COCONUT HUSK REMOVER

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COCONUT HUSK REMOVER

MOHD HAZIQ BIN NORDIN

A report submitted in partial fulfilment of the requirements
for the award of the degree of
Diploma of Mechanical Engineering

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

NOVEMBER 2009

SUPERVISOR'S DECLARATION

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

Signature:
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Position: TUTOR
Date:

STUDENT'S DECLARATION

I hereby declare that the work in this report is my own except for quotations and summaries which have been duly acknowledged. The report has not been accepted for any degree and is not concurrently submitted for award of other degree.

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ABSTRACT

Coconut Husk Remover is a tool to remove coconut husk. There are many type of coconut husk remover in the market such as pointy machete, pointy stick and basic coconut opener. Unfortunately, the method is dangerous and hard to operate. A new coconut husk remover will be development in this study to overcome the problem. Design and fabricates of a new coconut husk remover including several process. There are many process involve to fabricate the product such as gathering material, measuring, cutting material, drilling, joining, grinding, and product finishing process. A new coconut husk remover will be fabricating. It can open the coconut husk easily and safely.

ABSTRAK

Pengupas sabut kelapa adalah alat untuk membuka sabut kelapa. Terdapat banyak jenis pengupas sabut kelapa dipasaran sekarang seperti parang, telaga dan pembuka kelapa asas. Malangnya, cara ini merbahaya dan sukar dikendalikan. Pengupas sabut kelapa yang baru akan dicipta untuk menyelesaikan masalah tersebut. Mereka bentuk dan mencipta pengupas sabut kelapa yang baru mempunyai beberapa proses. Banyak proces yang terlibatseperti mendapatkan bahan, pengukuran, pemotongan bahan, menebuk lubang, menyambung, mengisar dan proses mencantikkan produk. Pengupas sabut kelapa yang baru akan dicipta. Ianya boleh membuka sabut kelapa dengan mudah dan selamat.

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LIST OF SYMBOLS

$T\mu$	Ultimate Strength (MPa)
A	Area (m^2)
g	Gravity (ms^{-2})
m	Mass (kg)
W	Force units (N)
F	Concentrated force (N)

m Distance (m)

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LIST OF ABBREVIATIONS

MIG	Metal Inert Gas Welding
PPE	Personal Protective Equipment
GMAW	Gas Metal Arc Welding
BOM	Bill of Material

CHAPTER 1

INTRODUCTION

Coconut Husk Remover is a tool to remove the coconut husk. In human life, there has many things has been developed to make human life easier. Same with coconut husk remover, people have develops to make it easy to use. From that purpose, coconut husk remover has to produce.

1.1 PROBLEM STATEMENT

The user are facing problem while the using traditional coconut husk remover. There are some common problem when use the coconut husk remover nowadays such as don't have safety cover, difficult to operate and not comfortable to be use. The traditional coconut husk remover are not has safety characteristic that can save the user from danger. It also not easy to use and did not has an ergonomics characteristics. There are many traditional method used to remove the coconut husk. Although, the methods are not safe, a coconut husk remover with proper technique should be created.

1.2 PROJECT OBJECTIVES

Basically, this thesis would be done for fulfil the following objective:

i. To design a safe coconut husk remover.
ii. To design a simple coconut husk remover and easy to be used.

iii. To fabricate an ergonomic coconut husk remover.

1.3 SCOPE

- The product can open the coconut husk in variety size.
- Estimate the maximum product cost.
- The product must have suitable holder position and easy to the user operate.
- The weight not more than 10kg and easy to move.

1.4 IMPORTANT OF THE PROJECT

There are many advantages that can benefit from the proposed coconut husk remover. First of all, this new product is developing to create the easiest way to open the coconut husk. Moreover, it is safe to be used, save energy and save time. Thus, this is capable for the consumers to open the husk easier.

1.5 ORGANIZATION OF THESIS

Overall, the thesis is explained about the problem to open the coconut husk, to reach the product purpose and the range of the product. Then, the study held to the research of the product and explained about coconut husk remover features, method uses and product specification. Besides that, the thesis continues with the product design. The final concept will be choosing in the concept selection. After that the thesis will continue with fabrication process. After fabrication process, this thesis proceeds with the result and discussion of the product. Then, the thesis discuss about the problems encountered during the whole project was been carried out. Finally, the thesis explain about the opinion reached of the project, concluding all the process that involved and the suggestion for improvement in the future.

1.6 CONCLUSIONS

For the conclusion, this chapter explained about the problem statement, objective, and scope of the study. Well arrangement of works is really important to keep the momentum of this study.

CHAPTER 2

LITERATURE REVIEW

2.1 COCONUT

The Coconut palm (*Cocos nucifera*) is a member of the Family Arecaceae (palm family). It is the only species in the genus *Cocos*, and is a large palm, growing to 30 m tall, with pinnate leaves 4 – 6 m long, pinnae 60 – 90cm long; old leaves break away cleanly leaving the trunk smooth. The term coconut refers to the seed of the coconut palm. The spelling cocoanut is an old-fashioned form of the word.

The coconut palm is grown throughout the tropical world, for decoration as well as for its many culinary and non-culinary uses; virtually every part of the coconut palm has some human uses. In cooler climates (but not less than USDA Zone 9), a similar palm, the Queen Palm or Syagrus romanzoffiana is used in urban landscaping. Its fruit are very similar to the coconut albeit much smaller. It was originally classified in Cocos genus along with the coconut, but was later moved to Syagrus. A recently discovered palm, Beccariophoenix alfredii from Madagascar is nearly identical to the Coconut, even more than the Queen palm. It is quite cold. It is cold-hardy and makes a good coconut-lookalike for many cooler areas

The coconut has spread across much of the tropics, probably aided in many cases by seafaring people. Coconut fruit in the wild is light, buoyant and highly water resistant and evolved to disperse significant distances via marine currents. Such fruits collected from the sea as far north as Norway have been found to be viable, subsequently germinating under the right conditions.

Coconuts received the name from Portuguese explorers, the sailors of Vasco da Gama in India, who first brought them to Europe. The brown and hairy surface of coconuts reminded them of a ghost (or witch) called coco (known in castellan as El coco. When coconuts arrived in England, they retained the coco name and the suffix -nut was added.

