DESIGN AND DEVELOPMENT OF COCONUT PALM COLLECTOR

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BORANG PENGESAHAN STATUS TESIS

JUDUL **DESIGN AND DEVELOPMENT OF COCONUT PALM COLLECTOR**

SESI PENGAJIAN: **2011/2012**

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DESIGN AND DEVELOPMENT OF COCONUT PALM COLLECTOR

MUHAMMAD AZAM BIN ISMAIL

Report submitted in fulfilment of the requirements for the award of the Diploma in Mechanical Engineering

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

DECEMBER 2011

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in my opinion this project is satisfactory in terms of scope and quality for the award of Diploma in Mechanical Engineering.

Signature :
Name of Supervisor : NASRUL AZUAN BIN ALANG
Position :
Date :

STUDENT'S DECLARATION

I hereby declare that this report titled "Design and Development of Coconut Palm Collector" and the result from my research are based on the references that have been used in order to complete it. I hereby declare that the work in this chapter is my own except for quotations and summaries which have been duly acknowledged. The report has not been accepted for any diploma and is not concurrently submitted for award of other diploma.

Signature :
Name of Student : MUHAMMAD AZAM BIN ISMAIL
ID Number : MB09060
Date :

DEDICATION

To my beloved mother, Zainab Binti Seman and father, Ismail Bin Hassan whose unconditional love and unfaltering support motivates me to always give my best, persevere and kept me going through.

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Bless towards Allah S.W.T the Almighty and Most Graceful for giving me the opportunity to finish this project, the coconut palm collector. I am also extremely grateful to my supervisor Mr. Nasrul Azuan bin Alang for his helpful ideas, priceless guidance, never ending encouragement and constant support for making this project success. He always gives the professional conduct along with his enthusiasm for science and his principle in making this project worthy to be proud of. I am also thankful for his concern in this progress research, his tolerance in my mistakes and weakness and his full support for to my future career.

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ABSTRACT

This project concerns on the assessment of making a product, the coconut palm collector which will consider all aspects and concepts for satisfaction of the users. The main objectives of this project are to design and develop the coconut palm collector. The project was start with development of design concepts that combine several ideas. The design concept generated then was analyzed using the matrix chart. All parameters and factor that related to customer satisfaction such as easy to maintenance or easy to uses was analyzed. The design concept that gave highest marks during analysis stage was selected as a final design. The structural three-dimensional solid modeling for final design concept that has been selected was developed using the computer-aided drawing software namely Solidwork. All the factors that need to consider was taken during material selection for fabrication stage. The factor was considered for material selection such as lightweight, not rust, hardness, cheap, and others are taken for fabrication process. After fabrication process, the final product has been tested to ensure that the product is functional or not. If the product is not following specification, some modification will be made. The modification process will be repeating until the products achieve the desire specification.

ABSTRAK

Projek ini berkaitan penilaian membuat suatu produk iaitu pengumpul buah kelapa sawit yang akan menyesuaikan semua aspek dan konsep-konsep yang baik dan menyediakan kepuasan kepada pengguna-pengguna. Objektif utama projek ini ialah untuk merekabentuk dan menghasilkan pengumpul buah kelapa sawit. Projek bermula dengan menghasilkan konsep reka bentuk yang menggabungkan beberapa idea. Konsep reka bentuk yang telah dihasilkan kemudian dianalisis dengan menggunakan carta metrik. Semua parameter dan faktor yang menghubungkaitkan dengan kepuasan pengguna seperti mudah diselenggaraan atau mudah digunakan telah dianalisis. Konsep design yang mempunyai markah atau kadar tertinggi semasa peringkat analysis dipilih sebagai konsep reka bentuk akhir. Struktur pepejal model tiga dimensi untuk konsep reka bentuk akhir yang telah dipilih dihasilkan dengan menggunakan bantuan perisian lukisan berkomputer yang dinamakan Solidworks. Semua faktor yang perlu dipertimbangkan telah diambil kira semasa pemilihan bahan untuk peringkat pembuatan. Faktor yang dipertimbangkan untuk pemilihan bahan seperti ringan, tidak karat, keras, murah dan selainnya diambil kira untuk proses pembuatan. Selepas proses pembuatan selesai, produk akhir diuji untuk menentukan produk berfungsi atau tidak. Jika produk tidak mengikut spesifikasi, sedikit pengubahsuaian dibuat. Proses pengubahsuaian akan berulang sehingga produk mencapai spesifikasi yang diinginkan.

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LIST OF ABBREVIATIONS

R&D	Research and development
PNK	Pendapatan Negara kasar
EU	European union
B.O.M	Bill of materials

CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

Malaysian is either country that largest production oil palm in the world. Malaysian has competitive advantage in palm oil industry because has owned experience more than century and lead market from productivity aspect and R&D. Malaysian palm oil industry is fourth largest contributor to Gross National Income (Pendapatan Negara Kasar; PNK) Malaysian. Palm oil is exported to West Asia, Pakistan, Singapore, Japan, Chinese, and EU (European Union). Oil palm can be processed and make various commercial material needed by market. There is high demand from local factories which made commercial material such as soap, wax, cooking oil, margarine, biscuit, and others.

The profit of oil palm crop is very large. Estimated that a tan of oil palm valuable more than RM1500. To produce a tan of oil palm, at least five tons bunch fresh oil palm needed. Every bunch of cutting will cause at least 5% oil palm fruit fall separated on the land. If this fruit uncollected, entrepreneur oil palm planter would loss big profit besides pay cost of area maintenance.

To collect the loose oil palm fruit cause big problem to this crop entrepreneur. Conventional or traditional methods to collect this fruit still been practiced widely in plantations. Loose Oil palm fruit normally picked up by hand and been put together into bucket, plastic bag or gunny. Other than that there were also different options like using rake, planks, and scoop. Employees have to bend their body to collect fruit on the land and need to move from one tree to another tree.

Time to collect fruit usually take almost 30% from harvesting time (Mohd. Zohadie, 1992). This method not efficient, waste time, trouble employee, and cause pain waist to the worker. Rubbish presence and impurity cause problem to oil processing works oil palm in factory. Is estimated almost 20% rubbish transported to factory. Until now various ways and techniques have been experimented for collecting loose oil palm fruits. Challenges in these operations are being identified and new approaches to the problem and solutions are being considered.

Coconut palm collector is created and experimented to solve this problem. Coconut palm collector is a method and apparatus to collect loose fruit on the land. Coconut palm collector also can be bring anywhere and easy to store when do not used. The design of coconut palm collector should be easy to repaired or change when the nail is damaged. Totally the coconut palm collector has been designed using acrylic material or clear plastic because this material easy to look the fruit whether it was stick at nail or not. Acrylic also not rust and lightweight. To produce this project need to buy nail, acrylic, mop, mild steel, plastic rod, bolt and nut. This product mostly uses drilling process to set up the nail, acrylic, mop, mild steel, bolt and nuts and others material to assembly all parts. The fruits can be collected and removed at once because this product have mechanism removed fruit from nail. So, the workers don't take long time to collect and remove fruits from nail. Employees don't bend their body to collect fruit on the land. Employees only need hold this product in a state of stand up and the workers don't have waist pain. However, this product possibility can cause rubbish or leaf put together during collected fruit.

Several aspects need to be taken attention to ensure machine or tool collect loose oil palm fruit can be commercialized for local market and are catching on from parties those involved. Research is effective through machine development and tool need to be carried out in order to meet need in plantation sector and small farmer oil palm. Machine and tool collect loose fruit that efficient and effective can facilities to collect loose fruit that all this while is carried out manually. The methods collection by different also need thought especially to get machine or tool that is easy, safe and cheap and comfortable.

1.2 PROBLEM STATEMENTS

(i) Using the conventional method to collect the separated coconut palm can waste the time.
(ii) Need more workers to collect the coconut palm separated on land
(iii) Conventional methods are not efficient because the workers need to sit, squat and bow
(iv) The conventional method can cause the workers always pain in waist part
(v) There is no specific product available in market in order to collect the separated coconut palm.

1.3 OBJECTIVES

1.3.1 General Objectives

The objective of this project is to train and expose the student on the process of design and fabricate a product. In addition student also able to apply their knowledge and skill they learnt before either during the class or outside the class. This project challenge the student to do research and solving any come out problem towards a successful project.

Student will be able to practice their soft skill on how to communicate well with person by person and also by presentation. Besides, it can train student's capability in answering, questioning, researching, data gathering, decision making, planning and problem solving by the research during this project.

This project will teach the student on how to make a good research report in technical writing. Furthermore, this project can encourage the student to be more independent in searching, detailing and expanding their knowledge and also their experiences under a minimal supervisory.

1.3.2 Specific Objectives

The main objectives of this project are as follows:

(i) To design portable coconut palm collector.

(ii) To fabricate the coconut palm collector.

1.4 SCOPES

(i) Designing process using Solidworks software

(ii) Design portable coconut palm with lightweight, good in durability, and user friendly

(iii) Fabrication process using basic engineering technique such as cutting, drilling, and others.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

According to history coconut palm derived from African country and suitable planted at warm climate. Country which produces oil palm mostly was in world north. Malaysia is either country that largest production oil palm in the world. Malaysia has competitive advantage in palm oil industry because has owned experience more than century and lead market from productivity aspect and R&D. Every seed coconut palm is very important to national income. Oil palm can be processed and make various commercial material needed by market. There is high demand from local factories which made commercial material such as soap, wax, cooking oil, margarine, biscuit, and others.

Palm oil originated from oil palm fruit. Oil palm fruit contain husk, shell and kernel. Palm oil is located in husk area and kernel. Palm oil which originated from husk called as palm oil and oil which originated from kernel called kernel oil. Hereby many new machines were created to facilitate works whether in aspect unload or knitting. Most machine or tools were created to discharge and cut bunch and oil palm fronds but no machine to facilitate process collection loose fruit.

