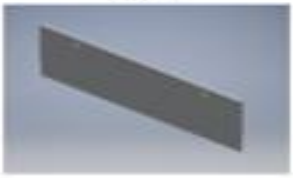
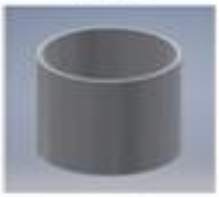
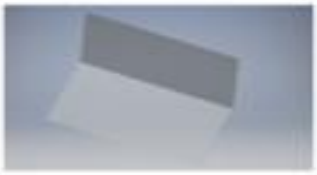


Figure 3.13: Machine Detail

The automatic slicer machine project was designed to innovate the cutting process accessories in the food industry. The product quality has to be considered as it is one of the satisfactions of the customer. Generally, the machined product can achieve better output than the traditional process. This project 's emphasis on creativity takes advantage of manpower as the primary energy for the functioning of the product. As shown in Figure 3.13, the project design was successfully proposed and manufactured according to the planned material and manufacturing process.

Table 3.4: Components of the machine

Component	Functionality
Motor 	• AC Motor • Power: 1.3 HP • Make the HDPE block spin to cut vegetables
Block 	• To hold blade for cutting • It was clamp on motor using bolt • Material: HDPE (High Density Polyethylene)
Dimmer 	• Light dimmer was used to control the speed of the motor • Can hold to 630W • 250V – AC only
Angle Bar 	• Frame for the machine • To mount motor on its place • Material: 304 Stainless *Steel*
Blade 	• The most important part on the machine • It was attached to the block with an angle • For cutting vegetables • Material: Stainless Steel
Pipe 	• The use of the pipe is to load vegetable • To flow the vegetables straight to the cutting blade • Material: PVC
Acrylic Plate 	• To avoid vegetables, scatter out from machine • It also being as safety protection • Material: Polymethyl Methacrylate (PMMA)

Summary of Chapter

In order to learn the facts and information needed to help the research instrument and to be clarified more clearly in this report, in the first level the design of the study and the collection methods, test instruments, data sampling and data analysis methods are carried out systematically in the methodological study. After review of the data, the results and conclusions of success or not of the trap must be confirmed or concluded.

CHAPTER 4

FINDINGS AND ANALYSIS

4.1 Introduction

This chapter combine data and analysis of the Automatic Slicer machine and its materials calculations. This data and analysis are very important for this project to achieve the objectives and scope of the project. This data indicates the successful results of the materials testing. After getting all of this data, we analyze every single possible to make it perfect.

4.2 Testing

On the other hand, the special feature of the project is having a portable port that can be mounted on, like speed controller. The experiment is conducted to test the machine 's efficiency for slicing service. The compartment used for the vegetable slicing process can be seen in Figure 4.2.1. On the HDPE block, there are 3 cutting blades and the distance between cutting blades is 60 degrees, 7 cm long. In order to achieve the desired thickness of the slice, a collar or spacer was used to separate the knives. A long bolt and nut were used to link all the sets of knives and spacers together. The machine can be easily controlled by rotating the motor speed controller. It can reduce the speed during slicing. In addition, this product also offers an inexpensive price, although it is maintenance-free, which means that it can save more than 50% of its cost from its competitor. Electricity produced by spinning blades drive motor generator shaft kinetic

energy that was linked below between the DC motor and the base shaft Finally, it can be concluded that the specified goals have been accomplished and executed effectively.

- These are the steps that have to be done to run the machine.

    1. Turn on the switch.

Figure 4.1: Testing

    2. Adjust the speed on the rotary dimmer.

Figure 4.2: Testing

3. Put the vegetables inside the elbow pipe.

Figure 4.3: Testing

4. Vegetables will be sliced.

Figure 4.4: Testing

4.3 Results

Figure 4.5: Result

It also shows that, for carrot, there is no major difference between medium and large size, but medium size will give the machine high performance in terms of efficiency. With increased knife speed, the performance increased and the carrot was unable to slice at lower speeds.

4.4 Performance Criteria

Test parameters that were measured in evaluating the performance of the machine are throughput capacity and slicing efficiency. Throughput capacity was defined as the ratio of the quantity of sliced materials collected from the machine outlet to the time taken.

$$s_C = \frac{w_s}{T}$$

Where;

Sc = Throughput capacity, kg/h

Ws = Weight of sliced material, kg

T = Time taken, sec

Thus, $S_c = \frac{0.19}{2}$

$= 342kg/h$

The slicing efficiency was described as the weight of any slice minus the weight of damaged slices by 100%

$$\alpha = \frac{\omega_2 - \omega_3}{\omega_2} x100\%$$

Where;

A = Slicing efficiency of slicing, %

ω2 = Weight of all sliced material, g

ω3 = Weight of damaged sliced material, g

Thus, $\alpha = \left(\frac{190-10}{190}\right) \times 100$

=94.74%

Test results with the machine showed adequate efficiency in the slicing of carrot samples. The optimal rotation speed of the knives obtained and regulated by speed controllers, which provided an optimum throughput capacity, with a sliced efficiency of respectively 342 kg / h and 94,74%. Additional machine modification is required to enhance the machine 's performance.