The coconut fruits grows nuts that are amazingly equipped for ocean voyaging and able to withstand days or weeks at sea, the crashing of waves, and ultimately being storm tossed onto a distant shore. A device for forcefully removing husks from coconuts provided with a pair of hinged connected wedge blades adapted to be inserted into the coconut husk. Two or more operations are required for removing the entire husk. The called stationary blade is fixed to a vertically movable cross bar, the ends of which slide on spaced rods forming part of a frame. The frame is intended to be mounted upright on a support, such as a post. The Figure 2.1 showed the coconut interior.

Figure 2.1: Coconut Interior

Source: Wikipedia, Coconut (2003)

The Philippines is the world leader in coconut production followed by Indonesia, and India in distant third. And, they are also famous for the coconut-based products like tender coconut water, copra, coconut oil, coconut cake, coconut toddy, coconut shell-based products, coconut wood-based products, coconut leaves, and coir pith.

2.1.1 Coconut Husk

The coconut husk is used as a potting medium because of its cost-effectiveness to produce healthy forest tree saplings. The process of husk extraction from the coir bypasses the retting process, using a custom-built coconut husk extractor designed by ASEAN-Canada Forest Tree Seed Centre (ACFTSC) in 1986. Fresh husks contain more tannin than old husks. Tannin produces negative effects on sapling growth.

The coconut husk is used extensively in the manufacture of coir, which is subsequently used in the production of rope as well as household products like door mats and sacks. Figure 2.2 showed the coconut husk.

Figure 2.2: Coconut husk

Source: Geocities (2004)

2.1.2 Coconut Shell

Coconut shells are used as bowls and in the manufacture of various crafts products. In certain parts of South India, the shell and husk also are burned for smoke to repel mosquitoes. Coconut shell is sometimes used to 'ward away the evil eye' in South India. Commonly, two traditional methods are already people use today. It is a pointy sharp stake and a pointy machete. Figure 2.3 showed the coconut shell.

Figure 2.3: Coconut shell

Source: Geocities (2004)

2.1.3 Coconut flexural strength

Flexural strength is defined as a material's ability to resist deformation under load. The flexural strength represents the highest stress experienced within the material at its moment of rupture. It is measured in terms of stress. The coconut flexural strength is the coconut properties to achieve failure when the forces impose down to the coconut shell and enter the coconut husk to open the husk with minimum forces. Appendix C shown the flexural strength of the coconut is 80.86 MPa.

2.2 TRADITIONAL METHOD OF COCONUT HUSK REMOVER

2.2.1 Pointy Sharp Stake

A stake (usually metal) is driven into the ground with the point up. Sometimes a pickaxe is used, the pointy end up. The coconut is held in both hands and jammed onto the stake then twisted to separate and eventually remove the husk. This can be extremely dangerous and is not recommended. If the stake strikes off centre or too aggressively, it slides up the coconut and into a hand or arm. Figure 2.4 shown the pointy sharp stake that usually use in previous method.

Figure 2.4: Pointy sharp stake

Source: Cay Caulker (1999)

2.2.2 Pointy Machete

The machete function is to chop down one end of the husk. The swap meet whittle away one end of the coconut with a machete can lop off the end and stick a straw in the top. This method sounds promising, but again it has the sharp object problem. Whacking a hard, round object with a big knife takes practice.

Besides, the machete is duller than a butter knife. One or two chops at the revealed nut should open it. Figure 2.5 show the pointy machete that uses as a conventional method to open the coconut husk.

Figure 2.5: Pointy machete

Source: Wikipedia, machete (1998)

2.2.3 Basic Coconut Opener

A device for forcefully removing husks from coconuts provided with a pair of hinged connected wedge blades. The wedge blades adapted to be inserted into the coconut husk. Then, apply the force and pull the holder outside. Two or more operations are required for removing the entire husk. This also can be dangerous because the coconut is not clamp during the blades insert into the coconut. Figure 2.6 show the basic coconut opener that uses to open the coconut husk.

Figure 2.6: Basic coconut opener

Source: Heywood, Coconut Opener (2008)

2.3 ERGONOMICS

Ergonomics is the necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability. It is relevant in the design of such things as safe furniture and easy to use interfaces to machines**.** For the coconut husk remover product, the heights of the product is the most important in ergonomics because it must have suitable holder position and easy for the user to operate it. The product will design in maximum height but not over than 164.7 cm. It is because the average people heights in Malaysia are 164.7 cm for male and 153.3 cm for female. Appendix A is listed the chart of people heights in Asia.

2.4 METAL INERT GAS (MIG) WELDING

(Metal Inert Gas) MIG or as it even is called (Gas Metal Arc Welding) GMAW uses an aluminum alloy wire as a combined electrode and filler material. The filler metal is added continuously and welding without filler-material is therefore not possible. Since all welding parameters are controlled by the welding machine, the process is also called

semi-automatic welding. The Figure 2.7 had shown the (MIG) Metal Inert Gas welding that use in joining the part.

Figure 2.7: Metal Inert Gas (MIG) Welding

Sources: Wikipedia, Metal Inert Gas (MIG) Welding (2009)

2.5 DRILLING

Drilling is easily the most common machining process. One estimate is that 75% of all metal-cutting material removed comes from drilling operations. Drilling involves the creation of holes that are right circular cylinders. This is accomplished most typically by using a twist drill, something most readers will have seen before. The chips must exit through the flutes to the outside of the tool. The cutting front is embedded within the work piece, making cooling difficult. The cutting area can be flooded, coolant spray mist can be applied, or coolant can be delivered through the drill bit shaft. The Figure 2.8 showed the drill press machine that use in fabrication.

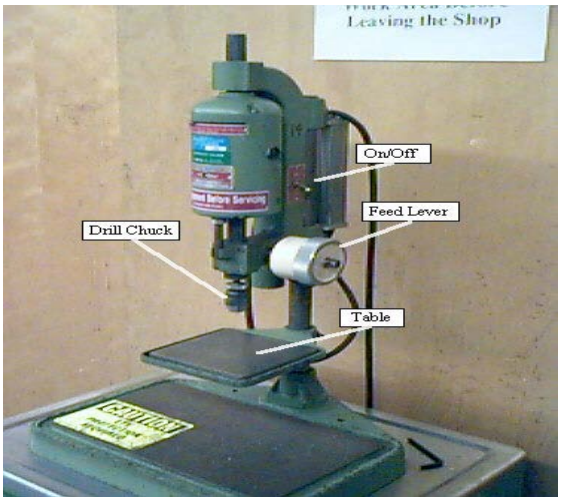


Figure 2.8: Drill Press Machine

Sources: Engineering Dartmouth, Drill Press Machine (2004)

2.6 GRINDING

Grinding is a finishing process used to improve surface finish, abrade hard materials, and tighten the tolerance on flat and cylindrical surfaces by removing a small amount of material. Information in this section is organized according to the subcategory links in the menu bar to the left. In grinding, an abrasive material rubs against the metal part and removes tiny pieces of material. The abrasive material is typically on the surface of a wheel or belt and abrades material in a way similar to sanding. On a microscopic scale, the chip formation in grinding is the same as that found in other machining processes. The abrasive action of grinding generates excessive heat so that flooding of the cutting area with fluid is necessary. The Figures 2.9 had shown the grinding machine that use in finishing process.