Every bunch of cutting will cause at least 5% oil palm fruit fall separated on the land. Loose fruit means lost income. If this fruit uncollected, entrepreneur oil palm planter would loss big profit besides pay cost of area maintenance. To collect the loose oil palm fruit cause big problem to this crop entrepreneur. Previously, method used to collect the loose fruit with conventional or traditional

methods. This meant collects using hand and employees have to sit squatting, bow or bend their body to collect fruit on the land and need to move from one tree to another tree. This methods cause backbone will feel pain. Oil palm owner will not let seed oil palm this without picked up because loose oil palm fruit also important role to increase the total collection and an individual's income.

2.2 HISTORY OF OIL PALM

The oil palm is a tropical palm tree. There are two species of oil palm. The better known one originated in Guinea, Africa and was first illustrated by Nicholaas Jacquin in 1763, hence its name, *Elaeis guineensis* Jacq. Oil palms were introduced to Java by the Dutch in 1848 and to Malaysia (then the British colony of Malaya) in 1910 by Scotsman William Sime and English banker Henry Darby. The first plantations were mostly established and operated by British plantation owners.

Federal Land Development Authority (Felda) is the world's biggest oil palm planter with planted area close to 900,000 hectares in Malaysia and Indonesia. Felda was formed on July 1, 1956 when the Land Development Act came into force with the main aim of eradicating poverty. Settlers were each allocated 10 acres of land (about 4 hectares) planted either with oil palm or rubber, or given 20 years to pay off the debt for the land.

After Malaysia achieved independence in 1957, the government focused on value adding of rubber planting, boosting exports, and alleviating poverty through land schemes. In the 1960s and 1970s, the government encouraged planting of other crops, to cushion the economy when world prices of tin and rubber plunged. Rubber estates gave way to oil palm plantations. In 1961, Felda's first oil palm settlement opened, with 3.75 km² of land. As of 2000, 6855.2 km² (approximately 76%) of the land under Felda's programmes were devoted to oil palms. By 2008, Felda's resettlement broadened to 112,635 families and they work on 8533.13 km² of agriculture land throughout Malaysia. Oil palm planting took up 84% of Felda's plantation landbank.

In 2007, Golden Hope Berhad, Kumpulan Guthrie Berhad and Sime Darby merged to form Malaysia's biggest publicly traded oil palm company with landbank exceeding 633,000 hectares. Its plantations are spread across Malaysia and Indonesian islands of Sumatera, Kalimantan and Sulawesi. Oil palm planting is Sime Darby largest revenue generator. As an integrated palm oil entity, Sime Darby produces specialty fats, oleochemicals and biodiesel for export.

Figure 2.1: African oil palm (*Elaeis guineensis*)

2.3 TYPES OF OIL PALM FRUIT

Oil palm fruit can be categorized into several types. The common types of oil palm fruit that usually found is dura, tenera and pisifera.

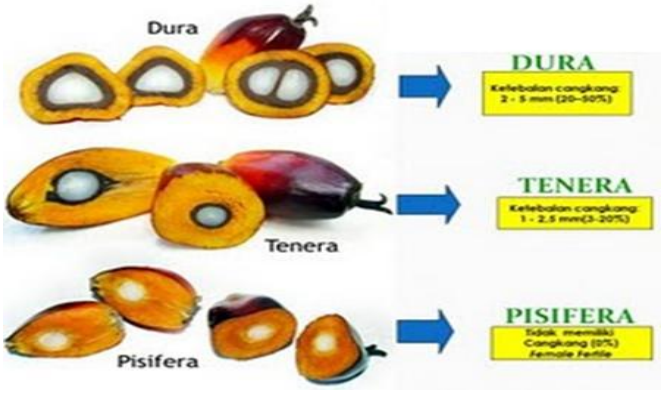


Figure 2.2: Types of oil palm fruit

2.4 CUTTING BUNCH OIL PALM FRUIT

Most oil palm planter that have high tree, they cut oil palm fruit bunch using a bamboo pole and harvesting sickle attached to a strong wooden pole. Every bunch of cutting will cause at least 5% oil palm fruit fall separated on the land.

Figure 2.3: A harvesting sickle

2.5 LOOSE FRUIT

Loose fruit means lost income. Every bunch of cutting will cause at least 5% oil palm fruit fall separated on the land. If these are not been collected, entrepreneur oil palm planter would loss big profit besides pay cost of area maintenance.

Figure 2.4: Loose fruit

2.6 PROBLEM TO COLLECT THE LOOSE FRUIT

Collection of loose fruit cause big problem to this crop entrepreneur. Loose fruit normally picked up by using hand and put together into bucket, plastic bag or gunny. Other than that there were also different options like using rake, planks and scoop. Employee has to bend body to collect fruit above land and move from tree to tree. Time collect fruit that usually take almost 30% from harvesting time (Mohd Zohadie, 1992). This method cause waste time, trouble employee and cause employee always sick waist.

Rubbish presence and impurity cause big problem to oil processing works oil palm in factory. Is estimated almost 20% rubbish transported to factory. To remove the rubbish presence take long times to employees. Until now several ways and technique was done to overcome problems above.

2.7 THE CURRENT PRODUCT

2.7.1 Using Hand

Some location, the conventional methods still used to collect the coconut palm fruit. They are using hand to collect the loose fruit on the land.

Figure 2.5: Using hand

2.7.2 Using Nail Rake, Hand Basket and Net

Some location, the conventional methods still used to collect the coconut palm fruit. They are using nail rake, hand basket and net to collect the loose fruit on the land.

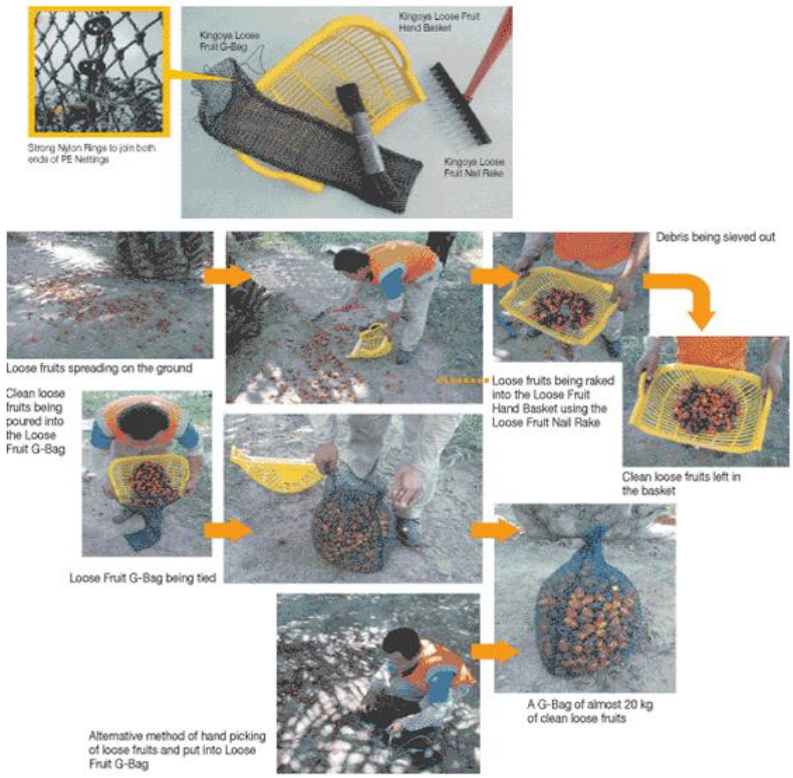


Figure 2.6: Using nail rake, hand basket and net

2.7.3 Using Scoop and Hoe

Some location, the conventional methods still used to collect the coconut palm fruit. They are using scoop and hoe to collect the loose fruit on the land.

Figure 2.7: Using scoop and hoe

2.8 ADVANTAGES AND DISADVANTAGES

Every methods of the current product have advantages and disadvantages respectively.

2.8.1 Using Hand

Advantages of using hand:

a) No rubbish is collected.
b) Injury fruit is low.
c) Easy to use.

Disadvantages of using hand:

a) Need more time to collected fruit.
b) Workers always face waist pain.
c) Workers need sat squatting or bow.

2.8.2 Using Nail Rake, Hand Basket and Net

Advantages of using nail rake, hand basket and net:

a) No rubbish is collected.
b) Injury fruit is low.
c) Easy to use.

Disadvantages of using nail rake, hand basket and net:

a) Need more time to collected fruit.
b) Workers always face waist pain.
c) Workers need to bend their body to collect the loose fruit.

2.8.3 Using Scoop and Hoe

Advantages of using scoop and hoe:

a) Injury fruit is low

b) Easy to use
c) Can collected many fruit at the same time

Disadvantages of using scoop and hoe:

a) Rubbish presence
b) Workers always face waist pain
c) Workers need to bend their body to collect the loose fruit

2.9 SUITABLE TECHNIQUE TO COLLECT THE LOOSE FRUIT

Based on the comparison, the conventional method or technique by using hand, nail rake or scoop is not suitable to uses in the collection loose fruit problem. This is because this technique always cause big problem to the oil palm planter because the workers always sick waist and need to sit when want to collect fruit. This technique cause trouble to worker and need more times to collect the loose fruit at the land. Workers need to collect loose fruit one by one and need to move from one tree to another tree.

The method or technique to collect loose fruit using disc collector is suitable to uses in the collection loose fruit problem. This is because this technique make easy to workers to collect loose fruit. Disc collector has nail as a sticker to stick the fruit and has a mechanism removed tool to remove fruit at once. Workers an able to see fruit those stick at nail because disc is made by acrylic or clear plastics. The loose fruit can collect and remove at once and no need to sit or band body. This product is portable and anywhere. These products also easy to bring on bicycle, motorcycle or any vehicles because the parts can be dissemble and separated between holder and fruit collector.

However, this technique has a several disadvantages but the workers can cover this problem to make sure that the time not waste and workers not sick waist. The problems appear from this technique usually such as rubbish presence and high injury fruit. The rubbish presence problem can easy to solve with separated the rubbish from the nail. The injury fruit problems are difficult to avoid. Every

technique has advantages and disadvantages respectively. Everything has advantages and disadvantages, benefits and weakness own. Anywhere, costumers cannot run or avoid from advantages and disadvantages or benefits and weakness for some products.

