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DWI FUNCTION PLATFORM (DFP)

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APPRECIATION

Grateful to the Divine presence and blessings on our great master, the Prophet Muhammad SAW, we were able to complete the final project with excellence within the stipulated period of 6 months without facing any problems that are difficult to solve as a condition for the awarding of the Diploma in Mechanical Engineering for session 1: 2021/ 2022. We would like to express our appreciation to all parties involved directly or indirectly, especially our supervisor Mr. Ahmad Fakaruddin bin Mohd Fauzi who has given us a lot of guidance, advice, encouragement and constructive criticism until we successfully complete this final project report. Not forgetting also to the friends and family members who helped a lot in terms of views and finances in completing this final project assignment.

With this, we are grateful to Allah SWT, so this final project is ready. We hope that this report can be used as an example and guide to the relevant parties in the future.

ABSTRACT

Food preparation is important in the food industry and also in every home. This preparation process is not easy as it requires proper techniques and methods. For example, cutting vegetables without emphasizing safety will result in injury to the knife user. In addition to appropriate techniques, the implementation of the cutting process in short period is also crucial. The production of products such as automatic vegetable slicer able to overcome various problem in the food preparation process majorly occur in most restaurant which consume longer time to serve. This study aims to redesign the existing automatic vegetable cutting machines. Methods involves problem statement, idea generation, detail drawing, material and selection, project fabrication, assembly and test run. A series of test will be carried out to determine the most suitable rotation speed in order to get the best cutting product. The main types of vegetable that will be tested are root and tuber crops. Periodic evaluations will be carried out to ensure that the operation of the machine reaches the set standards. The measurement has been identified to make sure the cutting process goes as planned. As a result, we successfully cut vegetable into common slice thickness ranging between 7mm to 9mm. Consideration for this design is ability to cut large size and moist content, product's thickness, and power requirement. In conclusion, this project primarily focuses on redesign current automatic vegetable slicer that able to tackle minor problem occur in current design with the help of mechanical and electrical engineering knowledge.

ABSTRAK

Penyediaan makanan adalah penting dalam industri makanan dan juga di setiap isi rumah. Proses penyediaan ini bukanlah mudah kerana memerlukan teknik dan kaedah yang betul. Contohnya memotong sayur tanpa menitikberatkan keselamatan akan mengakibatkan kecederaan kepada pengguna pisau. Selain teknik yang sesuai, pelaksanaan proses pemotongan dalam tempoh yang singkat juga penting. Pengeluaran produk seperti mesin pemotong sayur automatik ini mampu mengatasi pelbagai masalah semasa proses penyediaan makanan yang sering berlaku di kebanyakkan restoran dimana ia memakan masa yang lebih lama untuk menghidangkan makanan. Kajian ini bertujuan untuk mereka bentuk semula mesin pemotong sayur automatik sedia ada. Kaedah penghasilan ini melibatkan proses pernyataan masalah, penjanaan idea, lukisan terperinci, bahan dan pemilihan, fabrikasi projek, pemasangan dan ujian dijalankan. Satu siri ujian akan dijalankan untuk menentukan kelajuan putaran yang paling sesuai untuk mendapatkan produk pemotongan terbaik. Jenis sayuran utama yang akan diuji ialah tanaman akar dan ubi. Penilaian berkala akan dijalankan untuk memastikan operasi mesin mencapai standard yang ditetapkan. Pengukuran telah dikenal pasti untuk memastikan proses pemotongan berjalan seperti yang dirancang. Hasilnya, kami berjaya memotong sayur mengikut ketebalan kepingan biasa antara 7mm hingga 9mm. Pertimbangan untuk reka bentuk ini ialah keupayaan untuk memotong sayur bersaiz besar dan kandungan lembap, ketebalan hasil pemotongan, dan keperluan kuasa. Kesimpulannya, projek ini tertumpu terutamanya pada reka bentuk semula alat pemotong sayur automatik sedia ada yang mampu menangani masalah kecil yang berlaku dalam reka bentuk pemotong sayur terkini dengan bantuan pengetahuan kejuruteraan mekanikal dan elektrik

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

A healthy and balanced diet is one of the demands for a healthy body. Based on the food pyramid recommended by nutritionists, the intake of vegetables and fruits is in second place. That means the intake of vegetables in the daily diet is crucial and should take in large portions. Vegetables contain so many nutrients such as potassium, dietary fibre, vitamin A and Vitamin C. All these nutrients are crucial not only can prevent disease, but also to help the growth process.

However, cutting and preparing vegetables is one of the processes that require the use of manpower, good time management, and meticulous preparation. Along with the passage of time, more efficient methods of cutting vegetables need to be highlighted. With that, the idea arose to produce an automatic vegetable slicer. This innovation has brought many benefits to our community especially for food business sector.

The presence of this technology is indeed beneficial to various parties. For example, a restaurant that uses this automatic vegetable cutter can perform the task of cutting vegetables on a large scale for a short period while speeding up the food preparation process. In addition to its time-saving use, the cutting quality is also satisfactory.

1.2 PROBLEM STATEMENT

The use of this automatic vegetable cutter has indeed brought many benefits to its users. It can increase the productivity of vegetable cutting, reduce the manpower and time taken to complete the vegetable cutting process. The existing automatic vegetable cutter is a good product but a good one is not necessarily the best. Existing products offer an input to insert the vegetables to be cut while taking longer time to complete the vegetable cutting process. For example, on average a medium-sized potato takes 30 seconds to cut. So, 1kg of potatoes with 7 medium-sized potatoes takes 3 minutes and 30 seconds. The use of existing vegetable cutting machines in the market not only takes a long time, but even the cutting yield is also small. This is so because a small designed input size is only capable of cutting vegetables to a certain size.

1.3 PROJECT OBJECTIVE

- To design a vegetable cutting machine that have double input for cutting and a quiet motor.
- To improve the amount of the output product while decreasing the time consume to complete the vegetable cutting task.

1.4 PROJECT SCOPE

The scope and limits of the research are:

- Able to cut various type of plant such as bulbs (onion, garlic), seeds (green bean), tuber (potato, yam), roots (carrot) and leaves (cabbage, lettuce).
- Fully automatic machine that able to handle task in the kitchen.

1.5 SUMMARY

Research on the problems faced by management in the kitchen has inspired us to implement this project. Although only some types of vegetables will be highlighted in the implementation of this project, it can still achieve the main target of this project, which is to speed up the process of cutting vegetables. Optimal speed will be used throughout the evaluation process to obtain efficient results.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In literature review chapter, a discussion based on experience, past studies, journals, articles, and websites on automatic vegetable cutters triggers the idea of improvement to this project. This literature review was made to support the ideas of the producers of this project.

Vegetables are usually listed as edible herbaceous plants and are divided into specific classes. It can be eaten raw or cooked in several ways. Among the classes of vegetables that can be eaten are tubers, fruits, seeds, flowers, leaves, and roots. Preparing vegetables is indeed a difficult task as it requires a wide variety of skills such as time management skills. These skills are emphasized more and more to restaurant operators as the preparation of food on a large scale is undertaken every time they require the preparation of the preparation process in a short time and various cuts in the best conditions.

The presence of automatic vegetable cutters in our generation solved most of the problem in the kitchen. This automatic vegetable cutter is not a new invention. In fact, around the 1960s there was the first invention of automatic vegetable cutters. Advances over time have made this automatic vegetable cutter improved and can solve 1001 problems faced by users.

2.2 PREVIOUS RESEARCH

2.1.1 Research on existing vegetable slicer

(MUHAMMAD AKMAL BIN LOKMAN)

The use of technology and machines in this age of advanced technology is no stranger to society. The invention of this automatic vegetable cutter makes a great contribution in the implementation of the vegetable cutting process in the kitchen. Around the 1960s, the invention of the first automatic vegetable cutter was successfully produced by Brunner Anliker, a company from Kloten, Switzerland until in 1971, the production facility was then moved to Ticino. To this day, this automatic vegetable cutting technology is growing rapidly. Various companies around the world have produced this product as it can bring benefits. Here are some examples of automatic vegetable cutting products available in the market A.

Figure 2.1 shown the development of automatic vegetable cutter from Brunner Anliker

a) Dito Sama 600398 TRS Classic Vegetable Cutter

Figure 2.2

Dito Sama 600398 vegetable cutter is a product from Dito Sama. This speed cutting machine able to slice, dice, grate, julienne, or crinkle cut vegetables and fruits. It can produce huge number of French fries, shredded cabbage for coleslaw, and many more. Two hoppers with different size can handle the cutting of two different size of vegetable. It has a cover and feed arm made of polished aluminium that are removable in order to improve user access and ensure complete cleaning. As for safety factor, the cutter will stop automatically once the hopper is removed or the lever opened. The unit feeds and ejects the output from the front, so workplace is compact and efficient. Furthermore, this feature can also reduce the countertop footprint.

b) Presto 02910 Salad Shooter

Figure 2.3

Presto salad shooter is an electric vegetable shredder which will allow you to add ingredient after another with ease without having to stop and clean it. The concept of this machine is to cut and shoot the vegetable into cuisine or cooking. Although it comes in small size but it capable of doing most of the task in the kitchen. It able to shreds cheese for pizza, potatoes for hash browns, slice apple for salad and many more. It is made of plastic and weight for 0.9kg. Apart from having a lightweight body, it is also easy to use as it operates automatically.

c) Maxima VC540 vegetable cutter

Figure 2.4

Maxima VC540 vegetable cutter is one of the product from Maxima Kitchen Equipment. Weighing in at 22.5kg, this automatic vegetable cutter is capable of making various types of cuts such as slicing, grating and chopping with disc -formed blades. The main material to produce this product is aluminium. In addition, the capacity that can be accommodated in one hour is 50kg to 450kg. Seeing the capacity that can be accommodated, this machine is very suitable for the usage of restaurants as it can help to complete the cutting process on a large scale. The main components for this product are two hoppers of different sizes, a flat bottom and a housing. The power supplied for 1 phase motor is 550W. The price set for this automatic vegetable cutter is RM2200.