Figure 2.9: Grinder

Sources: Tradevv, Grinder (2005)

CHAPTER 3

METHODOLOGY

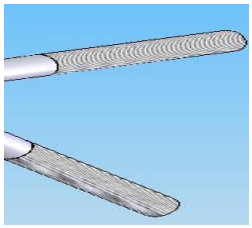
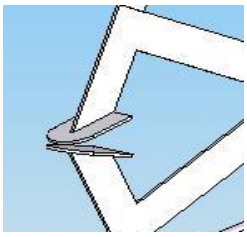
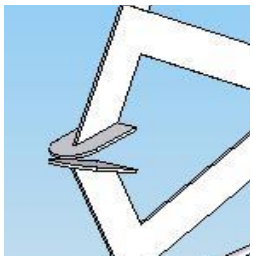
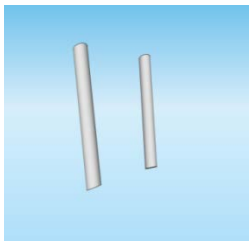
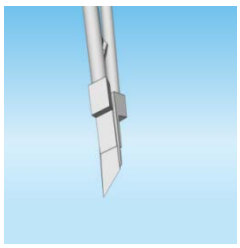
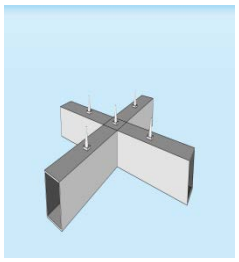
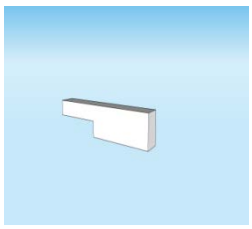
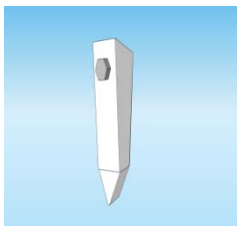
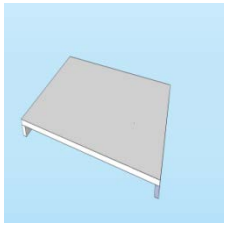
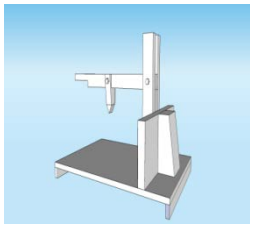
A flow chart in Appendix B shows the sequence of works to be done for this thesis. Project flow chart is explaining the overall project flow from start to the end.

3.1 CONCEPTUALIZATION

3.1.1 Concept Generation

Table 3.1 shows the different design components. These components are used to generate a new concept of coconut husk remover. The final concept will select after the combination of the components.

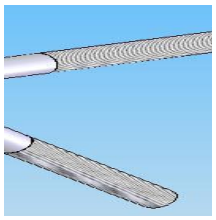
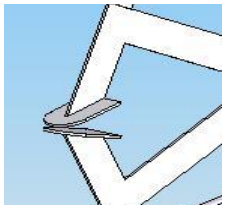
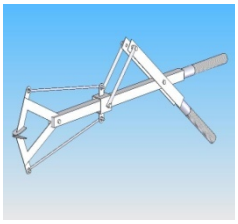
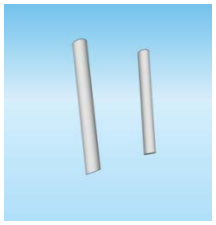
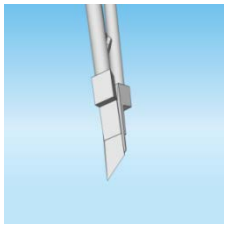
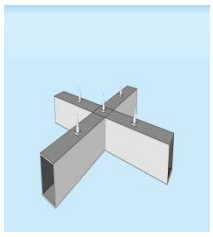
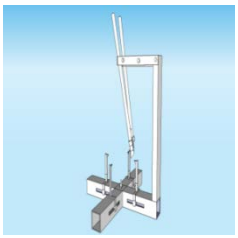
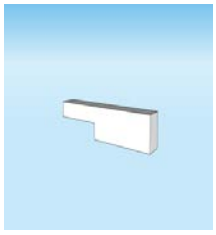
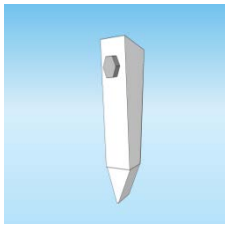
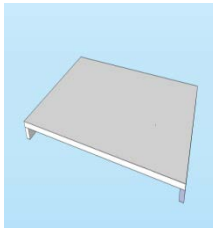
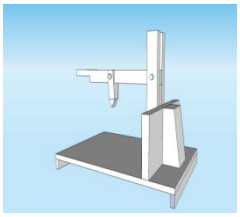
Table 3.1: Components for concept generation

Holder	Cutter	Base	Design
		**No Base**	
			
			

3.1.2 Concept Combination

Table 3.2 shows the concept combination of each component to develop the final design of coconut husk remover. This consists of detail description for this concept.

Table 3.2: Concept combination of coconut husk remover

Concept	Holder	Cutter	Base	Final Design
A			**No Base**	
B				
C				

Concept A use connecting rode to move the blades. It is difficult to operate because many junction and connecting are consist in the design. It also not has a clamp to clamp the coconut neat and orderly. It could be dangerous to the user. This concept has 2 holder same as concept B.

For concept B, it has a clamp at the base to clamp the coconut during open the husk. The pointy stick joins at the centre of the base act as the clamp to clamp the coconut. The basic coconut opener uses as the blades for this concept. The coconut impales to the pointy stick before the blades open the husk.

Concept C has only one blade to open the husk. Concept C has a table at the base but did not have a clamp to clamp the coconut during open the husk. It also only has one handle to hold.