2.10 CONCLUSION

Every bunch of cutting will cause at least 5% oil palm fruit fall separated on the land. If this fruit uncollected, entrepreneur oil palm planter would loss big profit besides pay cost of area maintenance. Collection of loose fruit cause big problem to this crop entrepreneur. Observation from studies above showed that machine and tool collect oil palm fruit above able somewhat in order to meet part of basic principle to collect loose fruit. Several aspects need to be taken attention to ensure machine or tool collect loose oil palm fruit can be commercialized for local market and are catching on from parties those involved.

Research is effective through machine development and tool need to be carried out in order to meet need in plantation sector and small farmer oil palm. Machine and tool collect loose fruit that efficient and effective can facilities to collect loose fruit that all this while is carried out manually. The methods collection by different also need thought especially to get machine or tool that is easy, safe and cheap and comfortable.

Techniques that were experimented need to be deepened in further to can give machine treatment or safety tool and consequently usable involved.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

In fabricate the coconut palm collector, there are several steps must be followed. In this stage, all designers should understand the principle of material selection and method in order to characterize the material. Methodology is one of the important processes in product development. In fabricating process, it includes the measuring, cutting, drilling, joining and finishing processes. Designers should totally understand a chronology of project from beginning to the end.

3.2 PROJECT PLANNING

3.2.1 Project Flow Chart

Based on the flow chart that shown in Figure 3.1, the project starts with the literature review and searching some information that related to the project. The process of gathering the information has been done by searching through the internet and some book that related to the project. In the literature review stage, some of the current products of the coconut palm collector, the specifications of the coconut palm collector and the various functions of the current coconut palm collector are viewed. A new design of coconut palm collectors have been generated based on the information gathered from literature. Once the information has been collected, the project continues with the process of conceptual design. In this stage, the information from the literature review and the knowledge are used to make the

sketching and designing the new concepts. In this project, there are four new design concepts were generated.

The next step is concept evaluation. All new design concepts are evaluated using metric chart bases on the criteria that have been determined. The concepts that satisfy in most criteria will be given highest rating. After the concept evaluation, the project continues with the process of finalization of the product. From the four designs, one concept was selected bases on highest rating. The final design was draw using engineering drawing software namely SolidWorks. All the parts of the final design are draw into the desired shape and assembled.

Once the design has been finalized, the process continues with the most suitable materials to fabricate the final design. After product was selected, the fabrication process is take place and this process includes the measuring, cutting, drilling, and joining processed. The parts are assembled into the desired or actual project concept shape. According to the drawing, the dimensions are specified for the measurements of the project. All the dimensions are important and used to get the desired size for the project materials during the material preparation process. For all the materials which not come in the needed size are cut through cutting process to get the desired shape and size or dimension.

After fabrication process, the product has been tested to ensure that the product is functional or not. If the product is not following specification, some modification will be made. The modification process will be repeating until the products achieve the desire specification. Finally, the product will undergo the finishing process that includes the painting of the product.

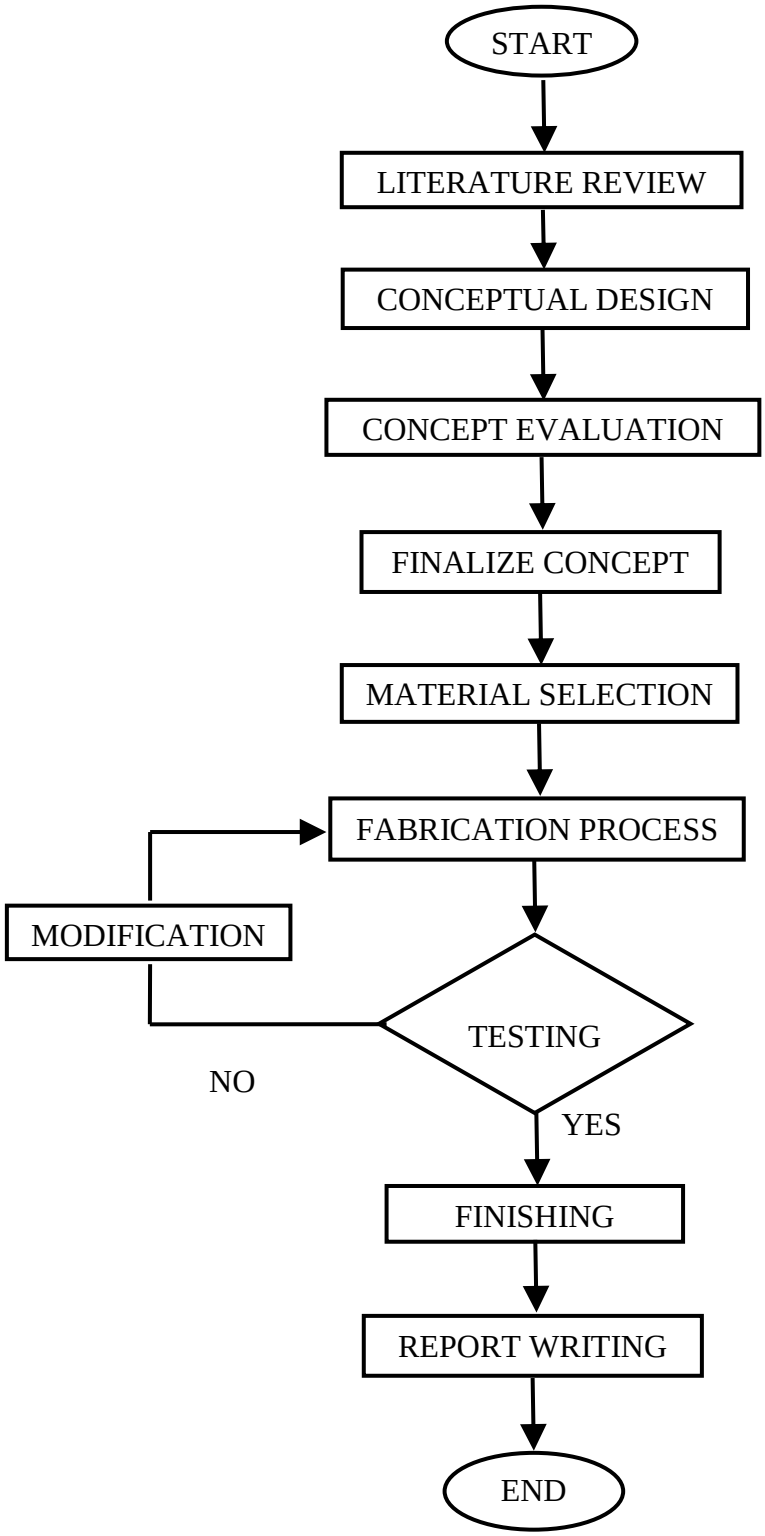


Figure 3.1: Project flow chart

3.3 CONCEPT GENERATION

3.3.1 Concept Design 1

This design uses nails, steel rod as a holder and wood to assemble the nails. Figure 3.1 shows the detail drawing of the first design concept whereas table 3.1 shows the advantages and disadvantages of the design.

Figure 3.2: Concept design 1

Table 3.1 lists the advantages and disadvantages of concept design 1.

Table 3.1: Advantages and disadvantages of concept design 1

Advantages	Disadvantages
• Lightweight • No rubbish is collected • Injury fruit is low • Easy to use	• Need time to collect the loose fruits. • Workers always sick in waist • Workers need to bend the body to collect the fruit

3.3.2 Concept Design 2

This design has a holder and use nails to trap the loose fruits. Aluminium sheet is used as a medium to assemble the nails. The detail of the design is shown in figure 3.3 and its advantages and disadvantages is listed in table 3.2.

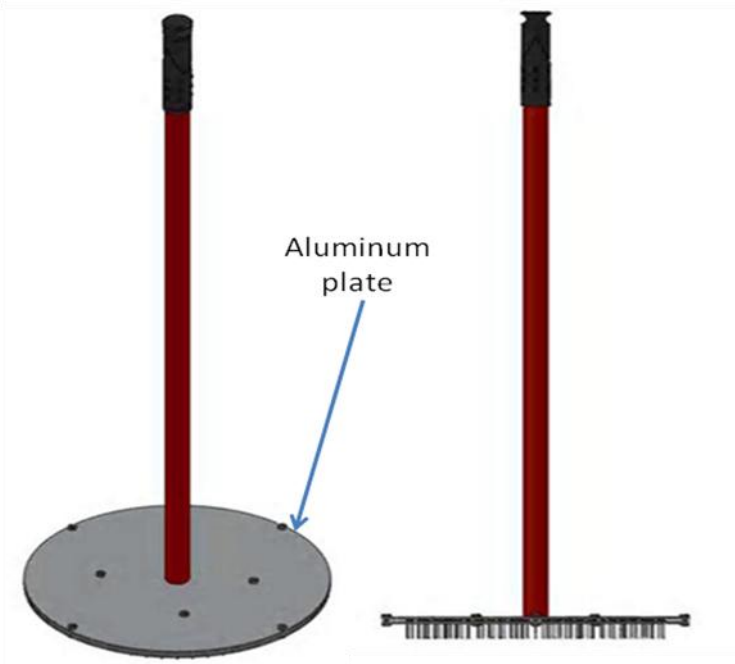


Figure 3.3: Concept design 2

Table 3.2 lists the advantages and disadvantages of concept design 2.

Table 3.2: Advantages and disadvantages of concept design 2

Advantages	Disadvantages
• Easy to collect loose fruit at once	• Take long times to remove loose fruit from nails • Difficult to see the fruit stick at the nails • Rubbish presence • Injury fruit is high

3.3.3 Concept Design 3

This design has similar criteria as second concept except it has puller at the holder. The function of the puller is to remove the fruit from the nails. The design is shown in figure 3.4 along with its advantages and disadvantages listed in table 3.3.