2.3 COMPONENT

a) AC motor

(MUHAMMAD AKMAL BIN LOKMAN)

2.3.1. Introduction

The word motor is another term for the actuator that drives the entire system. In this age of advanced technology, electric motors are used as devices that can convert electrical energy into mechanical energy. These electric motors have been classified into two types which is AC motors and DC motors. AC motors use alternating current DC motors draw direct current. These two motors can be categorized in various forms such as horsepower, power rating, and so on.

Present in a small size, however, this machine is capable of producing quite strong energy in the combustion systems in vehicles and motorboats. A moving product or human being, an auxiliary device as steam that receives and uses energy from various sources to produce movement and run a machine. Everything is called an electric motor.

2.3.2 History of motor

As early as the 1740s, early incarnations of electric motors first appeared a work produced by Scottish-born Benedictine monk and scientist Andrew Gordon. At the same time, experiments with electromagnetic fields were conducted by other scientists such as Michael Faraday and Joseph Henry to develop early electric motors. This experiment was successfully used to convert electrical energy into mechanical energy. In 1834, the invention of the first battery -powered electric motor was produced by Thomas Devonport. This electric motor is also the first electric motor that is able to produce enough energy to complete a task. This invention is used to generate power for small -scale printing presses. Frank Julian Sprague succeeded in producing the first practical DC motor capable of moving at uniform speeds under different weights. This motor became the starting point for the wider use of electric motors and is applied in industry. Before the invention of this first practical electric motor was produced, William Sturgeon invented the first Dc motor that was only capable of producing enough power to drive machinery.

Since the great discovery of Thomas Devonport, the use of electric motors has not yet been widely used commercially. Scientists and engineers took the initiative to develop various types of electric motors to realize the use of electric motors at the commercial level. Around the late 1880s, electric motors began to be used commercially in factories and home industries. In 1888, Nikola Tesla made the Induction AC motor and a year later he patented the Induction Ac motor. However, the motor he invented was applied to land vehicles. The creation of this Ac Induction motor was later adapted by Westinghouse engineers. The first practical induction motor was successful in 1892 followed by the rotating bar winding rotor used. The use of this induction motor is suitable for land vehicles.

General Electric developed a three -phase induction motor in 1891and in 1896 a cross - licensing agreement was signed between General Electric and Westinghouse engineers to use the bar winding rotor design. In the 21st century, AC motors and DC motors have been widely used in industry and even become a major component in the production of a product. The application of these AC and DC motors can be seen in automatic ladders, electric -powered wheelchairs, industrial automation and solar.

2.3.3 The Comparison between AC and DC motor

The selection of the appropriate motor is something that needs to be emphasized. The motor can be driven through two power sources either direct current (DC) or alternating current (AC).

Table 2.1: Comparison between AC and DC motor

AC motor	DC motor
Does not acquire the conversion of current	Current is converted from alternative (AC) to direct (DC)
Available in two phase type, single-phase or three phase	All DC motors are single phase
Armatures does not rotate with the continuous rotation of magnetic fields	Armature rotates while the magnetic field rotates
	Short life expectancy

Long life expectancy Cheaper maintenance	Expensive maintenance

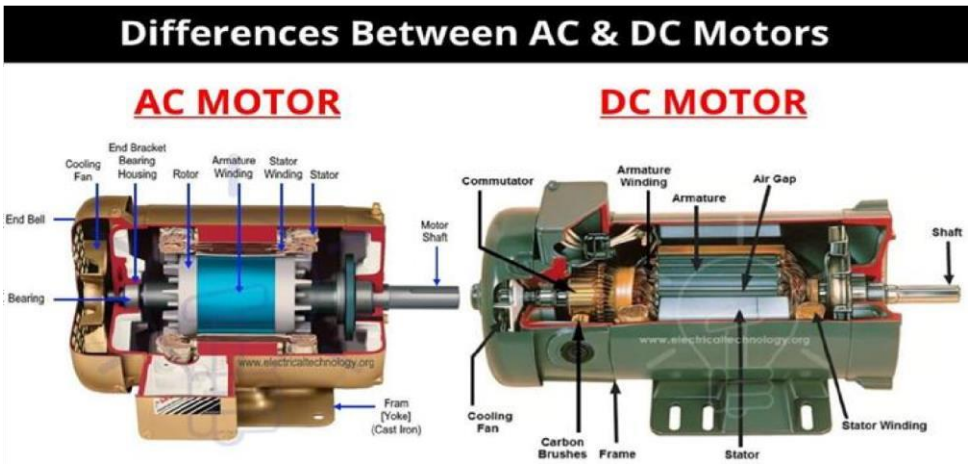


Figure 2.5

2.3.4. Advantages of AC and DC motor

Although AC and DC motors have significant differences, they still havetheir own advantages. This advantage makes this motor more suitable to use in an electronic device.

Table 2.2: Advantages of AC and DC motor

AC motor	DC motor
Low start up power demands	Simpler installation and maintenance

Protect components on the receiving end	High start-up power and torque
Controllable starting current levels and acceleration	Fast response to command such as start, stop and accelerate
Variable Frequency Drive (VFD) or Variable Speed Drive (VSD) add-ons that can control speed and torque at different stages of use	Available in several standard voltage
High durability and long life expectancy	
Capabilities for multi-phase configurations	

2.3.5. Main types and working principles of AC motor

The main class of AC motors is divided into two. They are synchronous motors and induction motors. These two types of motors are significantly different but these two types of motors have two similar parts, namely the stator and rotor. The stator and rotor are the two most important parts of an AC motor. The stator is the stationary part of the motor while the rotor is the rotating part. AC motors are available in single-phase or three-phase.

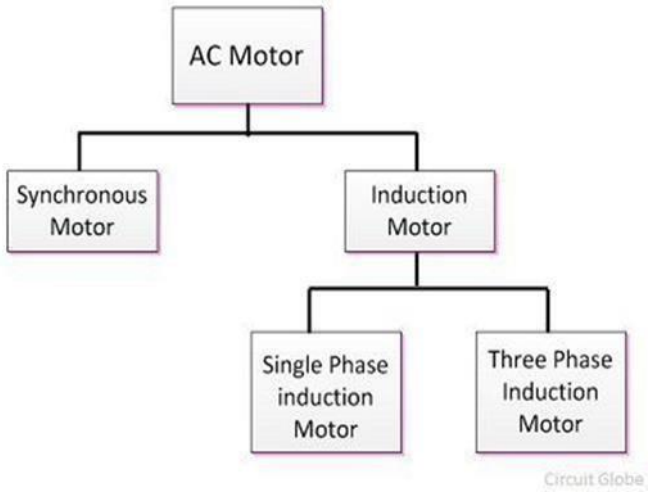


Figure 2.6

1. Synchronous Motor

Synchronous motor is a motor that converts AC electrical power into mechanical power. This motor only operates at synchronous speed. When the power supply is passed to the synchronous motor, a rotating field is available. This field will drag the rotor with it but in the presenceof inertia, the rotor cannot rotate. Therefore, the production of starting torque will not occur. So, a synchronous motor is not a motor that can bestarted on its own.

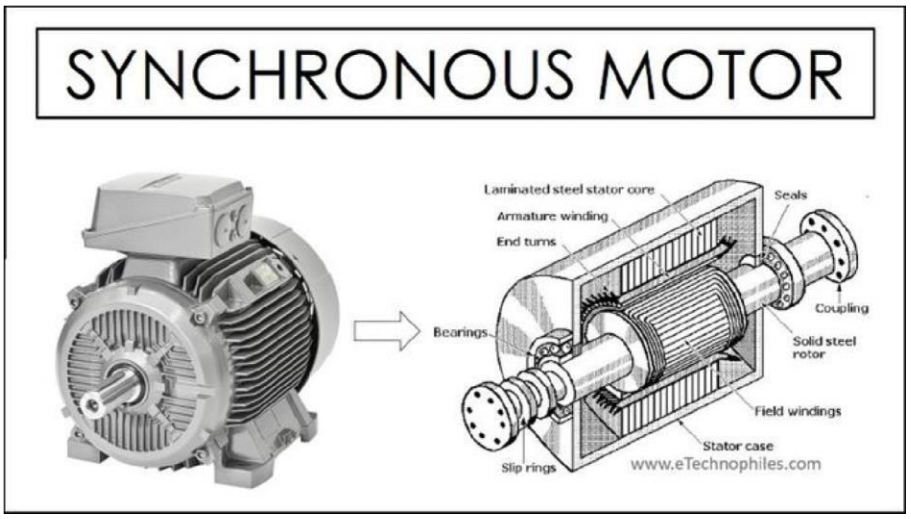


Figure 2.7

1. Induction motor

An induction motor is a motor that converts AC electrical power into mechanical power by using the phenomenon of electromagnetic induction. These motors can be classified into two types, namely single phase induction motors and single-phase induction motors. In induction motors, the armature windings have a function as armature windings andfield windings. Flux will result in the air gap when the stator windings are connected to the AC supply. This rotating flux will drive a voltage inthe stator and rotor windings. If the rotor circuit is closed, current will flow through the rotor windings and the response from the rotating flux will produce torque. In a steady-state, the rotor will rotate at a speed almost equal to the synchronous speed.