3.1.3 CONCEPT SELECTION

The final concept will selected after concept generation and concept combination. The entire concepts are comparing to select the final concept. Table 3.3 has showed the concept scoring of coconut husk remover characteristic based on objective tree in Appendix C. Concept B is selected as the final design for this project.

Table 3.3: Concept Scoring

Characteristics	Score	Concept A	Concept B	Concept C
Clamp Part	0.1	0	0.07	0.03
Machining Process	0.09	0.02	0.06	0.04
Fabrication Process	0.11	0.03	0.05	0.07
Sharp Wedges Blades	0.2	0.12	0.16	0.08
Joining Process	0.13	0.06	0.10	0.07
Easy to operate	0.1	0.02	0.06	0.04
Easy to maintenance	0.1	0.015	0.05	0.03
Base	0.05	0	0.045	0.015
Holder	0.05	0.02	0.04	0.03
Material	0.07	0.02	0.05	0.025
Total score	1	0.305	0.665	0.430

3.2 PRODUCT DESIGN SPECIFICATION

Product Title

Coconut Husk Remover

Purpose of the Project

This product is produce to open the coconut husk easily and safety. Besides that, the product developed to provide the ergonomics specification.

New or Special Features

The coconut husk remover operated to open the varsity size and coconut kind. Besides that, it also can open the coconut husk safely than other conventional method.

Competition

The product can open the coconut husk safely than traditional method such as pointy stick and pointy machete.

Intended Market

Sell to coconut factory or the villager that have coconut farm.

Need For Product

The existing traditional coconut husk remover such as pointy stick and pointy machete are not safe and skill required. Although, the traditional method are not ergonomics that consumer need during open the husk.

Relationship to Existing Products Line

This concept can improve the existing product by modify the method applied.

Price

A unit of coconut husk remover is selling at RM99.84. The labour cost is RM15.00 per unit.

Functional Performance

The coconut husk remover can be installing easily, ease to maintenance, and easy to operate. Besides that, the coconut husk remover can open any size and coconut kind. It has a clamp to reach ergonomics specification.

Physical Requirement

i. The weight does not exceed 10kg
ii. The width does not exceed 600mm
iii. The length does not exceed 600mm
iv. The height does not exceed 164.7mm (refer Appendix D)

Service Environment

The coconut husk remover should be stable from 0° Celsius to 40° Celsius. The product also can stand any rough surface because it has a clamp to clamp the coconut. The coconut husk remover can be use in any condition and everywhere.

Life Cycle Issues

The raw material of this product is stainless steel and mild steel. The steel can cycle like molten to produce steel again. If the raw material use is plastics, it will hard to abolish the material and take long time.

Human Factors

The pointy stick at the base is covert from safety cover part so does not course hurt or injuries.

3.3 FINAL DESIGN CONCEPT

Concept B has been choosing as the final design concept. This design show that the final idea of the Coconut Husk Remover. This concept has a clamp at the base to clamp the coconut during open the husk. The pointy stick joins at the centre of the base act as the clamp to clamp the coconut. The basic coconut opener uses as the blades to open the husk.

The final design drawings are draw using Solidworks software. The drawings show the overall part of the coconut husk remover. Final designs drawing and explode drawing shown in Appendix F.

3.4 Bill of Material

In order to make the design dimension and material selection, bill of material of the coconut husk remover are list.

Table 3.4: Bill of Material (BOM)

Bil.	Type	Size	Quantity
1	Stainless steel	600 mm X 50 mm X 50 mm	1
2	Stainless steel	275 mm X 50 mm X 25 mm	2
3	Stainless steel	600 mm X 50 mm X 25 mm	1
4	Stainless steel	300 mm X 20 mm X 5 mm	2
5	Screw	Diameter 10mm	2
6	Basic Coconut Opener	-	1

3.5 Fabrication Process

The fabrication process was started with measuring the material into the required dimension and cutting into its desired length using steel saw. As the base part, 600 mm x 50 mm x 50 mm and 275 mm x 50 mm x 25 mm hollow steel was the first material that cutting. 600 mm x 50 mm x 25 mm stainless steel hollow steel was the next that will be cut into 1 piece. Before proceeding with this process, safety measurement had been carried out by wearing Personal Protective Equipment (PPE). Cutting hollow stainless steel using steel saw as shown in Figure 3.10.

Figure 3.1: Cutting hollow stainless steel using steel saw.

Then, several locations were drilled to make holes for bolts and nuts for the support bar. Press drill was used during the process because all the hollow tube had been weld together. This process must doing carefully because any mistake of drilling will cause the material to damage. Drilling process is shown in Figure 3.11.

Figure 3.2: Drilling process

The joining process was carried out by using the Gas Metal Arc Welding or formerly known as MIG (Metal Inert Gas). First, the welding machine is set up to make sure that the output of the process will satisfy. Then, all the materials were weld together. During this process, a minor movement of the materials will give bad effect to the joint and to the framework. Welding process is shown in Figure 3.12.

Figure 3.3: Welding process using MIG welding

After finished welding, the entire welded places were then grinded to make sure that the entire joint surface was smooth from any spatters or sharp edge. Figure 3.13 are shown grinding process to smooth the edge.

Figure 3.4: Grinding process

After all the process had been done, come the last part that is tightening the bolt and nut of the wheels. Any rough surface cause by welding spark was shaped or smooth using file and followed by painting process.

3.6 CONCLUSION

Project methodology is a body of practices, procedures and rules used by those who work in a discipline or engage in an inquiry and a set of working methods. It explained about the process that involved during the fabrication process. Furthermore, the design that had been chosen as the final design was describe in detail in this chapter.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 FINAL PRODUCT

The final products are shown below after painting. The holder, base, blades, and pointy stick are the part of the coconut husk remover. The right holder is fix and the left holder can move to left side. The safety cover added to covert the pointy stick.

Figure 4.1: Final product

Figure 4.7 show the safety cover to covert the pointy stick at the base of the coconut husk remover. Using this rubber lid, its can avoid an injured or unexpected accident happen when use this coconut husk remover because of the sharp edges.

Figure 4.2: Safety cover and pointy stick

4.2 STEP IN OPERATE COCONUT HUSK REMOVER

4.2.1 Step Before Operate

i. Make sure the screw at the holder and the bar steel tight before use.
ii. Make sure the safety cover close the pointy stick.

4.2.2 Step in Running

i. Open the safety cover.
ii. Hold the holder and step the leg on the side base as shown in Figure 4.2.