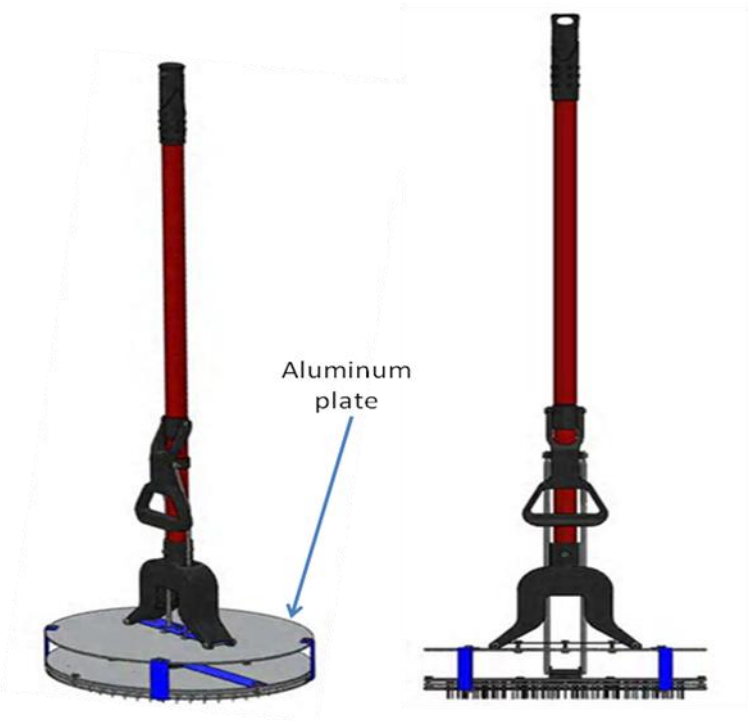


Figure 3.4: Concept design 3

Table 3.3 lists the advantages and disadvantages of concept design 3.

Table 3.3: Advantages and disadvantages of concept design 3

Advantages	Disadvantages
• Easy to collect loose fruit at once • Easy to remove loose fruit at once	• Difficult to see the fruit stick at the nails • Rubbish presence • Injury fruit is high

3.3.4 Concept Design 4

This design has similar criteria as concept design 3 except it use an acrylic or clear plastic and the length of the holder can be adjusted as desired. The design is shown in figure 3.5 along with its advantages and disadvantages listed in table 3.4.

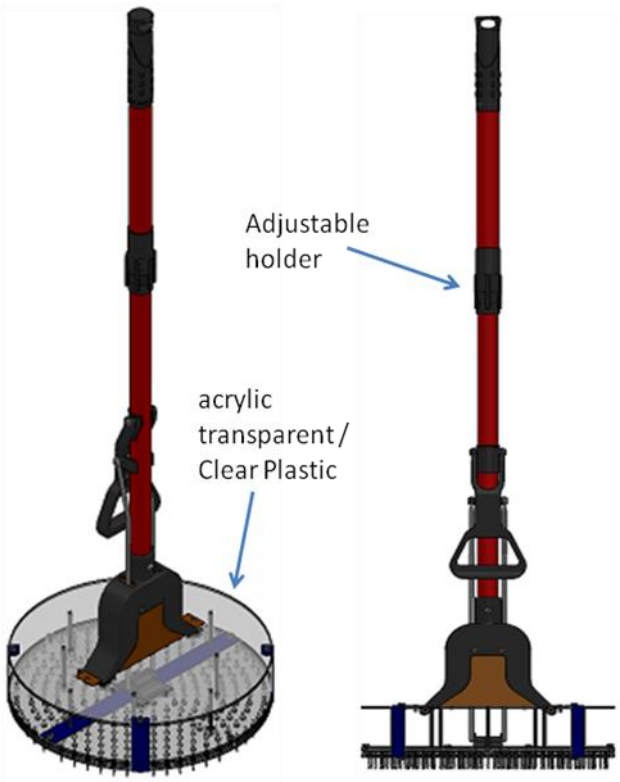


Figure 3.5: Concept design 4

Table 3.4 lists the advantages and disadvantages of concept design 4.

Table 3.4: Advantages and disadvantages of concept design 4

Advantages	Disadvantages
• Easy to collect loose fruit at once • Easy to remove loose fruit at once • Holder can be adjusted • Easy to see fruit stick at the nails	• Rubbish presence • Injury fruit is high

3.4 FINALIZE CONCEPT

3.4.1 Metric Chart

Table 3.5 shows the criteria in which each design concept will be assessed to determine the best design before fabrication process take place. Each concept is rated accordingly by the numbers of star. Highest numbers of stars represent good agreement between design concept and criteria and vice versa.

Table 3.5: Metric chart

Criteria	**1st concept**	**2nd concept**	**3rd concept**	**4th concept**
Easy to use	****	**	***	***
Easy to keep	*****	****	****	*****
Easy to bring	*****	****	****	*****
Change nail	***	*****	*****	*****
Easy to see fruit	***	*	*	*****
Cost production	****	***	*	**
Maintenance	****	****	****	****
Durability	***	**	*****	****
Portability	****	****	****	*****
Easy to remove fruit	**	*	*****	*****
Easy to collect fruit	*	**	**	***
Rubbish presence	*	**	**	**
Performance	*	**	***	*****
Ergonomics	***	*	**	****
Processes	****	***	*	**
Weight	***	**	*	**
Safety	****	*****	****	*****
Size	***	*	**	****
Total Star	**57**	**48**	**53**	**70**

Ratings:

***** = very bad ****** = bad ******* = medium ******** = good ********* = excellent

3.4.2 Concept Selection

Table 3.6 compares the rating among all concept design. Based on the table, it shows that concept design 4 has highest rating compare to others designs. Therefore, the concept design 4 has been selected as a final design. The fabrication process will conducted based on design concept 4.

Table 3.6: Concept selection

Rates	1st concept	2nd concept	3rd concept	4th concept
Excellent	2	1	3	7
Good	3	4	5	2
Medium	3	2	0	1
Bad	2	3	2	2
Very bad	2	2	2	0
Actions	Not proceed	Not proceed	Not proceed	Proceed

3.5 MATERIAL SELECTION

Material selection is one of the important stage in design process. Material is though as a main factor that related to the strength of the products. In this project, there are several factors will be considered during material selection such as strength of the materials, cost, easy to machine and others.

3.5.1 Mild Steel

Mild steel is used to support the assembly acrylic to ensure that the acrylic not broken and fail. Carbon steel is sometimes referred to as 'mild steel' or 'plain carbon steel'. The American Iron and Steel Institute defines a carbon steel as having no more than 2 % carbon and no other appreciable alloying element. Carbon steel makes up the largest part of steel production and is used in a vast range of applications. It’s very hard and suitable to support assembly acrylic.

3.5.2 Bolt and Nut

Bolts and nuts are used to assemble between mild steel and acrylic. Bolt and nuts were chosen because they can make the parts easy to dissemble when the product need to be repaired or replaces by other materials. In additional, bolt and nuts were easy to install compared to other fastener such as rivet and others.

3.5.3 Plastic Rods

The plastic rods are used as a rail between upper acrylic and lower acrylic. The final product has four layers of acrylic where the middle acrylic will pass away on the rail of this plastic rod and the movement of middle acrylic is straight line without sliding. Plastic rod is suitable to uses because it's small, lightweight and cheap.

3.5.4 Nails

The nails are used to collect the loose fruits from the land. Loose fruit will stick at the nails. The nails are suitable to use because it's sharp and difficult to bend compared to the needles or other parts or components.

3.5.5 Mop Holder

The final product uses the mop holder because it has a puller where the puller will acts as a remover of loose fruit from the nails. After impale the loose fruit, the loose fruit will stick at the nails and the loose fruit will be released from the nail by pulling the puller and the loose fruit will automatically remove from the nails.

3.5.6 Acrylic

Clear plastic or know as acrylic transparent was selected to hold the nails because this material is relatively good and it is also easy to see the loose fruit that was stick at the nails. Its also lightweight compare to others materials.

3.5.7 Rivet

This type fastener is used to assemble between mild steel and acrylic. Rivets are suitable to use because this material is lightweight, cheap, and in order to save the using bolts and nuts. However, there are some disadvantages of using the rivets. Since the rivets is one of the permanent joints, the process of disassemble of the product parts become difficult.

3.6 FABRICATION PROCESS

The fabrication process uses the materials that have been selected during material selection stage. The product was fabricated based on the final design by following the detail dimension that has been determined. In this process, many methods are used in order to make the design become reality. The methods used in this process are measuring, cutting, grinding, bending, drilling, finishing and others. The fabrication process starts with the dimensioning by using marking and measuring process until finishing.

3.6.1 Marking and Measuring

The marking and measuring process was done first base on the dimensioning. The common tools and devices used to mark and measure the raw materials are steel ruler, center punch, measuring tape, 90^{o} elbow, vernier calliper and pencil. The measurements are taken more than 3 times for accuracy reasons.

Figure 3.6: Marking and measuring process

3.6.2 Cutting

All materials are cut into the desired shape. Materials are cut excessively for safety reasons in case of error during measuring process. Hydraulic shearing machine are used to cut the mild steel. Acrylic cutter is used to cut the straight acrylic and scroll saw and bandsaw are used to cut the acrylic into circular shape. Figure 3.7 to 3.9 show various machines used in cutting of the materials.

Figure 3.7: Cutting with shearing machine

Figure 3.8: Vertical bandsaw

Figure 3.9: Acrylic cutter

3.6.3 Grinding

The materials are grinded carefully into desire shape using portable grinding machine and disc cutter to remove unwanted parts as well as to give smooth surface. This process also was performed to make sure that joining process can be done precisely. The acrylic and mild steel are clammed on the table and the grinding process is done first by grinding off unwanted parts. Figure 3.10 shows the grinding process.

Figure 3.10: Grinding process

3.6.4 Bending

Then, several materials that need to be bent are bending through bending process by using bending machine. Material such as mild steel is bend using cnc press brake to bend this material into 90°.

Figure 3.11: CNC press brake

3.6.5 Drilling

The marked holes are drilled to make holes for rivet, bolts and nuts using bench drilling machine and hand drilling machine. The size of each cutting tools varies according to the size of the hole of the part to be joined. Figure 3.12 and 3.12 show the portable hand drilling machine and bench drilling machine.

Figure 3.12: Portable hand drilling machine

Figure 3.13: Bench drilling machine

3.6.6 Joining

Most of the materials are joined together using 4mm diameter bolt. Material such as acrylic, mild steel and mop holder have been assembled using bolt and nuts. The assembly of the parts is done using wrench and screwdriver to tight of bolt and nut.