4.5 Suggested Solutions

In order to improve the performance of our automated slicing machine system, we suggest replacing the HP speed controllable motor with a higher speed controllable motor. A higher horsepower speed engine would improve the performance of the machine. For example, the efficiency of the machine would improve when we use a higher horsepower engine since a higher amount of carrot was needed in the first 2 passes as carrot is hard categorized vegetables. Therefore, we suggested replacing the engine with a higher horsepower speed controllable engine in order to provide better output for all machine functions and operations.

In addition, our system components are primarily made of pf stainless steel, wood and plastic and thus the weight of the unit is quite high. The size of our prototype is smaller in size and some of the material is recycled. Vegetables therefore expected to be cut into smaller pieces before the experiment is carried out. We suggest that an actual size machine be built to ensure that a large quantity of vegetables can be handled by the consumer in a short period of time.

In addition, due to budget limitations, we discontinued the use of the IOT module and advanced programming tools. Our computer is primarily intended for commercial use. A fully automated slicing machine is recommended for food and beverage industries. Our computer can be enhanced by using a IOT module and programming software, but this will increase the unit cost of each system.

We also need to improve our safety features for our automated slicing machine. Our prototype is not completely covered to demonstrate how the mechanisms operate and there is no sensor used to improve the protection of the system. As a result, our machine can be strengthened by attaching a cover to the ‘motor dc’ that prevents the user from unintentionally putting his hand on it

Last but not least, our prototype is not multipurpose cutting machine. We suggest to An automated multipurpose vegetable slicing machine is purposely designed to perform slicing, peeling, rolling and crushing operations. It would be greater for traders to use in the market. Besides that, this should improvise into innovative slicing system

and blade design. The innovative cutting method must be impressive. The cutting known as "gentle cut" ensures that the product is cut in a manner that is managed and smooth and that the strain is minimal. This vegetables or fruits can be cut with extreme precision and smoothness. The longer cutting edge and extended service life of the knives ensure higher efficiency as well as reduced effort and expense.

4.6 Advantages

- Save time

With a slicer, our working time can be decreased by half. After the vegetables have been sliced or slashed, our ability to set up a dish will automatically decrease. No more staying in the kitchen often for slicing vegetables for a long amount of time.

- Uniformity

The best thing about a vegetable slicer is the way our vegetable cuts or parts would be consistent. On the off chance that we cut an onion, we'll see the thickness of the rounds is pretty much the same. There is an unmistakable cut when it is fully cut up, decided when we see them evenly piled up.

- Reduce labor requirements

Terrible knife skills are instantly removed from the use of vegetable slicers and don't need to sweat the cooking skills of cutting and slicing because the vegetable slicer does all the work. As a general rule, a vegetable slicer was an easy contraption to keep up. Because it has to be handled physically, once the slicer is used, it is also easy to wash. Reduce labor requirements and eliminate the need for skilled cutters. The change to automatic cutting is an important factor in the labor market. Hand-cutting is a loss.

Summary of Chapter

The study and findings were concluded for this section. Each project has its own advantages and disadvantages, which benefit the people and the community. However, in order to increase the good and very successful product that can hardly find the downside of the project, we can strengthen or improve its disadvantages for the future. Therefore, the challenges are seen as a space for future generation improvements and further innovations and to strengthen their understanding of our project. Test runs are performed to identify the project's full potential.

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 Introduction

This chapter discusses the project's discussion, conclusion and upgrade plan all together. The study was carried out based on the data from the project's test run. The discussion of all the outcomes of the test run and interpretation will therefore be clarified in this chapter. Then, based on the discussion and enhancement plan that has been made.

5.2 Discussion

In order to improve the performance of our automated slicing machine system, we suggest replacing the HP speed controllable motor with a higher speed controllable motor. A higher horsepower speed engine would improve the performance of the machine. For example, the efficiency of the machine would improve when we use a higher horsepower engine since a higher amount of carrot was needed in the first 2 passes as carrot is hard categorized vegetables. Therefore, we suggested replacing the engine with a higher horsepower speed controllable engine in order to provide better output for all machine functions and operations.

In addition, our system components are primarily made of pf stainless steel,wood and plastic and thus the weight of the unit is quite high. The size of our prototype is smaller in size and some of the material is recycled. Vegetables therefore expected to be

cut into smaller pieces before the experiment is carried out. We suggest that an actual size machine be built to ensure that a large quantity of vegetables can be handled by the consumer in a short period of time.

In addition, due to budget limitations, we discontinued the use of the IOT module and advanced programming tools. Our computer is primarily intended for commercial use. A fully automated slicing machine is recommended for food and beverage industries. Our computer can be enhanced by using a IOT module and programming software, but this will increase the unit cost of each system.