Figure 4.3: Step leg and hold method

iii. Then, impale the coconut into the pointy stick at the base. Figure 4.3 shows the coconut impales into the pointy stick at the base.

Figure 4.4: Coconut impale into the pointy stick

iv. Apply the forces and down the blades into the coconut as shown in Figure 4.4.

Figure 4.5: Blades impale into the coconut

v. Pull the holder to the left side. Figure 4.5 show the holder is pulls to the left side.

Figure 4.6: The holder pulls to the left side

vi. Repeat the entire step to removing the entire husk.

4.3 ANALYSIS

4.3.1 Cost Analysis

Table 4.3: Cost Analysis Table

No	Items/Expenses	Quantity	Price (RM)
1	Stainless steel	6	25.00
2	Screw	2	1.20
3	Spray	2	12.00
4	Basic Coconut Opener	1	20.00
	SUM		**58.20**

Price of stainless steel is RM 25.00 that includes 600 mm x 50 mm x50 mm hollow steel 1 unit, 275 mm x 50 mm x 25 mm hollow steel 2 unit, 600 mm x 50 mm x 25 mm hollow steel 1 unit, and 300 mm x 20 mm x 5 mm bar steel. Other items are screw 2 unit, spray 2 unit and basic coconut opener 1 unit. Labour cost and shipping cost are count in cost analysis.

Assume that labour cost is RM 15.00 and shipping cost is RM 10.00. Total material cost for stainless steel, screw, spray and basic coconut opener is RM 58.20. The total is added with labour cost and shipping cost is RM 83.20. If the profit margins is 20%, the total price of the product is RM 99.84.

4.3.2 Cutting Force

From the Figure 2.3 Coconut Flexural Strength shows the Ultimate Strength of coconut husk in Appendix C, $T\mu$ are 80.86 MPa

Ultimate Strength of coconut husk, $T\mu$ = 80.86 MPa.

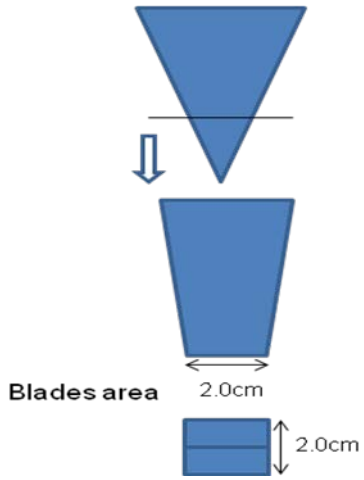


Figure 4.7: Cutting Area

$$T\mu = \frac{F}{A} \tag{4.1}$$

Find F minimum, F min = $Tu \ x \ A$

F min = 80.86 $x10^6$ x (0.020m x 0.020m)

= 32.344$x10^3$ N

$$F = mg \tag{4.2}$$

W = 32.344$x10^3 N$/ 9.81ms^{-2}

W = 3.297$x10^3$ kg

Assume that weight of user hand during forces is 1.5kg,

W = 3.297 x 10^3 – 1.5 = 3.2955 x 10^3 kg

$$F = mg$$

$$F = 3.2955x10^3 \text{ x } 9.81$$

$$= 32.329x10^3\ N$$

Based on calculation above, the value of force need to open the coconut husk is 32.329 x10^3 N.

4.4 PROJECT PROBLEM

Problem during this stage is very critical that make the project schedule is delayed. The problem comes when the dimension raw material that have in the Mechanical Lab are not suitable for the design. The raw material such as stainless steel and mild steel only can earn to buy at the city. Besides that, the cutter machine in Mechanical Lab cannot be use so to cut the material, steel saw was be use to cut the material.

The clamping parts are not use after the last design decision. It is because of the clamping will take much time to open and close back to clamp the coconut fruit. To solve the problem, the pointy sticks are joining in the middle and the each edge of the based.

There are so many things happen in fabrication the product during welding process such as defect. This defect happens because lacks of skill to operate a machine such as when handling Arc welding and MIG welding machine. There is many type of defect occur during the fabrication such as gap, and bead.

4.5 CONCLUSION

The final fabrication of the coconut husk remover is done from only limited times due to several problems occur to the project.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

In this chapter will discuss mainly about the conclusion of the project, concluding all the process that involved. Besides that, recommendations are also included in this chapter.

5.1 CONCLUSION

The objective of the project is to design a coconut husk remover that more safety, simple, and efficient are successfully done and achieved. This product also have achieves the ergonomics specification successfully. A coconut husk remover is user-friendly because it is easy to handle and suitable to use by people. It is also useful for the users who need to remove the coconut husk in any position. This will be reducing the risk of accident at the work places.

The design of this coconut husk remover is giving a lot of benefits in order to make the human life easier and safety. This project was done around thirteen week included almost all steps of the report such as literature review, design, fabrication process and others.

5.2 RECOMMENDATION

Lighter material can be used to decrease the weight of the coconut husk remover and thus improve the mobility of the product. Coconut husk remover with different colors and designs can be attractive as well. Besides that, come up with a coconut husk remover that can use different types of clamping. However, this product can be further improved by taking into consideration different types of clamp part.

Come up with a coconut husk remover that can use different types of clamping. The new clamping design maybe can rotate the coconut without need to pull out the coconut and impale again to the pointy stick. This product can be further improved by taking into consideration different types of clamp part.

A small lamp can also be attached to the product using electrical system. It can to allow the users to be easier when using the coconut husk remover in the night or dark place. The lamp can use battery as a source and easy to replace the battery.

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APPENDIX A

COCONUT FLEXURAL STRENGTH

3.2. Flexural Properties of Epoxy/Coconut Shell Filler Particle Composites

Stress at fracture from a bend or flexure test is known as flexural stress. Figure 5 shows the typical flexural stress *vs.* strain curves for three different epoxy/coconut filler composite materials. The effect of coconut filler content on maximum flexural stress, strain and modulus of elasticity are shown in Figures 6–8 respectively. Almost similar pattern were obtained from the flexural mode as was obtained from tensile test. The maximum flexural strength for 15% filler composite was higher (80.68 MPa) and other two (5% and 10%) combinations exhibited lower flexural strength. At lower concentration of the filler material, specimen demonstrated slightly nonlinear behavior prior to sharp failure or fracture. This means that specimen deformed plastically immediate after elastic deformation.