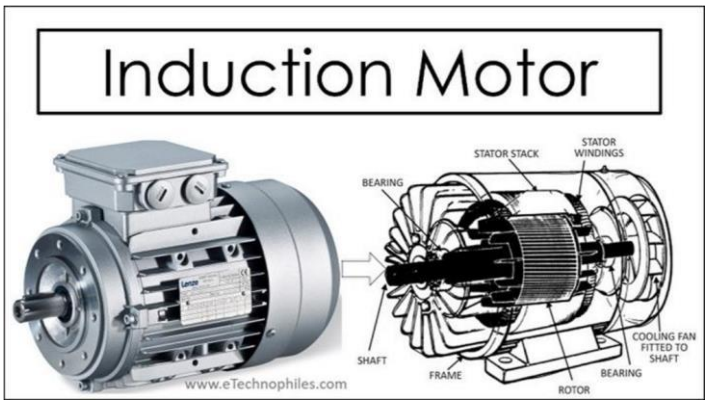


Figure 2.8

2. Working principle

The principle of magnetism is the basic operation of an AC motor. AC motor rely heavily on this principle. Briefly, an AC motor contains a coil of wire and two fixed magnets around the shaft. Once an electric charge (AC) is on the coil of wire, it will become an electromagnet and this electromagnet produces a magnetic field. On the stator, there are several components such as coils, solid metal axles, wire loops, squirrel cages made of metal bars, and other freely rotating metal parts that can conduct electricity. Power can be sent to the outlet coil that forms the stator in this AC motor. A magnetic field will result in the presence of a coil. The coils are energized in pairs and sequence. The rotor is suspended in a magnetic field and this magnetic field will always change due to rotation. According to the laws of electromagnetism, a magnetic field will produce an electric current in a rotor. If the conductor is in the shape of a ring or wire, an electric current will flow around it in a loop. As for the conductor of a piece of solid metal, the eddy current will flow around it. According to another law of electromagnetism, the force of a magnetic field will rotate according to its conductor. Therefore, the induced current can produce its magnetic field. The shaft and coil of wire will rotate and operate the motor immediately after interaction with the magnet.

b) Stainless steel 304 blade

(NUR EMELIA ARISSYA BINTI MOHD RASHID)

2.3.7 Introduction

Stainless steel has many different types. Unlike other steels, stainless steels use a composite mixture of added chromium and other alloy elements such as nickel. The result of this mixture of elements is stainless steel. According to chemistry, iron will corrode during a chemical reaction between iron and oxygen. This chemical reaction is called the oxidation of iron which then produced Iron (IIII) oxide. This reaction happened due to the instability of the iron as it is artificiallymanipulated into a pure form and the probability for this iron to combine with oxygen becomes very high.

The presence of chromium causes oxygen to react with chromium. The result of this combined reaction is chromium oxide which plays a protective role in the use of air and moisture causing corrosion to occur. As much as 10.5% to 30% chromium is added into this steel according to its environment and application. This type of stainless steel can be classified into 5 main grades.

Austenitic is the most widely used type of stainless steel. Among the propertiesof this steel are its excellent heat and corrosion resistance as well as its mechanical properties that are suitable for all temperatures. It is widely used in industry and construction. Next is ferrite stainless steel which has properties similar to ordinary steel but has better corrosion, heat, and cracking resistance. The use of this ferrite steel is on boilers and interior architecture. Another grade of stainless steel is martensitic stainless steel which has hard and strong properties. As much as 13% chromium is found in this grade steel however this steel is not resistant to corrosion. Products that can be produced using this gradeof stainless steel are turbine blades and blades. Duplex stainless steel is a strongand flexible stainless steel. This steel grade is the result of a combination of austenitic and ferrite steels. This steel is applied in

shipbuilding and petrochemicals. Hardening stainless steel is a highly physically strong steel combined with other elements such as aluminium and copper.

2.3.8 History of Stainless Steel

In 1913, an individual known as Harry Brearley originally from Sheffield,

England had used “anti -rust” steel. Many attempts have been made however Brearly successfully produced the first stainless steel and has been given credit. Stainless steel is produced by it by adding chromium to molten iron. Therefore, the stainless steel produced by adding 12.8% chromium. Chromium is the main material that gives steel resistance to corrosion. Sheffield became a famous city with iron and steel and metallurgy as a result of this discovery. The emergence of this idea of making stainless steel early on he wanted to solve the problems of corrosion at the internal surface of weapons in the British army often happened during the start of the First World War.

The discovery of this stainless steel has inspired every individual of the other companies to improve this stainless steel. Among those involved were Elwood Haynes obtained a patent on martensitic stainless steel in 1919, William J. Kroll, originally from Luxembourg was the first to use hardened stainless steel in 1929in and Avesta Ironwork from Sweden successfully made duplex stainless steel first. Over time, more and more people are aware of the extraordinary properties found in stainless steel. Therefore, the use of stainless steel is increasingly widely used.

Among the uses of stainless steel can be seen in 1925 where stainless steel tanks are used to store nitric acid while proving that this steel can prevent strong acid corrosion. In addition, the use of stainless steel was once used in the manufacture of aircraft which was also the first aircraft to use stainless steel in 1931.

In 2010, the production of this stainless steel reached 30 million tons. This large figure can conclude that the use of this stainless steel is becoming more widespread. More and more products are produced using stainless steel as this steel has many benefits of

its own.

2.3.9 Comparison between stainless steel 304 and 316

Stainless steel 304 and 316 are among the grades for stainless steel. Slight differences in composite alloys cause there to be slight physical differences between these two stainless sheets of steel. Yet such common features have at least 10.5% chromium and there are additional alloying materials such as molybdenum, nickel, titanium, aluminium, copper, nitrogen, and phosphorus.

Table 2.3: Comparison between Stainless steel 304 and 316

Stainless Steel 304	Stainless steel 316
Less nickel and no molybdenum	Have more nickel and a bit of molybdenum
A bit higher melting (difference of 50 – 100 degree Fahrenheit)	A bit lower melting point
Lower resistance to chemical	High resistance to chemical
Lower cost	and chloride (such as salt)

	Higher cost due to addition of molybdenum

Based on the comparison made in the table 2.3, the use of stainless steel 304 is the most suitable main material for cutter. Nickel is not a soft metal but will cause the steel to stay in the soft crystal structured when there is presence of heat. Furthermore, the cost of stainless steel 304 are much cheaper than stainless steel 316.

2.3.10 Stainless steel 304 as blade

Figure 2.9

The flat knives that are on the market today use stainless steel as the main material of their manufacture. However, not all of this stainless steel is suitable to use as cutlery as each stainless steel has a different composite. Stainless steel 304 is the most widely used steel for the manufacture of utensils in the kitchen. This is due to its corrosion resistance to most corrosion agents and its heat resistance. Furthermore, this stainless steel is highly weld able where it can be combined with other materials to carry out the fabrication process. Most household cleaners are acidic, but this steel will not corrode due to its resistance to most materials. In addition, this stainless steel also has good hardness and toughness. According to the Rockwell B test, stainless steel 304 has hardness with a rating of 70. When compared to the copper material which has a rating of 51.304, stainless steel is much harder. A higher rating value in the Rockwell B test indicates a higher hardness of a material. Due to that, this stainless steel is much more suitable to be used as kitchenware rather than copper.

2.3.11 Advantages and disadvantages of stainless steel 304 as blade.

Although the use of stainless steel brings many benefits, it still has its advantages and disadvantages. Among the advantages of using stainless steel 304 is that this steel has physically still look new. In addition, this stainless steel also has good hardness. Good hardness is essential in the manufacture of knives or cutters so that they can withstand the force exerted on them. The corrosion resistance which is one of the features found in this stainless steel simplifies the cleaning process with any cleaning agent without having to worry.

However, the disadvantage of stainless steel 304 is that this steel can still be corroded with chloride solution and easily corroded in a saline environment. Chloride substances can produce pitting on this steel and physically damaging this steel. This stainless steel has a high amount of nickel and although it is not a soft iron the presence of nickel to some extent forces the steel to remain in a soft crystal structure when it is manipulated with heat high corrosion resistance.

This can make the knife can be used for a long time.

c) Acrylic

(SELWENDHRAN A/L PARMESPARAN)

2.3.12 Introduction

Acrylic is a transparent thermoplastic homopolymer similar to polycarbonate in that it is suitable for use as an impact-resistant alternative to glass (especially when the impact strength of PC is not required). This acrylic is also known by its trade name of "plexiglass". In 1928, the first acrylic was produced and around 1933, the Rohm and Haas Company successfully brought acrylic to market. It is one of the clearest plastics available on the market. Among the applications of acrylic at the time was in World War II, it was used in submarine periscopes as well as tower windows, airplanes, and canopies. Airmen who were injured in the eye as a result of being hit by acrylic fragments were considered fortunate to have been hit by broken glass fragments.