We also need to improve our safety features for our automated slicing machine. Our prototype is not completely covered to demonstrate how the mechanisms operate and there is no sensor used to improve the protection of the system. As a result, our machine can be strengthened by attaching a cover to the ‘motor dc’ that prevents the user from unintentionally putting his hand on it

Last but not least, our prototype is not multipurpose cutting machine. We suggest to An automated multipurpose vegetable slicing machine is purposely designed to perform slicing, peeling, rolling and crushing operations.It would be more greater for traders to use in the market. Besides that, this should improvise into innovative slicing system and blade design. The innovative cutting method must be impressive. The cutting known as "gentle cut" ensures that the product is cut in a manner that is managed and smooth and that the strain is minimal. This vegetables or fruits can be cut with extreme precision and smoothness. The longer cutting edge and extended service life of the knives ensure higher efficiency as well as reduced effort and expense.

5.3 Conclusion

We learned how to handle an engineering project collaboratively and effectively from component design up to machinery manufacturing. Good communication and project supervisor helps us to finish our assignment and develop our communication skills as soon as possible. Finally, our goals have been accomplished with the automated slice machine. Our goal is to empower users to reduce their human strength in the preparation of food in a short time and improves the safety of a slicing system for vegetables.

The automatic cutting device for vegetables was manufactured successfully. The main objectives of this project are accomplished entirely, where the computer has allowed the organization, with just one staff, to reduce its number of employees. Our aim is to allow consumers to reduce the human strength of food preparation and to enhance the safety features of the cutting machine by reducing large numbers of vegetables in a shorter period. The consumer must cut various kinds of vegetables for the cutting process

REFERENCES

Xiaowei Jiang 2013, Design and Research on Household Food Slicer, viewed on 10 Dec 2015, <http://maxwellsci.com/print/ajfst/v5-1296-1300.pdf>

Xie, Z., 1996, Review of slicer development abroad. Special. Equip. Electron. Ind., 2536-42, viewed on 22 Sept 2015

C.P.N. Awili, B.V. Omidiji and I. I. Awili, Design of Manual Vegetable Slicing Machine,viewed 22 Sept 2015.

Bird J.O. (1995). Science for engineering, N. Y. Kent Newness viewed 24 Sept 2015

Javier Hidalgo Garcia 2012, Vegetable Cutting Machine, viewed 24 Sept 2015. <http://www.faqs.org/patents/app/20120211577>

Britannia Direct Catering Equipment, viewed 18 Dec 2015, <http://www.britanniadirect.co.uk/dito-sama-combined-vegetable-cutter-and-slicer-trk-

Maxima Vegetable Cutter VC450, viewed 12 Dec 2015, <http://www.maximakitchenequipment.com/en/maxima-vegetable-cutter-vc450.html>

10 Differences Between Aluminum and Stainless Steel, viewed 15 Dec 2015, <http://metalsupermarkets.com/blog/10-differences-aluminum-stainless-steel/>

Vegetable preparation machine CA-401, viewed 15 Dec 2015, <http://www.sammic.com/catalog/dynamic-preparation/commercial-food-processor/ca-

Automatic Vegetable Slicer, viewed 16 Dec 2015, <http://www.onetouchproducts.com/pdf/Slicer_manual.pdf>

Daka One touch Automatic Vegetable Slicer 3-Blade Kitchen Cutting Mandolin, viewed 16 Dec 2015, <http://www.ebay.com/itm/Daka-One-Touch-Automatic-Vegetable-Slicer-3Blade-KitchenCuttingMandolin/391342032089?hash=item5b1dcd84d9: g: yKMAAOSwcBhWbjBL>

ATTACHMENT A

Questionnaires

Section A

1. Sex
   (_) Male
   (_) Female

2. Age

   _____

3. Do you cook regularly?

   (_) Yes
   (_) No

4. Spending time in the kitchen (per day)
   (_) Less than 15 minutes
   (_) 8 hours
   (_) 2 hours
   (_) 4 hours

5. You agree that the preparation of vegetables is tough and too long?
   (_) Yes
   (_) No

6. Do you own a machine for slicing vegetables?
   (_) Yes
   (_) No

7. What is the benefit of having automated slicing machines, in your opinion?
   (_) Manage huge amounts of vegetables
   (_) Safety
   (_) Reduces human energy
   (_) Time saving
   (_) Cleanness

Section B

From the scale of 1-5 review the requirements below

1. Safety
   ( )

2. Cost
   ( )

3. Material
   ( )

4. Appearance
   ( )

5. The Features
   ( )

6. Workable
   ( )

7. Hygienic
   ( )

ATTACHMENT B

Project Activity Planner (GANTT CHART)

WEEK	STATUS	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15
Project Activity																
Briefing and Project Planning	P															
	A															
Project Design	P															
	A															
Material Selection	P															
	A															
Materials Purchase	P															
	A															
Method Selection	P															
	A															
Build	P															
	A															
Test Run	P															
	A															
Analysis Data	P															
	A															
Report Writing	P															
	A															
Video and Slide making	P															
	A															
PITEX preparations	P															
	A															
PITEX presentation	P															
	A															

PLANNING	
ACTUAL	