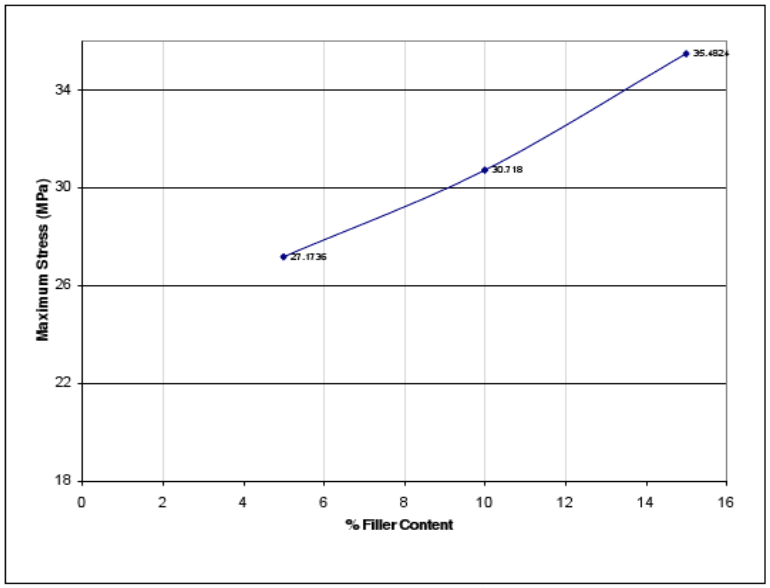


Figure 2. *Maximum tensile stress* versus *filler content*

The increase of filler content results in the steady linear increase in flexural stress and quadratic increase of flexural modulus of elasticity, which can be seen in Equations 4 and 5 with a correlation factor of about 0.9973 and 1 respectively. This increase is due to the relationship between the interface of fillers and matrix in which the fillers strengthen the composite materials. However, the strain decreases following a quadratic form with the increase in the filler content due to the fact that the materials have become harder with the increase in filler content, as obtained for tensile testing. Therefore, the elongation decreases as filler materials reduce the ductility of matrix. The corresponding correlated equation for the strain is shown in Equation 6 with a correlation factor of about 1.

$$S_{fs} = 2.4914\ Pf + 42.931 \quad (4)$$

$$E_{fmax} = 16.584\ P_f^{\,2} - 175.89\ P_f + 220.14 \quad (5)$$

$$\varepsilon_{fmax} = 0.0002\ P_f^{\,2} - 0.0054\ P_f + 0.0523 \quad (6)$$

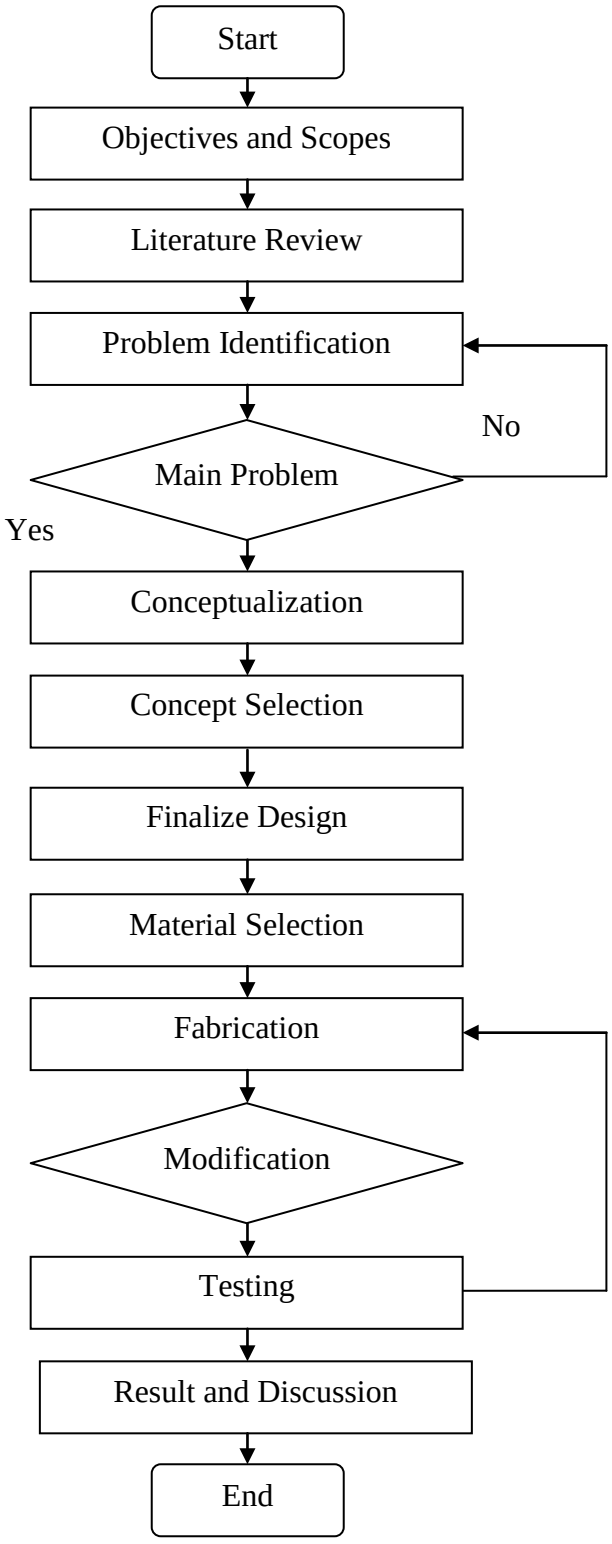
where: S_{fs}, E_{fmax}, and ε_{fmax} are the maximum flexural stress, modulus of elasticity, and maximum strain respectively.