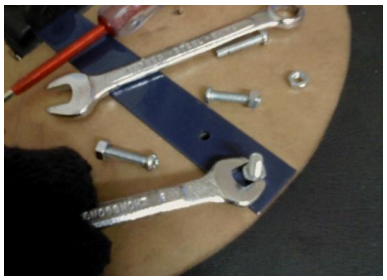


Figure 3.14: Joining process using bolt and nuts

3.6.7 Finishing

After joining process and product testing, the final stage in which the product will undergo is finishing. The main process in product finishing is filing and painting. In filing process, sand papers and smooth filer are used to clean and avoid sharp edge on the product. This process also be done to produce smooth surfaces on the product as well as to remove dirt and rust. By this way, the accident cause by the product such as sharp edge and rust can be eliminated. For the next finishing process, the product is painted using a metallic spray paint. The selected colour is dark blue colour to paint the mild steel. The process is done by spraying the product in a smooth and even coat of paint.

Figure 3.15: Painting process

3.7 CONCLUSION

All the importance parts on the flow chart is highlighted. This is to make sure the progress of the fabrication process runs well and will be on time. The effectiveness of the flowchart however depends on the work schedule.

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

This chapter focuses on the result and discussion of the project. It includes design process, bill of materials (B.O.M) and also testing the final product based on functionality. This chapter also provide whether there is an error or problem occur so that further improvement can be made onto the product. Also the result will compare whether meet the specification required or expected by referring to the data provided.

4.2 RESULT

The result for the project is aimed for this chapter including the fabrication process, the product specifications and the problem with the cause of the project. The result will be used to find the ways to solve the problems and make some improvements to the product. After made some improvements, the comparison between latest and the precious result before the improvements was made to achieve the target.

4.2.1 Final product

After finishing the fabrication process, Figure 4.1 shows the final product of this project. The final product is properly examined and carefully stored to avoid damage. The final product also shows that this project is fully done. The product was successfully functioning. Selection of design made on concept design 4 based

on criteria given. Design concept 4 is to be finalized and used as guideline for fabrication.

Figure 4.1: Final Product

4.2.2 Solidworks

After choose the selected design for the project, the early sketch is transfer to the engineering drawing and also for the solid modelling by using the SolidWorks software to show the actual design for the coconut palm collector. Figure 4.2 shows the final product drawn using Solidworks software after combination of all parts such as mop holder, acrylic, bolt and nut. The details explode view for the digester body is shown by Explode View in Appendix E.

After select the design and the early sketch, the next step are to set the dimension and perform the dimensioning process. The dimensions were set before run the project drawing in the SolidWorks software according to the relevant

dimensions by refer to the currents coconut palm collector and the other parts to make sure all of them were fit.

After the dimensioning process, the solid modelling and the engineering drawing for all the parts are performed using the SolidWorks software. Part by part are been draw according to the dimensions that have been set, and after finish the drawing, all the parts were assembled to give and show the actual design for the project.

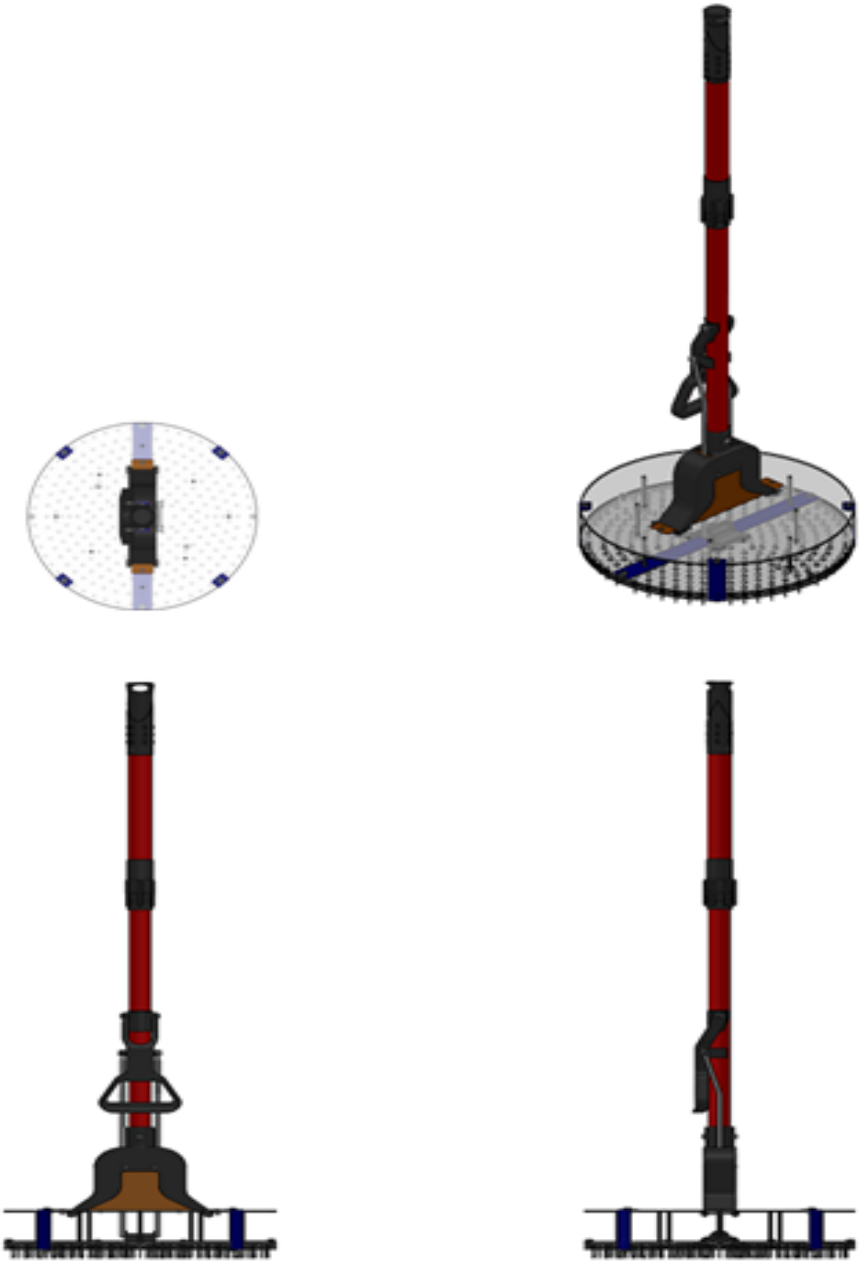


Figure 4.2: Orthographic views of the product

4.2.3 Bill of materials

Bill of materials below explains on the materials ordered or used in this project. The materials used are listed in Table 4.1 according to it material, quantity, and size.

Table 4.1: Bill of materials

No.	Material	Quantity	Size
1.	Bolts and nuts	21 unit	M4 X 0.7
2.	Nail	294 unit	1 inch
3.	Mild steel	4 unit	1mm x 20mm x 95mm
		1 unit	1mm x 25mm x 300mm
4.	Mop holder	1 unit	Length: 981mm
5.	Acrylic	4 unit	Diameter : 300mm Thickness: 3mm
6.	Plastic rod	8 unit	Diameter: 4mm Length: 64mm
7.	Rivet	11 unit	Diameter: 3mm

4.3 OVERALL DESIGN VIEW

4.3.1 Design Descriptions

The design shows the finalize design for the coconut palm collector. Most of the parts are made by using plastic, and then follow by the connection between upper acrylic and lower acrylic that made by using mild steel, nail, bolt and nut. The reason why the mild steel is mostly use is because of its properties which are fair in corrosion resistance, high technical stability, temperature resistance high and relatively strong. The disc that made from clear plastic or acrylic transparent is used because of its lightweight, easy to look the loose fruit whether stick at the nail or not. The mop holder is use as the holder for coconut palm collector because mop

holder was attached with puller where the function of puller is to remove the loose fruit from the nails. After impale the loose fruit, the loose fruit will stick at the nail and when want to remove the loose fruit from the nail, the puller will be pulled and the loose fruit automatically release from the nails.

From the result after drawing, sketching selection, generate and evaluate the concept selection, the design concept 4 is the best design for this project to be fabricated.

4.3.2 Method of Joining

Some parts of the body such as mop holder, plastic, and mild steel are mostly joined by using bolts and nuts. These parts joined using bolt and nut to ensure the part can be easily open and close when the product must be repaired or replacing to other materials.