In this modern era, acrylics are generally used in a variety of applications that take advantage of the natural transparency of these acrylics and the impact resistance of certain variants. Among its applications can be seen on lenses, acrylic nails, safety barriers, medical devices, paint, LCD screens, windows, tanks, covers around displays and furniture. Among the acrylic features that allow the acrylic to enjoy great popularity and influence in the market are high impact resistance, high optical clarity, natural weather resistance and UV resistance, excellent dimensional stability, lightweight, and excellent chemical resistance. Of all these properties, the advantage of acrylic that steals the attention of various parties is its durability. It has 10 times better durability than a glass even though the price is much cheaper. If this acrylic breaks, it will not break due to sharp and dangerous fragments such as glass instead it will only break into dull-edged pieces. Therefore, acrylic has such good popularity that it is used as a window for commercial buildings

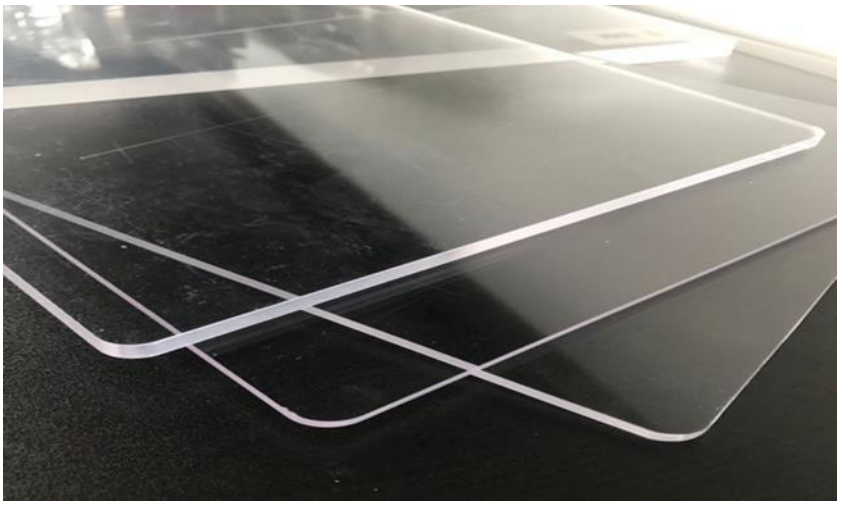


Figure 2.10

2.3.13 History of acrylic glass

The existence and production of this acrylic are much older than most people think. Even acrylics can last for longer than expected. There were reports of the polymerization of acrylic (methacrylate) around 1877. About 50 years later, Herr Doctor Otto Röhm became the first to produce the first acrylic sheet through a polymerization method that enabled commercialization. In 1934, about 7 years from the production of the first acrylic sheet, factory production by the Röhm & Haas Company based in Darmstadt, Germany began under the Plexiglas brand.

The acrylic casting method that is still used to this day was developed by I. Crawford, an engineer from the UK in 1935. Acrylic sheets were used to produce lenses, covers, and windows on the first day. Acrylic played a very important role in World War II. German aircraft and vehicles were equipped with Plexiglas while Perspex was used on behalf of the British. After the end of World War II, there was a sharp decline in the demand for acrylic. This is because at that time the use of clear acrylic was an important material during the war.

The development of acrylic initiated now involves other uses, therefore the design, color, and dispersion (opal) should also be changed according to the suitability of the product. Among its applications are protective covers for fluorescent street lights and many illuminated advertising bins. The characteristic features of acrylic such as lightweight, weather-resistant, hard to break, and durable make acrylic very suitable for the application. Demand for acrylics that have increasing sheet and block sizes is also hot in the market. It is used for protection, roof panels, and furniture. Over time, the demand for these acrylics is increasing. In addition, the laboratory has also developed various new variants with the addition of materials that can add benefits to acrylic. For example, the addition of latex into acrylic can increase the impact resistance of acrylic.

In addition, many acrylics are also used for injection molding and extrusion. This type of acrylic is different from cast acrylic. This type of injection molding and extrusion acrylic has a lower molecular weight so that it can flow better. The application of acrylic is also more different so that there is acrylic that is almost not polymerized to be used as an additive to motor oil, lubricating oil. The presence of this acrylic can help add a very important viscosity. Demand for acrylics is also increasing for paints and varnishes. Acrylic is also the basic raw material for making some types of textiles. Acrylic plays a role in retaining heat. After World War II, almost every country in the world created a cast and extruded acrylic company. Altuglas from France and Setacryl from Italy by Madre Perla are examples of companies. Most of these acrylic businesses are small family businesses that serve a particular sector. In addition, some specialists can produce thick and large-sized blocks for aquarium manufacture as well as specialists who produce multi-layer tubes or sheets or special diffusers for the lighting market.

Figure 2.11

2.3.14 Advantages and disadvantages of acrylic

Acrylic sheet is an excellent replacement for traditional glass as it can be used for a variety of purposes. Acrylic is a versatile material that has many uses in addition to having a much cheaper price than glass. However, each material has its own advantages and disadvantages. Table below shown the advantages and disadvantages of acrylic.

Table 2.4: Advantages and disadvantages of acrylic

Advantages	Disadvantages
• Stronger than glass • Lighter than glass • Cheap • Easier to work with • Durable • More translucent • Safer than glass	• More liable to scratching than glass • Not heat-resistant

2.4 SUMMARY

Summaries from this chapter, reading and research are very important because a lot of new knowledge can be gained by conducting this study. All data and information obtained from this chapter are based on reliable sources. Various studies have been conducted involving existing products and important components to be used on the project. In addition, the writing of this chapter has greatly sparked the idea of selecting items that are suitable for the project as well as understanding the functions and advantages of each material more clearly.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This technique is a general research programme that specifies how research will be carried out and, among other things, describes the methods that will be used. These methods, as identified in this approach, determine how data is collected or, in some cases, how a specific outcome is to be estimated. Even if more importance is placed on the nature and types of procedures to be followed in a specific process or to accomplish a specific goal, method does not describe specific methods.

As the title suggests, this chapter contains the dissertation's research technique. In more detail, this section will be divided into four sections: project design, design evaluation, materials selection, and data analysis tools that will be used to perform this research.

Finally, the selection mode of analysis used is thoroughly explained in this chapter.

3.2 PROJECT DESIGN

a) Design 1

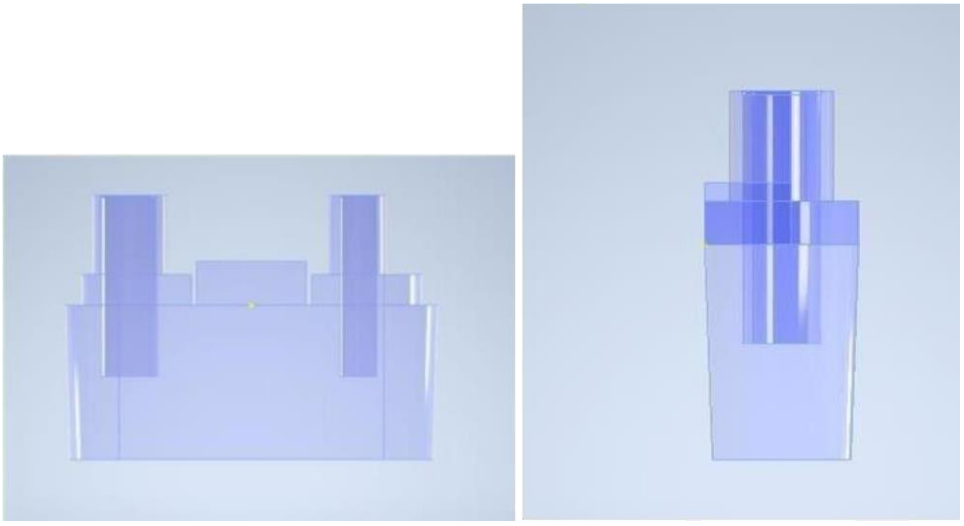


Figure 3.12

Design 1 depicts the initial design of our Automatic Vegetable Slicer created with the Autodesk Inventor Professional 2021 application. The disadvantages outnumber the benefits with this design. For example, the glass container for this design is notorious for its fragility and might induce bleeding if cracked. This design is additionally expensive due to the stainless steel material decision, which is more expensive than aluminium. Aside from that, its dimension of 55cm x 40cm x 35cm gives it a lot of mobility. Furthermore, two distinct vegetable entry sizes can be handled at the same time.

b) Design 2

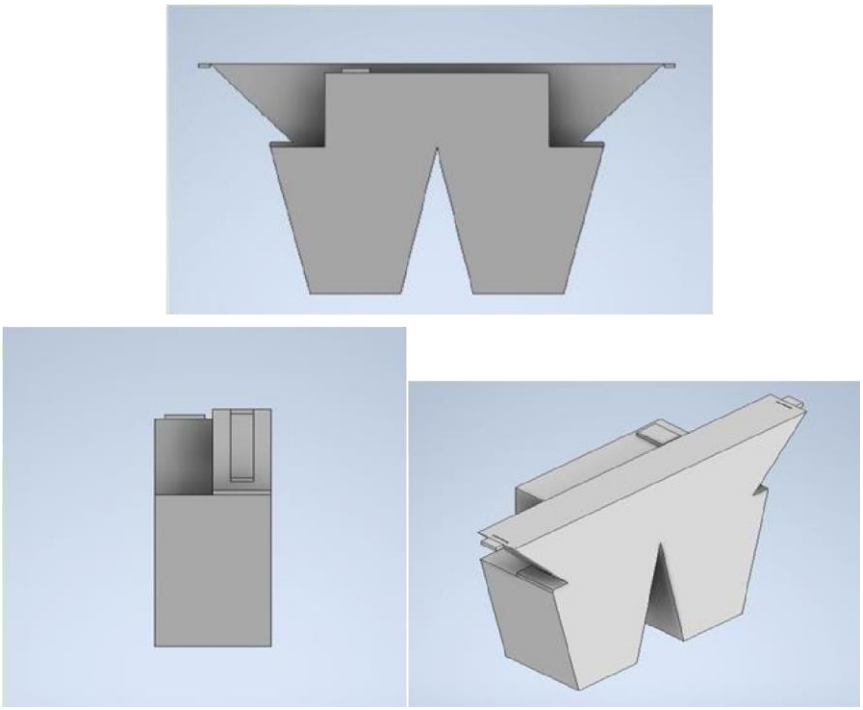


Figure 3.13

Using the Autodesk Inventor Professional 2021 application, Design 2 depicts the second design of our Automatic Vegetable Slicer. This design is distinct from the first. This design focuses on the oval and round shapes of veggies. Vegetables must also be tiny in size, making them unsuitable for catering or large events. Aside from that, its design has a pusher to prevent the veggie from slipping and becoming filthy. However, because the capacity for this design is 4kg - 6kg, the pusher can be difficult to use at times. Aside from that, the container is constructed of plastic, and the power button is water resistant.