Coconut Flexural Strength

Source: Mechanical Properties of Epoxy/Coconut Shell Filler Particle Composites (2006)

APPENDIX B

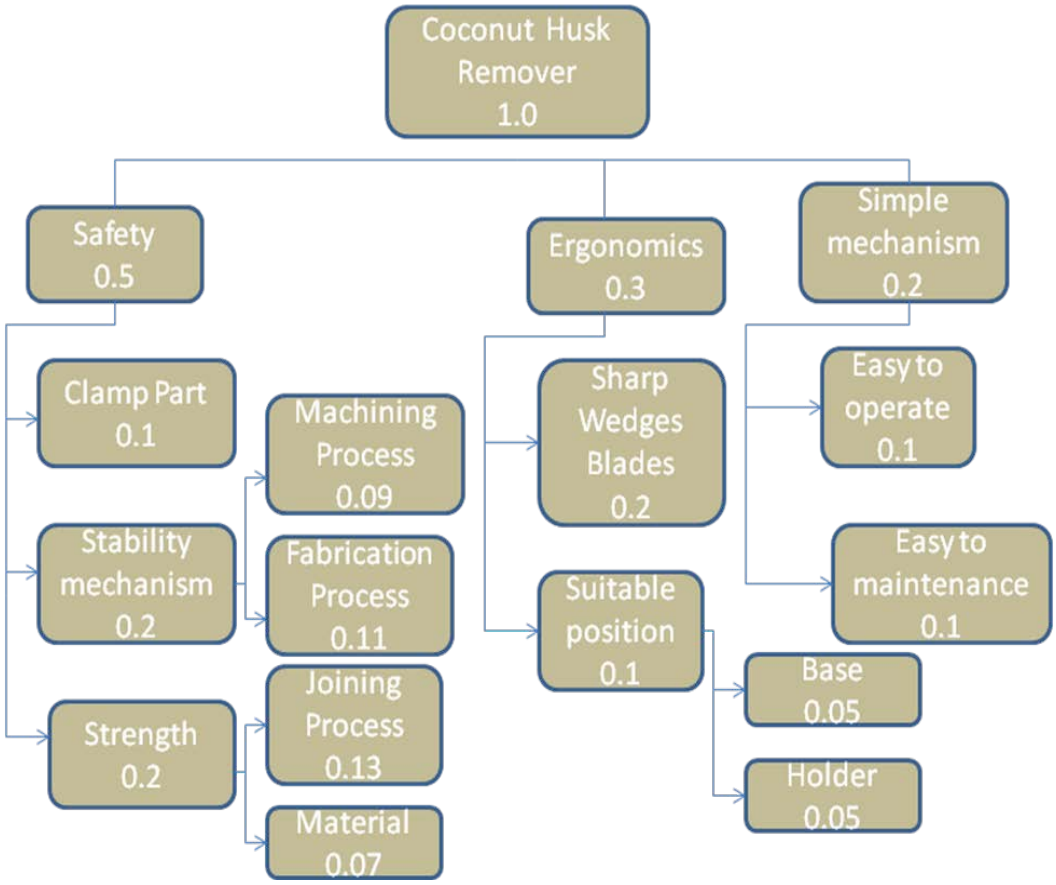
FLOW CHART


Start
Objectives and Scopes
Literature Review
Problem Identification
No
Main Problem
Yes
Conceptualization
Concept Selection
Finalize Design
Material Selection
Fabrication
Modification
Testing
Result and Discussion
End

Flow chart

APPENDIX C

OBJECTIVE TREE



Objective tree

APPENDIX D

TABLE OF AVERAGE PEOPLE HEIGHTS IN ASIA

Average people heights in Asia

Country/ Region	Average male height	Average female height	Sample population / age range	Methodology	Year
China (PRC)	170.2 cm (5' 7.0")	158.6 cm (5' 2.5")	Urban, 17	Measured	2002
Indonesia	158.0 cm (5' 2.2")	147.0 cm (4' 10.0")	50+	Self-reported	1997
Korea, South	174.5 cm (5' 8.7")	161.3 cm (5' 3.5")	19	Measured	2005
Korea, North	165.6 cm (5' 5.2")	154.9 cm (5' 1.0")	20–39	Measured	2005
Lithuania	176.3 cm (5' 9.4")		Conscripts, 19–25	Measured	2006
Malaysia	164.7 cm (5' 4.8")	153.3 cm (5' 0.4")	20+	Measured	1996
Norway	179.7 cm (5' 10.7")		Conscripts, 18–19	Measured	2008
Philippines	163.5 cm (5' 4.3")	151.8 cm (4' 11.8")	20–39	Measured	2003
Singapore	170.6 cm (5' 7.2")	160.0 cm (5' 3.0")	17–25	Measured	2003
Thailand	167.5 cm (5' 5.9")	157.3 cm (5' 1.9")	STOU university student	Self-reported	1991–1995
Vietnam	162.1 cm (5' 3.8")	152.2 cm (4' 11.8")	25–29	Measured	1992-1993

Source: Wikipedia, Average people heights in Asia (2008)