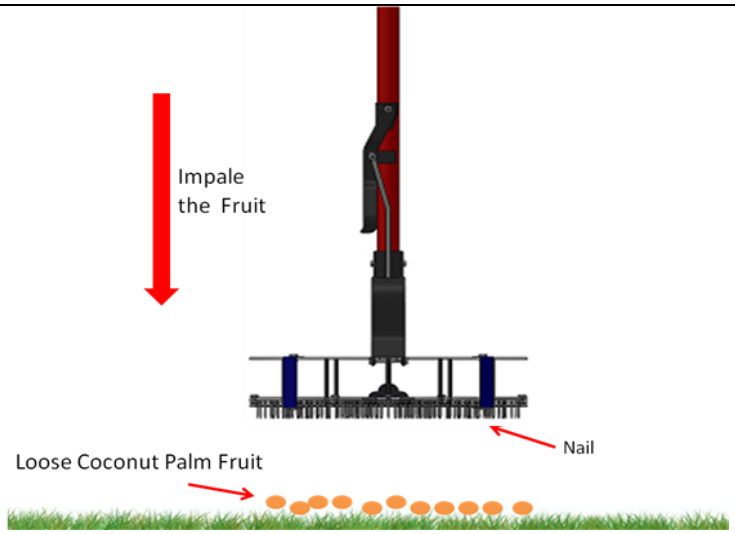
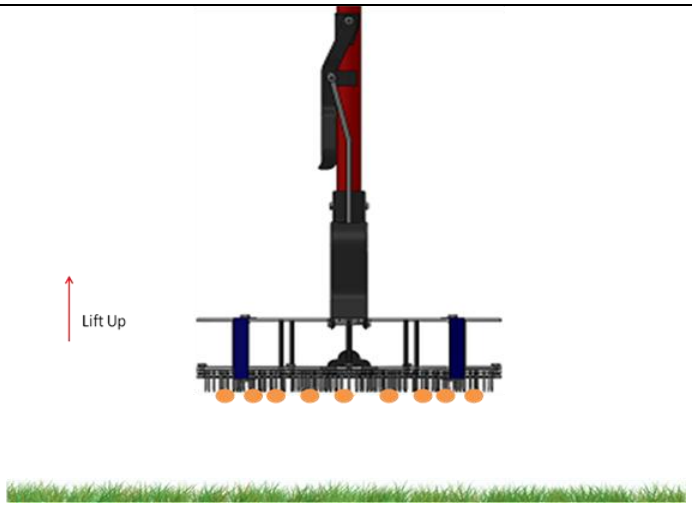
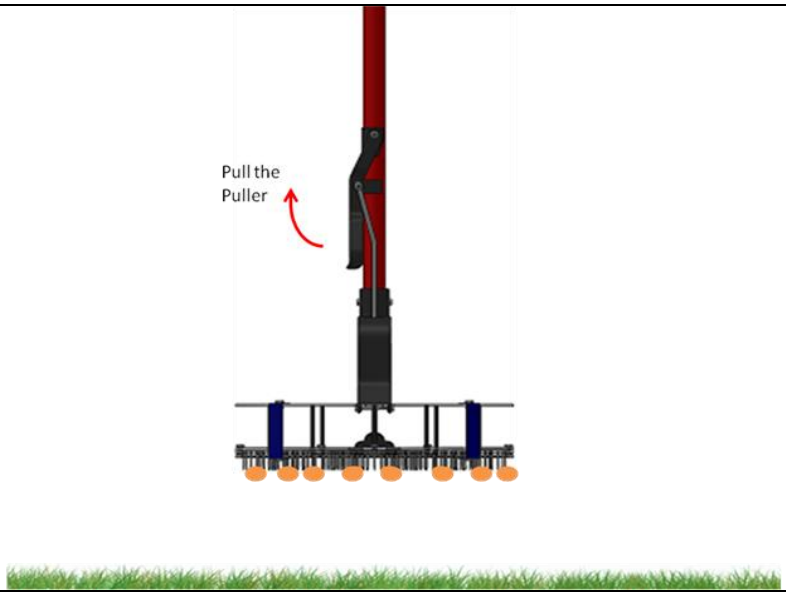
4.3.3 Special Feature

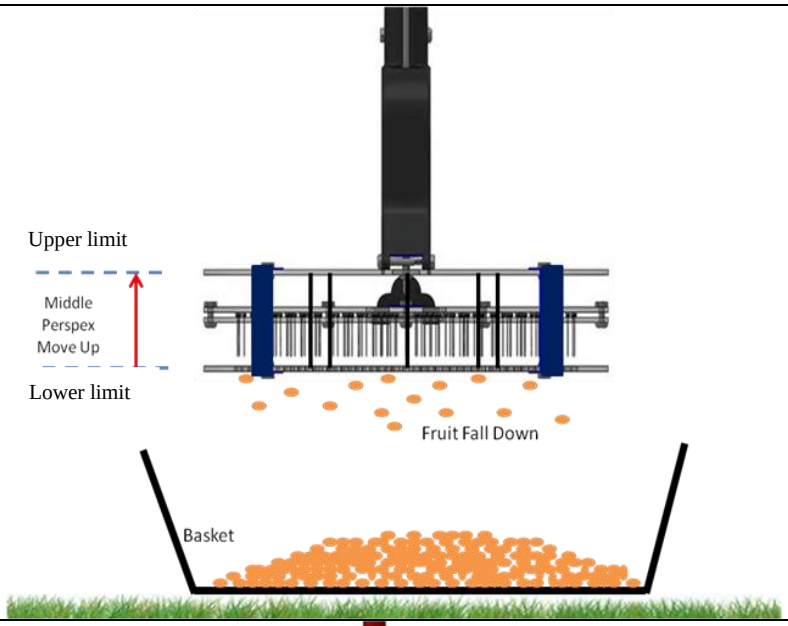
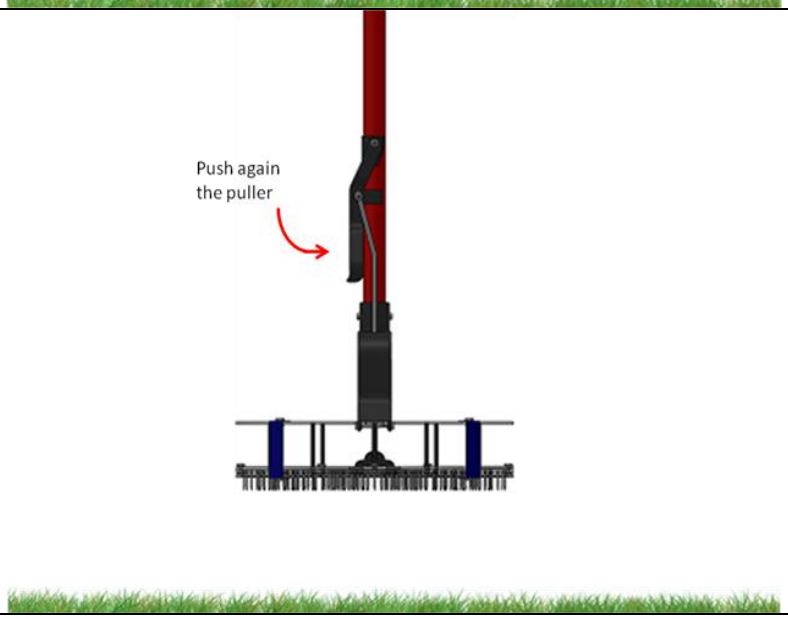
The coconut palm collector has adjustable holder that will make the user work be easier because holder can be adjustable to long or short depend on suitability of the workers. The coconut palm collector was completed with the clear plastics or acrylics which can ease for user to look the loose fruit whether stick at the nail or not. It also uses some of joining method, which is using rivet, bolt and nut. By using all of the joining method, the coconut palm collector was constructed more stable.

4.3.4 How It Works

This product has an own function. Table 4.2 shows the step by step how this product operates with some explanation.

Table 4.2: Steps of operation

Step	Details	Explanation
1		Impale the loose fruit on the land. The loose fruit will stick at the nail.
2		Lift up the coconut palm collector.
3		Pull up the puller that attached to mop holder to remove the loose fruit into basket.

4		When the puller is pull up, the nail automatically moves up and at the same time, the loose fruit will fall down into basket.
5		Push again the puller to lock the movement of nails. Repeat the step1 to step 5.

4.3.5 Expected Result

It is functional base on our needed. However it fails to separate rubbish presence with loose fruit as we estimate. However the rubbish presence is not so much compare using the nail rake. The product must easy to handle and safe to used.

4.3.6 Result of the Coconut Palm Collector Testing

The product was successfully functioning. This product has undergone testing process or experiment to determine this product successfully functioning and what the important thing is this product has better than another product. The loose fruit has lay randomly on the land and the testing of the product and comparison with another product was being conducted. Firstly, the testing using hand technique has been conducted and the results were recorded in the table. The next technique is using rake and the last is using this product. All the aspects in this experiment were considered. The time of each technique has given 5 seconds only. In this time, the technique that has more fruit collection was considered as the product.

Table 4.3 shows that the result of the experiment. The result shows that using with disc technique is better than other techniques because the workers can save the times and also not sick at waist during collecting the loose fruit. It is confirmed working. However, the product fail to achieve the specific requirement as expected. The injury fruit is very high if compared with using hand. However the result is not constant because the collection is using energy of workers. If the worker has high energy, the result is high and if the worker has low energy, the result will be low. The energy in the human body is not constant. At the some time its high and at the some time its low. Therefore, the energy or potential of worker to collect the loose fruit is influence the result of this experiment. Total fruit collection also different using disc technique. The bigger diameter of disc, the fruit collection also will be increased.

Table 4.3: Result of the experiment

Collection Technique	**Power Supply**	**Time (Second)**	**Total Collection**	**Rubbish Presence**	**Injury Fruit**	**Workers Health**
Hand	0	5	7	Low	Low	Sick Waist
Rake	0	5	11	High	Medium	Sick Waist
Disc	0	5	23	Medium	High	-

4.4 DISCUSSION

There are 4 design concepts have been generated. All design has been assessed accordingly based on specific criteria. The design concept 4 has been finalized and used as guideline for next step of fabrication. The total cost to produce this product can be reduced if the usage of bolts and nuts are less. Many errors have occurred during making this project. These errors occur from the beginning until the end of the project. The errors occur were identified and observed to be analyzed.

4.4.1 Project problems

a) Literature review

The concepts and ideas review for this project can varies from many sources due to the range of types of coconut palm collector available in the market. These information has a very specific criteria in which determines whether the design along with the functions is match able and can be accepted in usage for this project. To add improvement to this information available in the market, students have to develop new ideas to imply in the project so that there are improvements in it.

b) Material preparation

Materials required for this project are ordered through bill of materials (Refer to Table 4.1: Bill of materials) whereas some of the materials can also be bought by students themselves from hardware shops. Some materials required are already available in the university laboratory main store.

c) Designing and sketching

For designing, ideas are develop entirely from the student. References aren’t available due to all measurements and drawing designs are generated from the students. However there are the matters of stability within the design.

Students has to focus on stability a functions since it is a platform which has to hold a heavy object and also able to rotate it in a certain position. This criteria has been the guideline as well developing the design not only to fit the main function but also practical to users.

d) Budget preparations

The budget for this project should be entirely handled by the university. The students have to inform the University regarding the matter whereas the budget itself is not affordable and practical for a student of such level to provide.

4.4.2 Fabrications problem

a) Materials

The problems regarding the materials are the available materials some aren't sufficient within the University materials store. Some materials require strict procedure to be extracted out of the store which cause valuable time spend on handling the paperwork and asking for permission. Some materials required long period of time to arrive. This does not only cause a major error in fabrication process, but also halted the schedule behind time period required. This has caused the project to be finished behind required or desired time.

b) Fabrication

During fabrication, there is a matter of precise measurements which can affect the project. The measuring has to be taken more than once. There are also the cutting processes in which some materials require scroll saw and band saw to be used to cut plastic into circle shape. This process requires intense accuracy in which can produce defects once a minor error occur.