c) Design 3

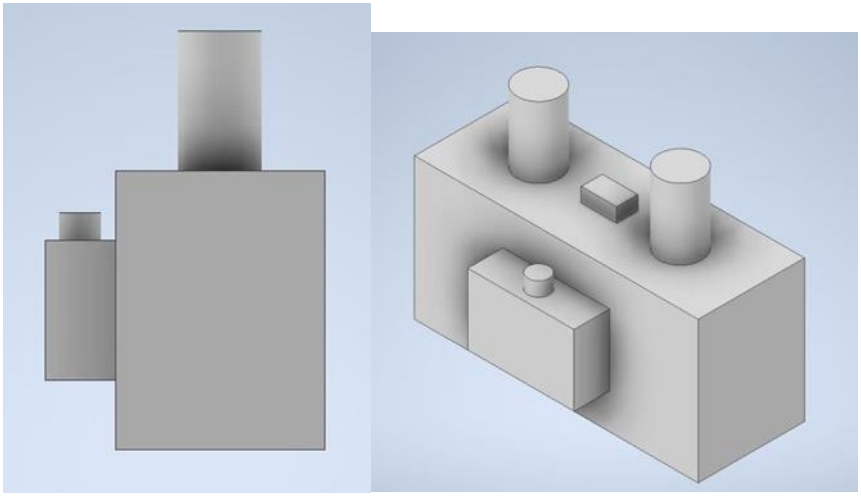
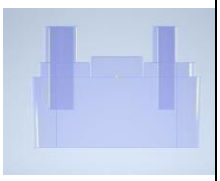
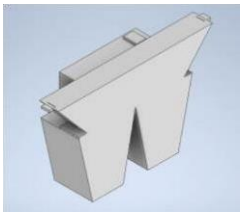
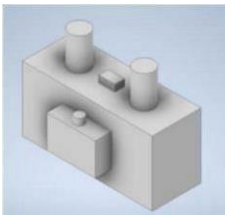


Figure 3.14

Using the tool Autodesk Inventor Professional 2021, Design 2 depicts the third design of our Automatic Vegetable Slicer. This is a more advanced variant of design 1. This design focuses on avoiding the use of plastic and allowing all components to be recycled. Aside from that, the power button is firm, and there are several types of buttons, such as the speed level. Glass and aluminium are used to make the container and thebody, same like in design 1. Aside from that, due to the materialselection, this design may be costly. The tube and the container are bothdelicate.

CRITERIA EVALUATION

Table 3.5

	1	2	3
Design			
Main Material (body)	Stainless steel	Aluminium	Acrylic
Cutter Blade Material	Stainless steel	Stainless Steel	Stainless Steel
Dimension(cm)	55 x 40 x 35	40 x 28 x 19	30x 15 x 20
Capacity (kg)	8 - 10	4 - 6	8
Mass (kg)	18	15	6
Container Material	Glass	Plastic	Acrylic

Design 3 is the best design in terms of material, aesthetics, utility, Eco-friendliness, and convenience, as shown in the tablet below. In the end, we chose to go with Design 3 as the winning design.

3.2.1 PROJECT PRODUCTION METHOD

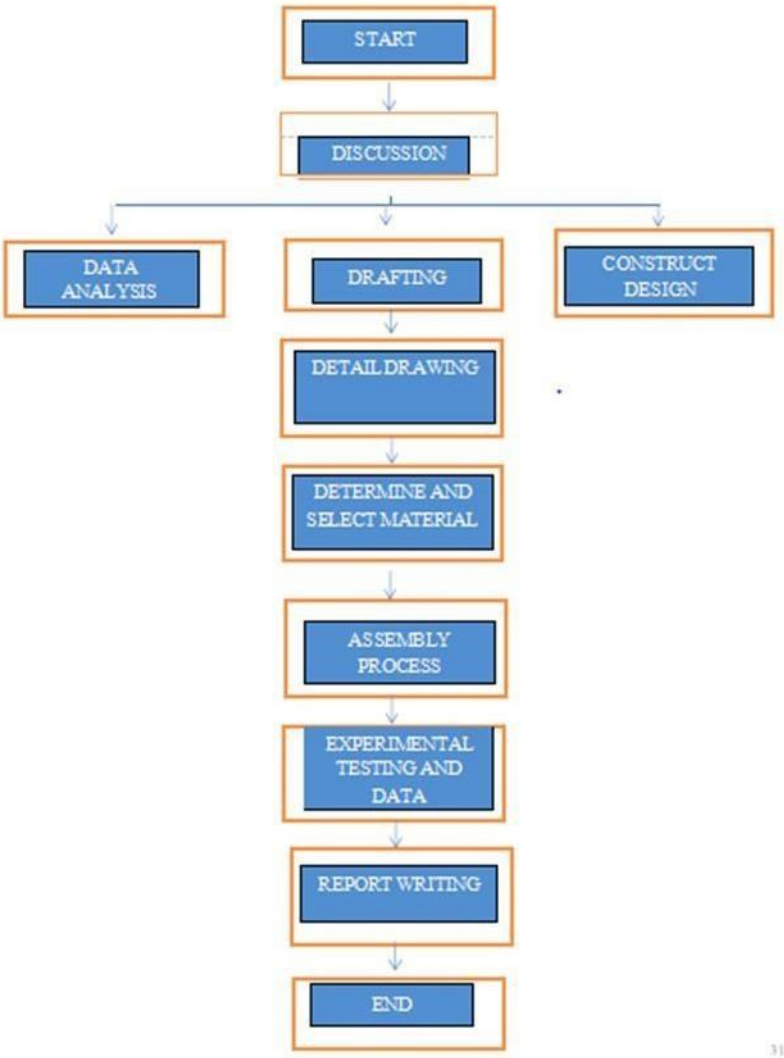


Figure 3.15 : Project production method

Discussion

This debate is between group members, and those who are presenting ideas must present relevant facts and follow to the concept, which is innovative and sustainable. The project's goal should be to solve difficulties that we face in our environment. The project's aim is to develop improvements to our current goal.

Data Analysis

This section should discuss products that are similar to our project. Therefore, each member of the group is required to produce a product that is already on the market for us to improve our project.

Project Design

In this process, each design produced must have a detailed design that hasits own function on each part.

Material Selection

To produce a good model, the selection of appropriate materials is an importantaspect that needs to be detailed carefully and well**.**

Assembly Process

Assembly process will be done when all components and materials are complete enough. Other than that, finishing will be carried out when the installation process is completed perfectly.

Experimental Testing and Data

Conduct evaluation to obtain the resulting data through project evaluation design. It is proven to have a better effect in identifying project problems and helping to improve the project.

3.2.2 MATERIAL TYPE AND EQUIPMENT

- AC motor
- Acrylic
- Acrylic Tube
- On/Off Button
- 304 Stainless Steel Blade
- Wire

a) AC motor

Figure 3.16

We chose to use an AC motor as the main engine to move the motorised vegetable slicer. This alternating current motor may convert electrical energy to mechanical energy. The stator and rotor are the two fundamental components of all types of AC motors. Single-phase and three-phase AC motors are offered. AC is also noted for having a longer life expectancy, making it suitable for a wide range of applications.

b) Acrylic

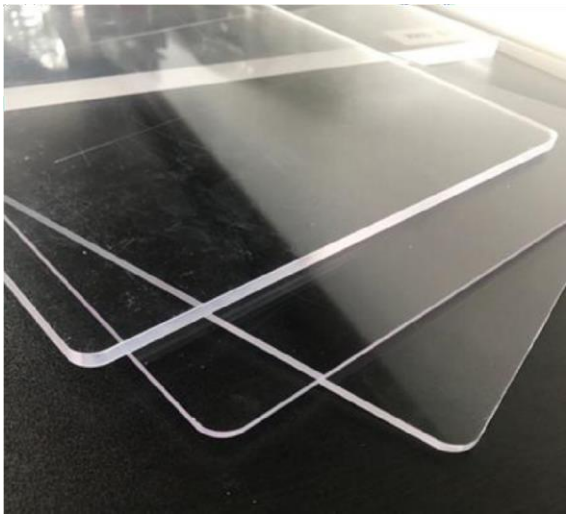


Figure 3.17

Acrylic is a well-known material that is utilized for a wide range of applications. Acrylic is similar to glass, however it is far less expensive, more durable, easier to work with, and lighter. The thickness of acrylic variesfrom 5mm to 10mm.

c) 304 Stainless steel cutter

Figure 3.18

The blade or cutter is made of stainless steel 304, which is the most common stainless steel. This material has a lower electrical and thermal conductivity than carbon steel and is fundamentally magnetic, though not as magnetic as steel. Aside from that, this material can be used in a range of home and industrial applications, including food handling. Aside from that, this material is very resistant to a wide range of climatic conditions and corrosive fluids**.**

3.2.3 DATA ANALYSIS METHOD

The process of systematically applying statistical and logical approaches to explain and explain any type of data is known as data analysis. There are two types of data analysis approaches: quantitative and qualitative methods.

The data analysis approach employed in this process is a Google Form application in the form of a questionnaire. The application will save every data that can be obtained. The information gathered from the community is then presented in the form of graphs and charts for easy comprehension. This strategy entails questioning the community's issues in order to attain the project's objectives. As a result, adopting the questionnaire approach to create this project can help the process.