APPENDIX E

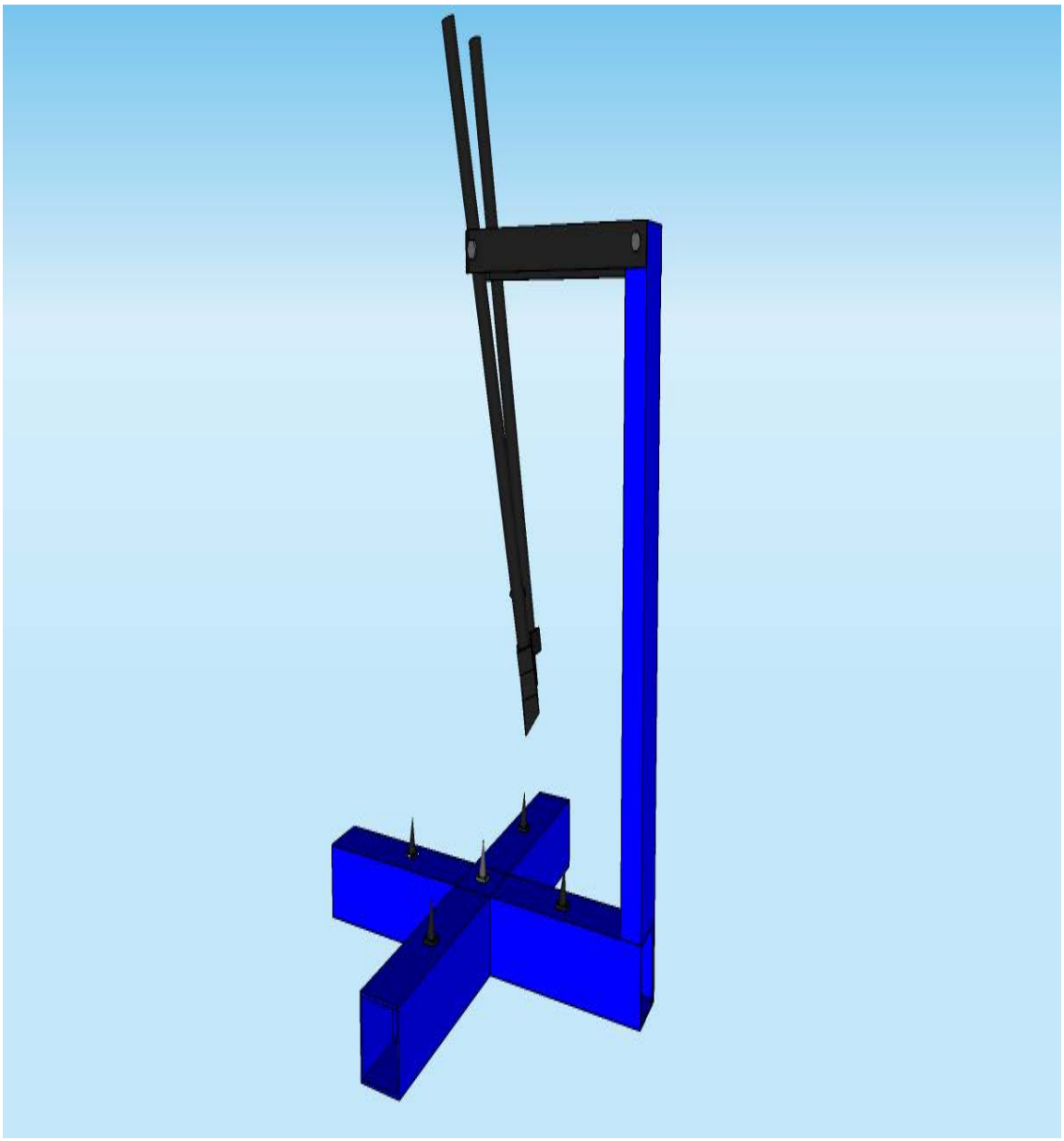
GANTT CHART

Gantt chart

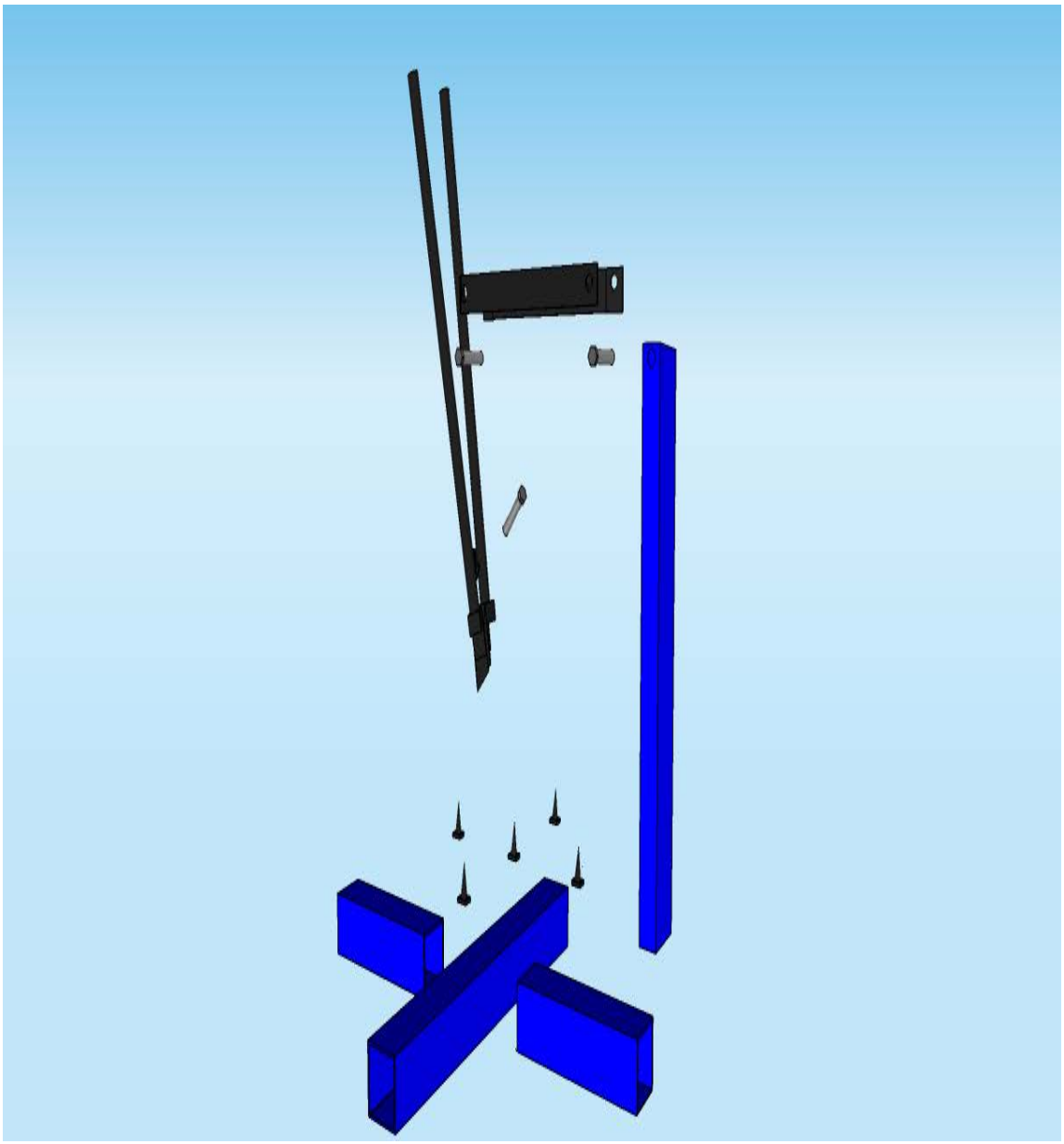
Bil.	Task		Week													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Title selection, scope and objective	Plan														
		Actual														
2	Literature review	Plan														
		Actual														
3	Identify problem	Plan														
		Actual														
4	Design concept	Plan														
		Actual														
5	Selection concept	Plan														
		Actual														
6	Collecting data and information	Plan														
		Actual														
7	Preparing mid presentation	Plan														
		Actual														
8	Mid presentation	Plan														
		Actual														
9	Fabrication	Plan														
		Actual														
11	Preparing final presentation	Plan														
		Actual														
12	Making report	Plan														
		Actual														
13	Final presentation	Plan														
		Actual														
14	Correction and submit final report	Plan														
		Actual														

APPENDIX F

DRAWING



Final Design



Explode Drawing