4.5 CONCLUSION

The product still can be improved. Note that this product really need a quality of fabrication. Avoiding the error of fabrication, the product will function well. The product fulfil the basic specification need. However the product are still not safe. There are a few consideration need to be focused.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

For this final chapter, it will discuss and represents about the project conclusion along with the recommendation for the whole of the project. The main topic for this chapter is concern on the final conclusion that is based on previous data. Some recommendations will be discussed in order to improve the final product. All the problems that have been faced during running the project from the beginning to the end will be consistently discussed. All the right action that needs to do before, present and after the project is stated in this chapter. The recommendations are considered as improvements to this project for future references.

5.2 CONCLUSION

As a conclusion, the project to design and develop of coconut palm collector has achieved its target and the objective of the project was successfully accomplished. Although some of the project activities are behind schedule, this project was able to be done within the 14 weeks period. The concept design 4 is selected as a final design and improved. By referring to the gantt chart provided, the project had confronted several unavoidable setbacks but manage to be done accordingly. This project is hope do to be a good use especially to the students for studying and also benefits in their studies.

Overall view on the project that had been carried out was good. The project provides deep insight in knowledge through research by internet and consultation

with the lecturers and instructor engineers. The data and information provided helped in making the project more effective in all aspects. The research along with the constant consultation with the supervisors and instructor engineers added with presentation of the project gives a good verbal communication and help strengthen the vocabulary.

Even more, this project has given a chance in training time management, writing skills and independent on searching and providing results to problems. Experiences along with deep knowledge are gained from this project through fabrication work involving usage of various machines available in the laboratory. It also includes improvements in software handling such as Solid Work Software. To conclude it, this final year project has provided self discipline to the student and punctuality along with good management skills. The project scope is covered very well for the design and development of coconut palm collector. The product also be more portable and be more friendly to the users. The system of the coconut palm collector also was in the best performance and this project will be the best product. It is tested with one experiment has been made to determine if the product works well or not. The experiment is also done in determining of any weaknesses of the design. All the data have been recorded for improvement purpose. After all of the process, the report is established. With the creation of this coconut palm collector, this project is hope that it can bring much convenience and satisfaction to users.

5.3 RECOMMENDATIONS

These are a number of recommendations provided for future references on this project. They are proposed to other researchers in improving the product.

5.3.1 Design

Change the holder to more durable and lightweight material such as aluminium or other materials. The nail must be ease and faster to replace or repair. So that, the using bolt and nut should be used because it ease to open and close compare with rivet. The using of bolt and nut must be used but the rivet also should

be used in order to reduce the using bolt and nut. Build a mechanism that can separate the loose fruit and rubbish. Therefore, the rubbish problems can be eliminated easily.

5.3.2 Facilities

While proceeding with this project, students had encountered a few problems with the machines which couldn't produce the complex shape desired with project. Mechanical laboratory don't have the machine to cut the material into circle shape such as plastics that can't capable with high temperature. But, the students can be uses the conventional tool such as scroll saw. Students also had problem to drill the hole with small diameter. Some numbers of machine and equipment aren't sufficient to the use of students in which causes problems during fabrication. These have cause students to share equipment which can lengthen the fabrication period. The faculty can provided more machines in which can fasten the work and help students to improve more in time management.

5.3.3 Materials

The product should be improve by chosen the materials based on characteristics such as difficult to rust, lightweight, can recycle, hardness, and have better properties, so they can give the best performance, the great features and more ergonomic value to the project. The materials that need to be use to fabricate the project must be prepare after the concept selection and designing the concept selected.

5.4 FURTHER RESEARCH

Every weakness are detected and repaired to ensure maximum comfort towards users. This project may be modified so that it can add more functions with more interesting shapes.

REFERENCES

This report is prepared based on the following references;

Parameseven Narayan. 1992. *Preliminary Observations on the Performance of an Oil Palm Loose Fruit Collector*. Universiti Putra Malaysia, Serdang, Malaysia.

Zalizan Mohd Tahir. 1993. *Reka Bentuk dan Perlakuan Mesin Pungut Buah Kelapa Sawit Terlerai*. Universiti Putra Malaysia, Serdang, Malaysia.

Abdul Rahim Hassan. 1989. *Alat Pemungut Buah Kelapa Sawit Terlerai Pada Permukaan Rata*. Universiti Putra Malaysia, Serdang, Malaysia.

APPENDIX A

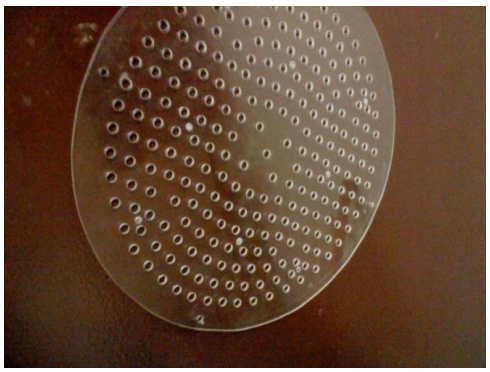
Project Schedule

Activities / Project	Week													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Identify the Problem														
Identify the scope, objective & project background														
Literature review														
Conceptual design/ selection														
Material selection														
Concept evaluation & finalized design														
Material preparation & fabrication process														
Testing & modification														
Report writing														
Presentation														