3.2.4 SAMPLING

The sampling involved several types of vegetables. The vegetables will be put into the input and cut through a rotating knife. The types of vegetables tested were root and gourd vegetables. This sampling is carried out to determine the time taken to cut a unit of vegetables and the number of vegetables that can be cut.

3.3 RESEARCH INSTRUMENT

In the instrument of this study, the questionnaire method was chosen. The selection of respondents consisted of various parties. The questionnaire used consists of a multiple choice question format. The questionnaire that will be prepared is divided into three (3) main sections, namely:

a) Part A: Demographics of Respondents (Gender, Age, Status)

b) Part B: General views on the study

c) Part B: Respondents' perspective on Automatic Vegetable Slicer

3.3.1 PRODUCT REVENUE

Here are the way to produce Automatic Vegetable Slicer :

(SELWENDHRAN A/L PARMESPARAN)

Figure 3.19

Figure 3.19 shows the first step in producing an Automatic Vegetable Slicer. Acrylic is coated with epoxy glue that is able to attach acrylic to other acrylic surfaces. Acrylic for the cutting container parts and the blade base are joined according to the predetermined measurements.

(MUHAMMAD AKMAL BIN LOKMAN)

Figure 3.20

Once the stitching part is complete, the next step is wiring. This wire connection takes quite a long time due to lack of experience and understanding in wiring. **Figure 3.20** shows the process of merging the wires of two AC motors. The wires are joined using soldering and soldering wire. Wires are connected as appropriate to prevent the occurrence of electric shock.

(NUR EMELIA ARISSYA BINTI MOHD RASHID)

Figure 3.21

After the wiring procedure is completed, the material manufacture process must be completed. The merging procedure is depicted in **Figure 3.21**. An Automatic Vegetable Slicer will be made from the assembled acrylic, stainless steel blade, and wired motor. Because there isn't much material involved, this process takes only a few minutes.

Figure 3.22

Figure 3.22 depicts the results that are ready to be put to the test. This project is evaluated based on the amount of time it takes to complete and the quantity that can be produced in order to meet the study's objectives. Cucumber and carrot vegetables will be used in the experiment.

3.4 METHODS OF DATA ANALYSIS

In the process of analysing this, the data that has been collected will be analysed and the results to be achieved are displayed in the form of a pie chart

3.5 SUMMARY

The design of the study, as well as the collection methods, test instruments, data sampling, and data analysis methods, are carried out systematically in the methodological study in order to learn the facts and information needed to help the research instrument and to be clarified more clearly in this report. The observations and conclusions of the trap's success or failure must be confirmed or determined after evaluating the data.

CHAPTER 4

PRELIMINARY FINDINGS

4.1 INTRODUCTION

This chapter explains the results of the questionnaire that was distributed over WhatsApp to randomly chosen persons. We can learn about customer input and potential improvements by filling out this form. Because the results are presented in a pie chart, this chapter is similarly simple to present. On June 1, 2021, we began distributing surveys. We received 38 responses until June 11th, 2021. The respondent answers eight questions that will aid us in the completion of this project.

The data analysis methods utilised in the study to collect data and information to meet the study's objectives are discussed in this section. As a result, the results of data analysis obtained from a questionnaire with 30 participants were used to determine the autonomous slicing machine's specifications.

4.2 PROFILE OF RESPONDENTS

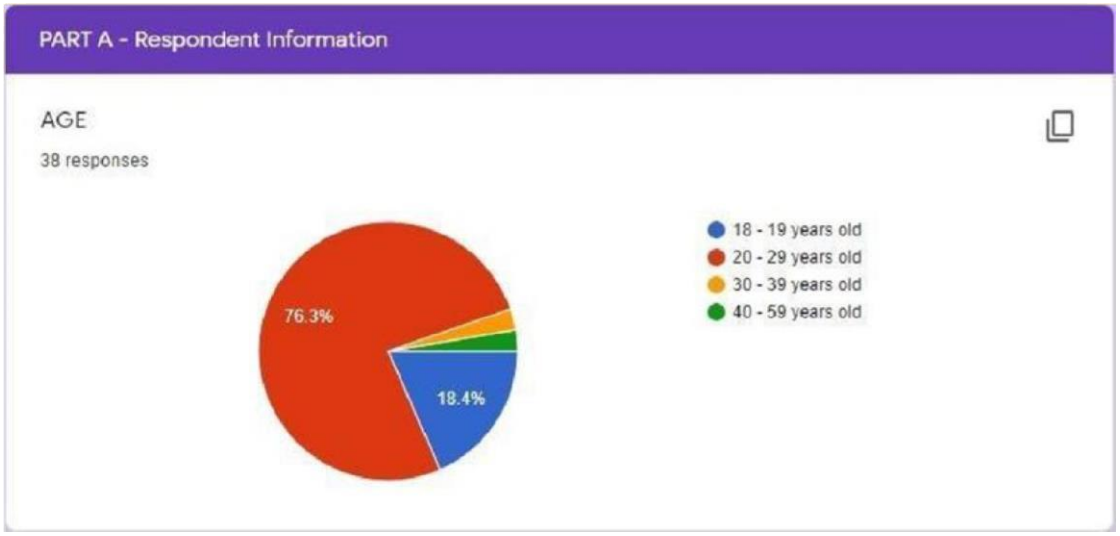


Figure 4.22

The majority of respondents, according to the study, are between the ages of 20 and 29, with adolescents aged 18 and 19 coming in second. According to our research, teenagers are more likely than older adults to participate in the survey.

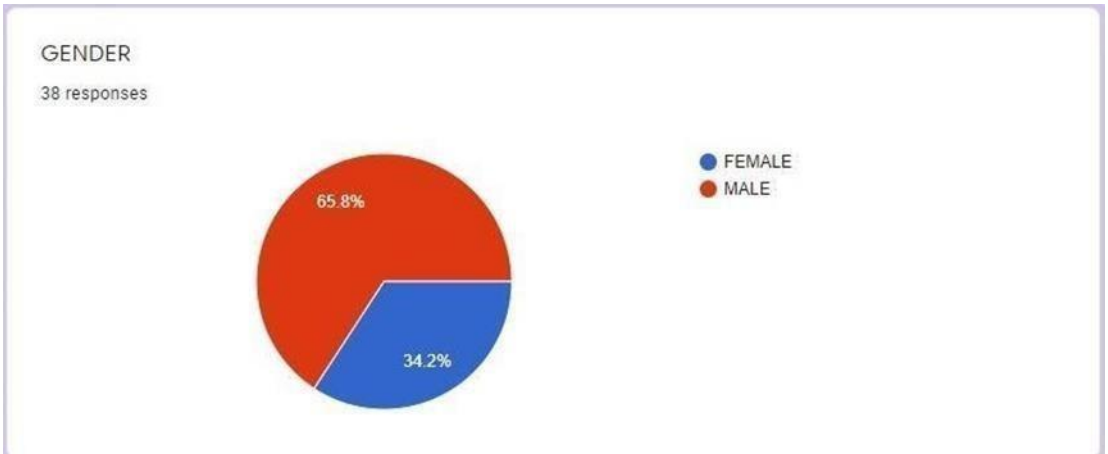


Figure 4.23

Male respondents made up 65.8% of the total, while female respondents made up 34.2 percent. We can deduce from this that men are more likely to engage in the survey than women.

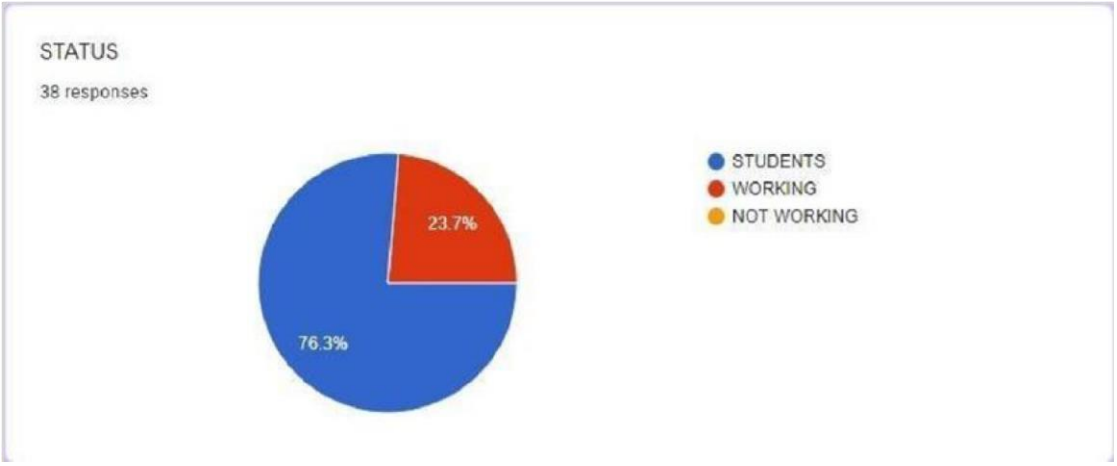


Figure 4.24

The average response is a student in the majority of cases. Due to the activity of the workplace, the percentage of respondents who have worked has decreased. When compared to students who spend a significant amount of time on the internet performing assignments and projects.

4.2.1 COST OF COMPONENTS

Table 4.2.1 : Component Cost List

NO	COMPONENT	QUANTITY	THE UNIT PRICE (RM)	TOTAL (RM)
1	Acrylic Glass	1	137	137.00
2	AC motor	1	20	25.00
3	AC motor	1	45	45.00
4	Glass Tube	2	2.20	4.40
5	Switch	1	2.20	2.20
6	Wires	1	5.00	5.00
7	Stainless Steel Blade (small)	2	15.00	30.00
9	Hardex Brand Glue	2	12	24.00
TOTAL (RM)				272.60

The cost of materials allotted in developing our project, namely Automatic vegetable slicer, is shown in Table 4.2.1. This information was gathered from sources including as Facebook, Lazada, Shopee, Carousell, and an electrical goods store. Aside from that, ourmaterials are environmentally friendly and convenient.

4.3 FINDINGS

4.3.1 PLACE RUN PROJECT DATA

The location where we wanted to test our project should have a power source, such as a switch. This is due to the fact that our project involves wires, which must be linked to the proper switch. The project test site should also be at a high elevation, such as on a table, so that it is simple to test and clean.

4.3.2 ANALYSIS OF STUDY DATA

The results of the data analysis will be presented in the form of graphs and tables. The quantity of vegetables that can be cut according to the weight and size of different vegetables with the same type of motor is covered by this Automatic vegetable slicer analyser. A calculation will be used to display the outcomes of the data analysis.

4.3.2.1 STUDY QUESTIONNAIRE

The questionnaire approach has been given to targeted individuals via social media to further improve this investigation. We can learn about customer input and potential improvements from this survey. The information below refers to the questionnaire that was administered.

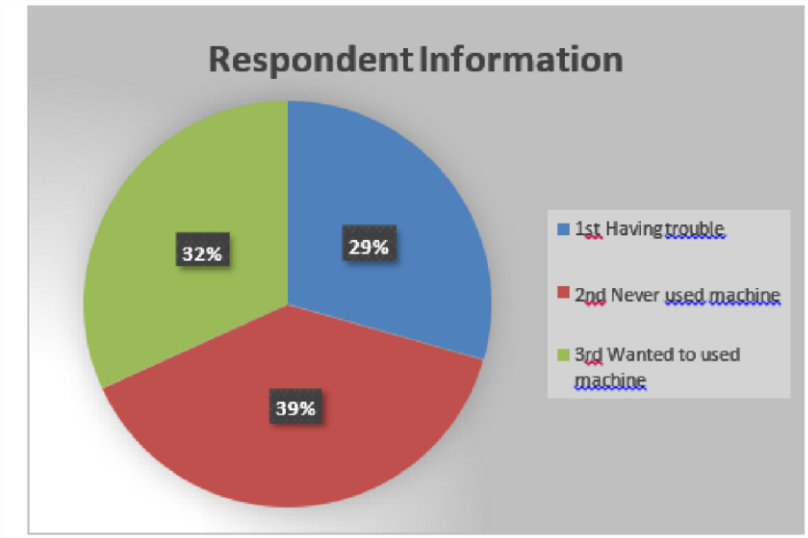


Figure 4.25

The goal of this questioning is to determine how useful an automatic machine is in comparison to a knife. According to the poll, 65.8% of participants had difficulty cutting vegetables in large numbers, while 13.2% provide the opposite answer and 21.1 percent say maybe. Aside from that, 86.8% of those surveyed said they had never used an automatic machine. It is because most people in houseables do not have an automatic machine and rely on knives in their daily lives, which might be expensive for them to purchase. Furthermore, if an automatic machine is available in their home, 71.1 percent of the population (28.9%) prefers to cut vegetables with an automatic machine rather than a knife.

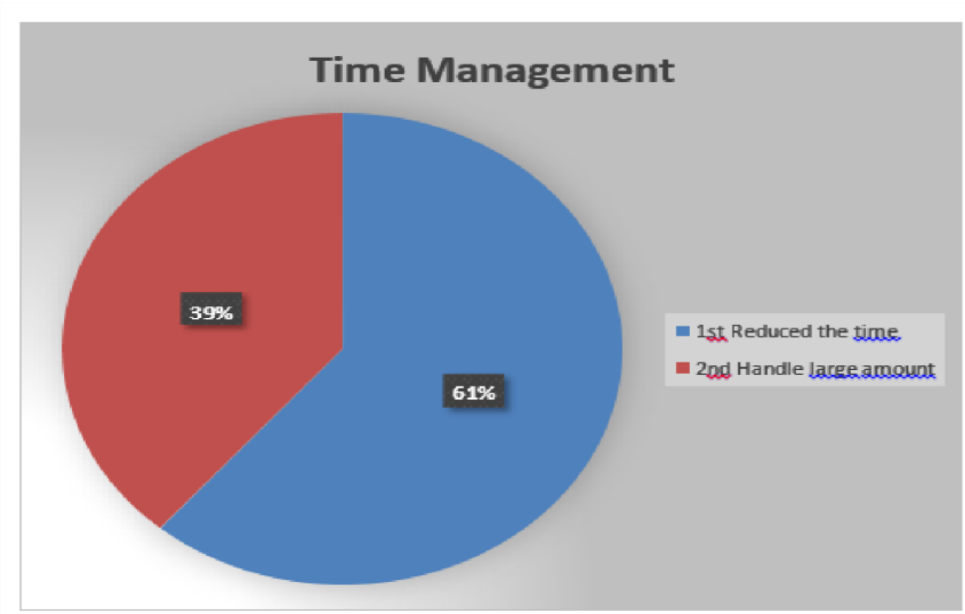


Figure 4.26

According to the results of the survey, 61% of respondents demand that this machine able to increase their time management by handling large amount. Meanwhile the other 39% believe that this machine can cut fast enough to reduce the time.

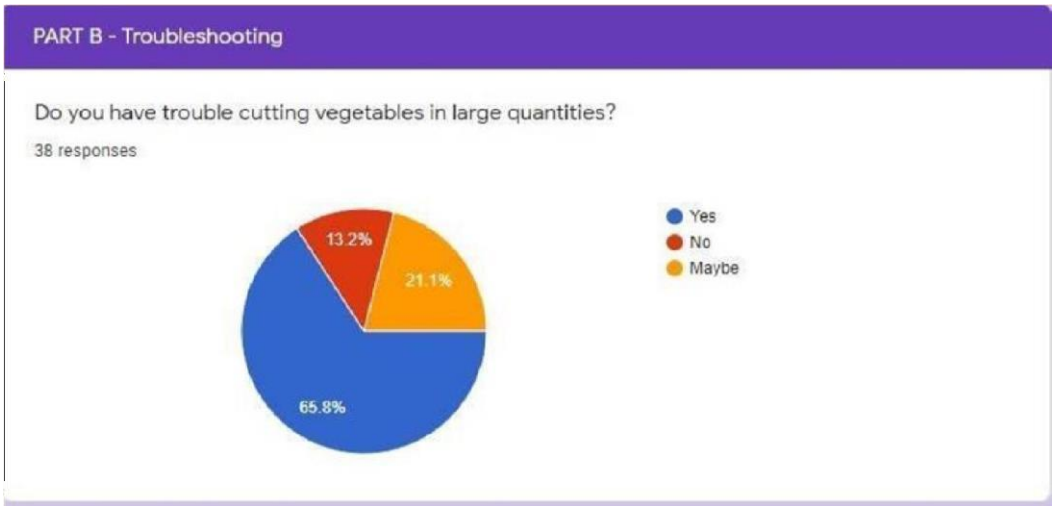


Figure 4.27

A total of 65.8% of respondents felt that chopping vegetables on a large scale is challenging for them. Consumers find it difficult to cut vegetables on a wide scale since it requires a lot of time and effort.

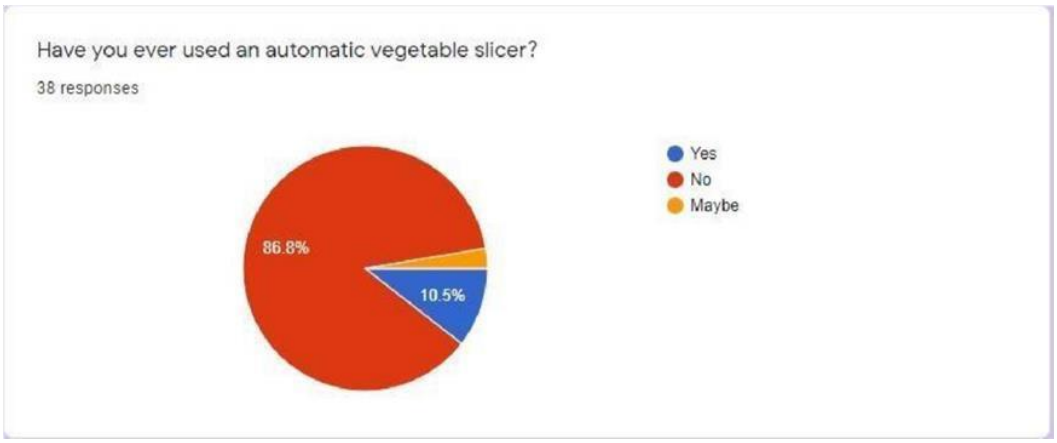


Figure 4.28

The majority of people, 86.8%, said they don't use this mechanical vegetable cutter. Various variables that can be considered based on this high percentage include the machine's high price, lack of community exposure, and the tendency to use a knife in the traditional fashion.