Gantt Chart

APPENDIX B

Materials Selection



Acrylic

Bolt and Nuts

Mild Steel

Mop

Plastic Rods

Nails

Rivets

APPENDIX C

Machine and Tool Application

Acrylic Cutter

Portable Hand Drilling Machine

Shearing Machine

CNC Press Brake

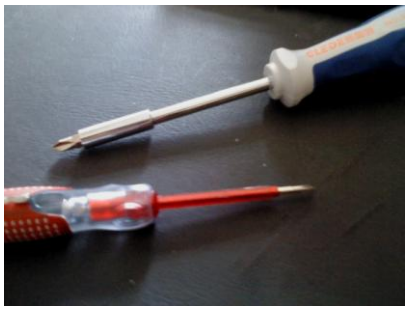
Bench drilling machine

Vertical bandsaw

File

Portable grinding machine

Wrench



Screwdriver

APPENDIX D

Result

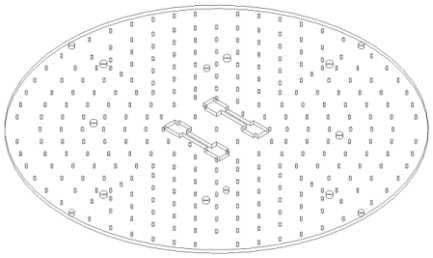
Final Product

APPENDIX E

Detail Design

a) Main Components

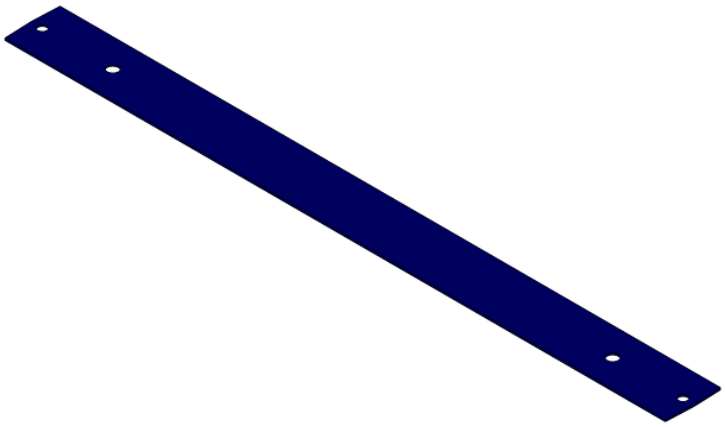
Mop holder



Acrylic

Nail

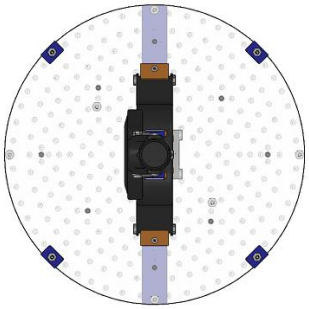
Plastic rod



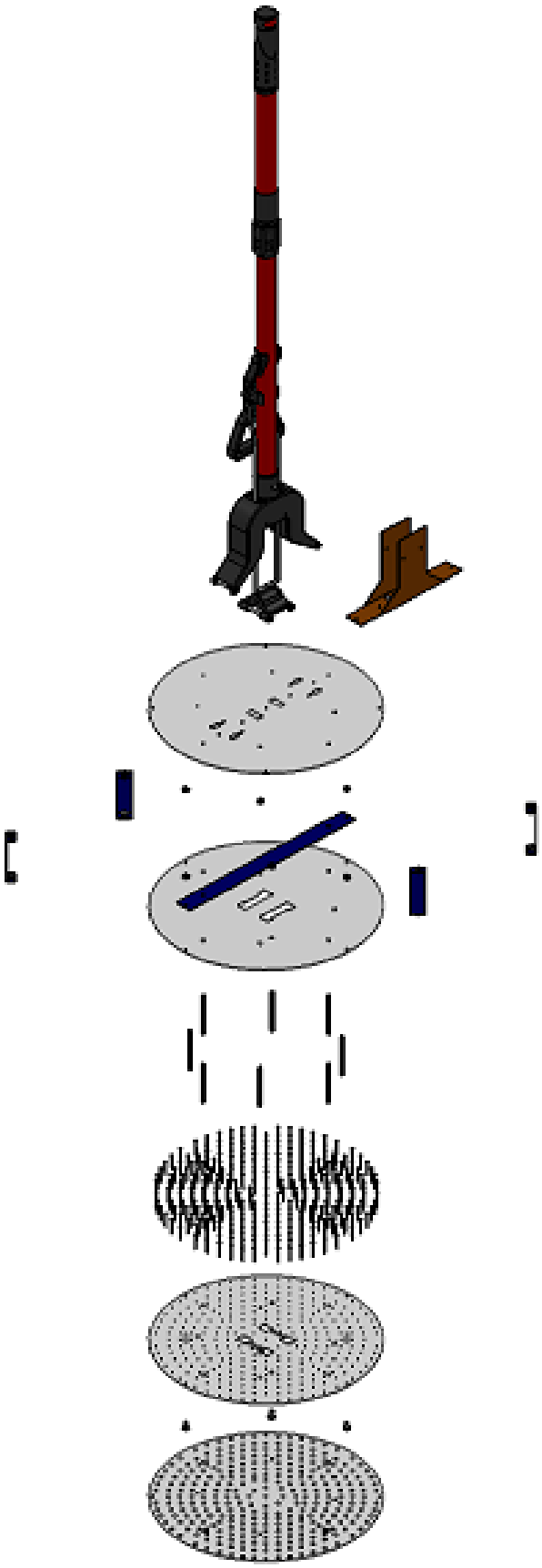
Mild steel

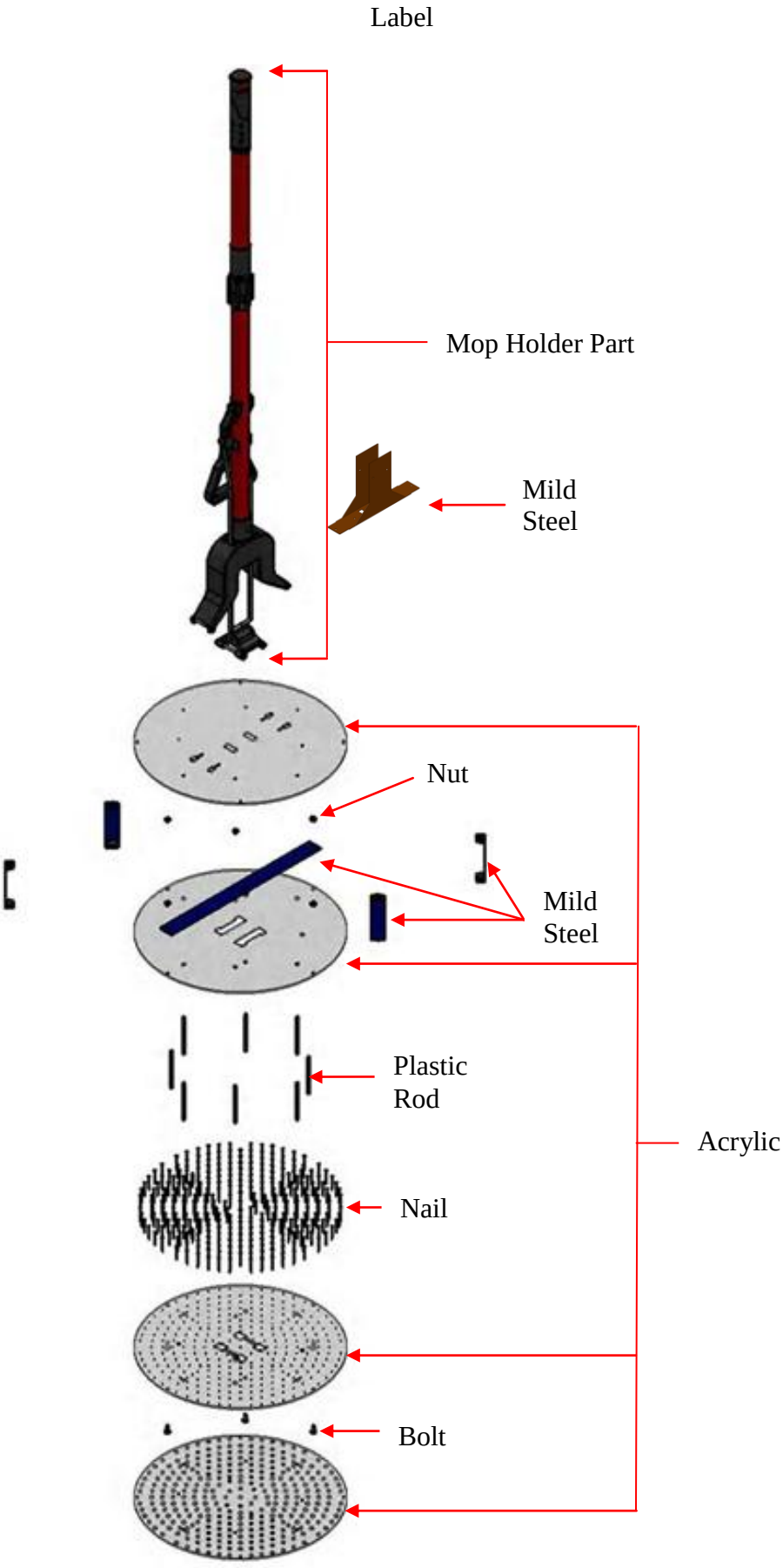
b) Overall View of the Design

Orthographic View



Exploded View

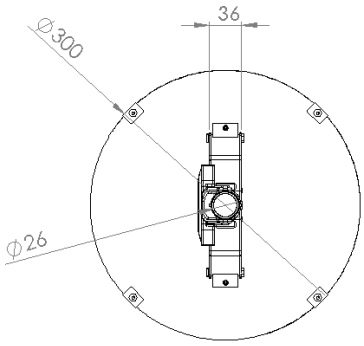


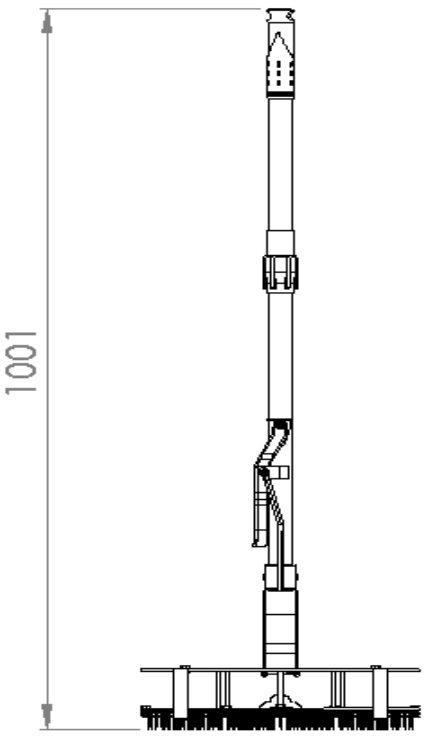

Label
Mop Holder Part
Mild
Steel
Nut
Mild
Steel
Plastic
Rod
Acrylic
Nail
Bolt

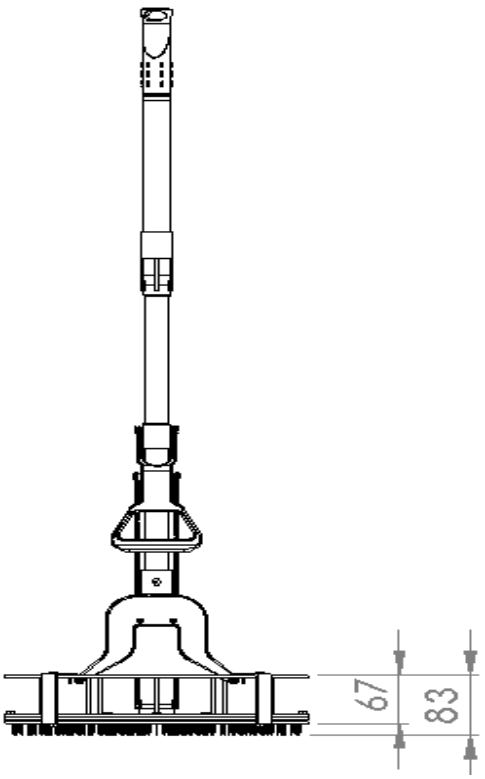
APPENDIX F

Dimension Drawing

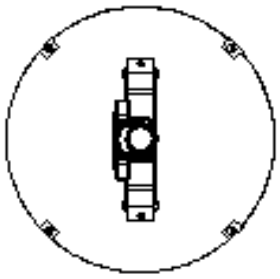
Full Assembly

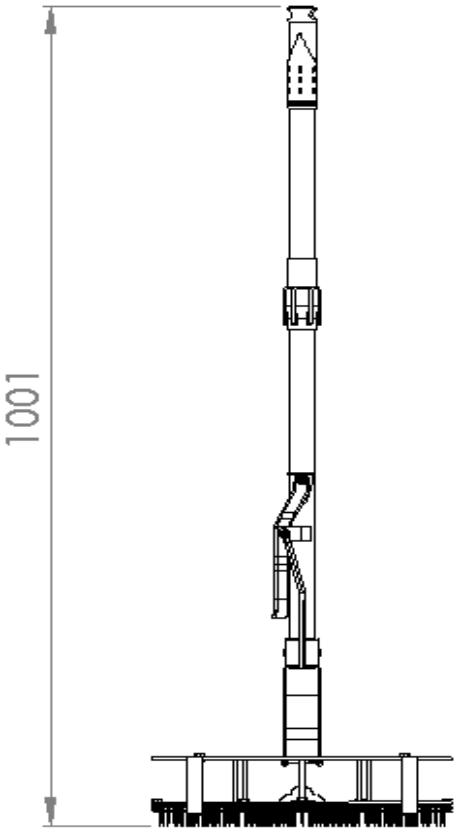


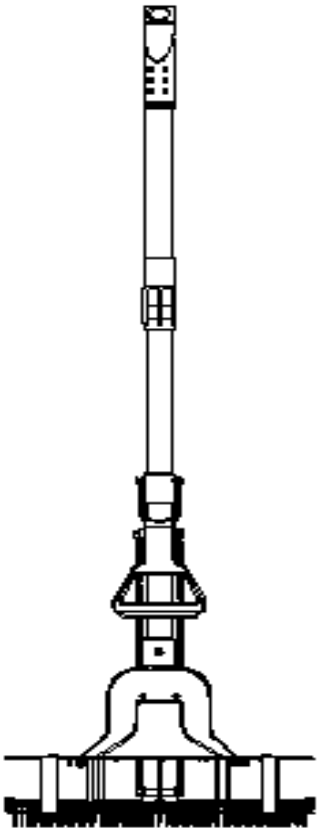




Long Holder







Short Holder