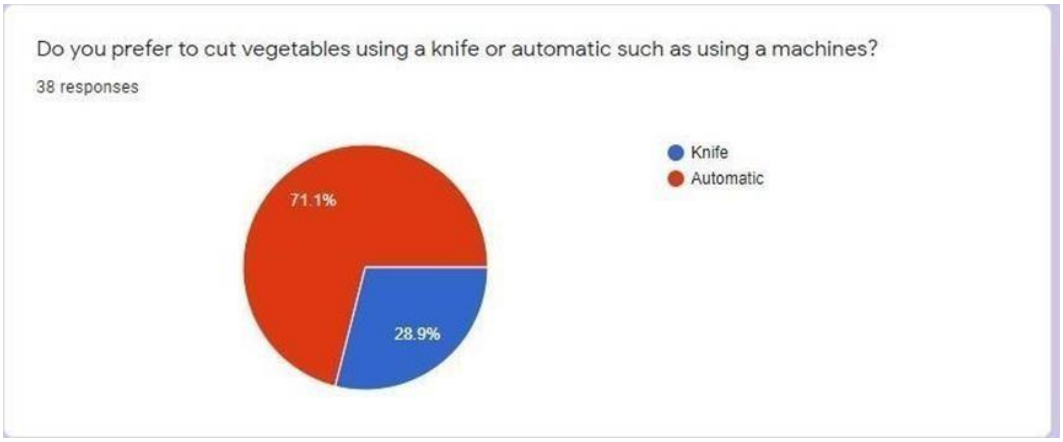


Figure 4.29

Despite the fact that the majority of consumers have never used an automatic vegetable cutter, they still prefer an automatic vegetable cutterto a knife. This is most likely because the ordinary response is realizing that technological expertise needs to stay up with the presenttechnological age. Today's technology can assist in the completion of daily chores.

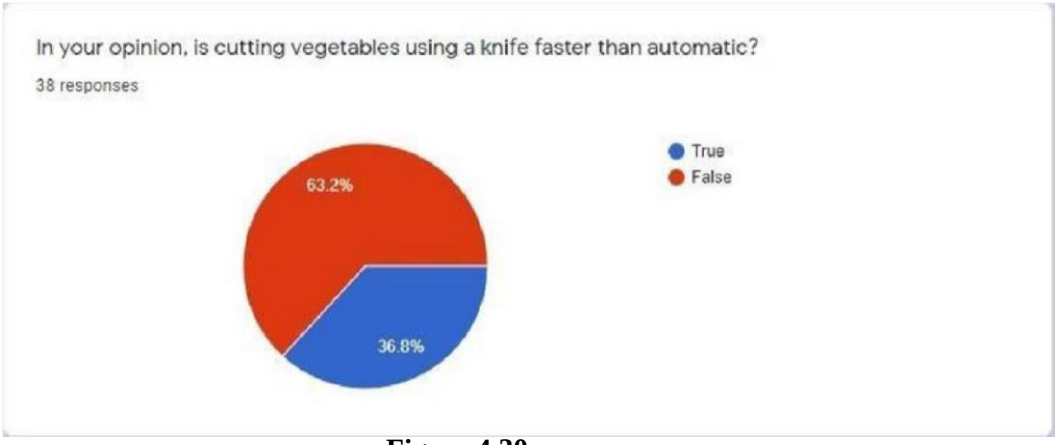


Figure 4.30

The majority of respondents say that this automatic vegetable cutter can cut veggies in a short amount of time. When compared to manual methods, the time it takes to perform a procedure is quite short, much like with other technologies or equipment. Without a doubt, the procedure of cutting vegetables can be finished in a short amount of time,but the consistency will suffer as a result.

Figure 4.31

If it can help with time management, 100% of respondents agreed that thisautomatic vegetable cutting product will be purchased.

4.3.2.2 DATA OBSERVATION

Throughput capacity were test factors used to evaluate the machine's performance. The ratio of the quantity of sliced materials gathered from the machine outlet to the time consumed was described as throughput capacity.

I. CARROT (PER UNIT)

$$Sc = ws / T$$

Where;

Sc = Throughput capacity, kg/h

Ws = Weight of sliced material, kg

T = Time taken, sec

Thus, $sc = 0.01 / 5$

$= 7.20\ kg/h$

II. CUCUMBER (PER UNIT)

$$Sc = ws / T$$

Where;

Sc = Throughput capacity, kg/h

Ws = Weight of sliced material, kg

T = Time taken, sec

Thus, $sc = 0.015 / 3$

$= 18\ kg/h$

4.5 SUMMARY

The usage of automatic vegetable cutters is still not prevalent in this country, as evidenced by the pie chart above, as the average user prefers the manual method. The primary goal of developing this Google form is to determine whether or not the use of this automatic vegetable cutter is useful and capable of solving everyday problems. Automatic vegetable cutters, on average, are able to solve difficulties such as time management and are extremely relevant to use today, according to respondents. To determine the project's full potential, test runs are conducted.

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 INTRODUCTION

The conclusions taken in this chapter are based on all of the results collected from the tests performed and the previous chapters' discussions. The important information in this chapter is also about the study's objectives as well as recommendations for the study. In addition, conclusions for this study were drawn.

5.2 DISCUSSION

(NUR EMELIA ARISSYA BINTI MOHD RASHID)

The major goal of this research is to create a double-input vegetable cutting machine. According to the findings of the study, individuals utilised knives more than the machine, which can benefit people in the future. Our double-input design allows us to harvest a large number of vegetables at once while also saving time and energy. Aside from that, with this idea, individuals should be more likely to use technology instead of human energy. This is due to the fact that all of the equipment has been technologically advanced nowadays. We can reduce our burden to complete something or work by using technology.

(MUHAMMAD AKMAL BIN LOKMAN)

Our project, Automatic Vegetable Slicer safety measures also need to be improved. Our prototype isn't totally covered to show how the mechanics work, and there isn't a sensor to improve the system's protection with loud motor. As a result, we can enhance our machine by attaching a cover to the 'Motor AC' that prevents the user from accidentally touching it.

(SELWENDHRAN A/L PARMESPARAN)

Overall, the last goal of the Automatic Vegetable Slicer project was met, which was to increase the volume of output product while reducing the time it took to perform the vegetable cutting activity. Obtain the capacity per unit of carrots, which is 7.20kg/h, and cucumbers, which is 18kg/h. Using the formula Sc = ws/T, where Sc stands for throughput capacity in kilogram / hour. In addition, ws stands for weight of sliced material in kilogram, and T stands for time taken in seconds.

5.3 CONCLUSION

(NUR EMELIA ARISSYA BINTI MOHD RASHID)

From component design to equipment manufacturing, we learnt how to manage an engineering project collaboratively and effectively. A good project supervisor and good communication enable us finish our work and improve our communication skills as quickly as feasible. Finally, the project, Automatic Vegetable Slicer helped us achieve our objectives. Our goal is to enable customers to lower their human strength in food preparation in a short amount of time while also improving the safety of a vegetable slicing system.

(MUHAMMAD AKMAL BIN LOKMAN)

Our project, Automatic vegetable slicer, has a lot of benefits. One of them is that this technology allows you to save time. Our working time can be cut in half with the use of a slicer. Our capacity to set up a dish will instantly reduce once the vegetables have been sliced or slashed. No more staying in the kitchen for long periods of time slicing vegetables. It also reduces the amount of labour required. Vegetable slicers eliminate the need for terrible knife skills, and they eliminate the need to sweat the kitchen skills of cutting and slicing because the vegetable slicer does all the work. In general, a vegetable slicer was a simple mechanism to maintain.

(SELWENDHRAN A/L PARMESPARAN)

The Automatic Vegetable Slicer gadget was successfully produced. The project's key objectives have been completely met except the quiet motor. Our goal is to enable consumers to lower the human strength required for food preparation while also improving the cutting machine's safety characteristics by reducing big quantities of vegetables in a shorter amount of time. For the cutting process, the consumer must cut a variety of veggies.

5.4 RECOMMENDATIONS

Our prototype does not function as a multipurpose cutting machine. We recommend that slicing, peeling, rolling, and crushing activities are all performed by an automated multipurpose vegetable slicing machine. Traders would be more likely to employ it in the market. Aside from that, the slicing system and blade design should be improved. It has to be an impressive cutting procedure. The "gentle cut" method of cutting ensures that the product is sliced in a controlled and smooth manner with minimal strain. These fruits and veggies can be cut with remarkable precision and smoothness. The knives' longer cutting edge and longer service life ensure more efficiency as well as less labour and expenditure.

5.5 SUMMARY

Each project has its own set of benefits and drawbacks that help both the people and the community. However, we may enhance or improve the project's drawbacks in the future in order to increase the good and very successful product that can scarcely identify the project's downside. As a result, the obstacles are viewed as opportunities for future generations to develop and innovate, as well as to deepen their understanding of our project.

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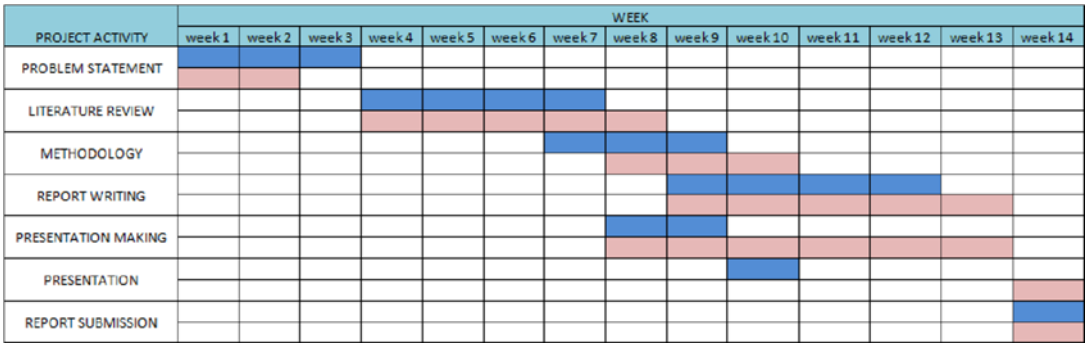
ATTACHMENT

ATTACHMENT A Gantt Chart (Project 1)



ATTACHMENT B Gantt Chart (Project 2)

ATTACHMENT C Render View