

DEVELOPMENT OF A MECHANICAL FRUIT PICKER

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A report submitted in partial fulfilment of the requirements
for the award of the degree of
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NOVEMBER 2008

SUPERVISOR DECLARATION

“I declare that I have read this thesis and in my opinion, this thesis is enough to fulfill the purpose for the award for the Diploma of Mechanical Engineering from the aspects of scope and quality.”

Signature :

Supervisor : MUHAMMAD AMMAR BIN NIK MU'TASIM

Date : 11 NOVEMBER 2008

DECLARATION

I declare that this report entitled “Development of A Mechanical Fruit Picker” is the results of my own work and research. The report has not been degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

The idea to create and build a **mechanical fruit picker** is come from supervisor that gives me this title and task for this project. To design and fabricated this fruit picker, it must be compare with other product that maybe available in the market. First, get an idea from internet, magazine, newspaper or other from available data. Form there the information and idea to design and fabricated can be created. Whole project involves various methods such as collecting data, concept design and fabrication process. The whole project involved various method and process that usually use in engineering such as concept design, analysis process and lastly fabrication process. This final year project takes one semester to complete. This project is individual project and must be done within this semester. In this project, students must able apply all knowledge during their studies in this Diploma of Mechanical Engineering course. Overall from this project, time management and discipline is important to make sure this project goes smooth as plan and done at correct time.

ABSTRAK

Idea untuk menghasilkan dan membina **pemetik buah mekanikal** ini datang daripada penyelia yang memberi saya tajuk dan tugas untuk projek ini. Untuk merekabentuk dan pembinaan pemetik buah, ia hendaklah dibandingkan dengan produk lain yang mungkin berada dalam pasaran. Langkah pertama, dapatkan maklumat daripada internet, majalah, suratkhbar atau daripada sumber yang lain. Keseluruhan projek melibatkan pelbagai cara atau kaedah seperti mengumpulan data, rekabentuk konsep dan proses membina. Kaedah yang selalu yang digunakan dalam kejuruteraan seperti proses analisis juga digunakan. Projek akhir tahun ini mengambil satu semester untuk disiapkan. Projek ini adalah projek individu dan mesti disiapkan dalam semester ini. Didalam projek ini, pelajar mesti berupaya menggunakan segala pengetahuan yang mereka perolehi semasa pembelajaran mereka di dalam kursus Diploma Kejuruteraan Mekanikal ini. Secara keseluruhan daripada projek ini, pengurusan masa dan disiplin adalah penting dalam memastikan projek berjalan lancar dan siap tepat pada waktunya.

TABLE OF CONTENT

CHAPTER	TITLE	PAGE
	SUPERVISOR DECLARATION	ii
	STUDENT DECLARATION	iii
	ACKNOWLEDGEMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENT	vii
	LIST OF TABLES	xi
	LIST OF FIGURES	xii
	LIST OF APPENDICES	xiv
 CHAPTER 1	 INTRODUCTION	
	1.1 Project Synopsis	1
	1.2 Problem Statement	2
	1.3 Project Objective	2
	1.4 Project Scopes	2
	1.5 Planning Project	4
 CHAPTER 2	 LITERATURE REVIEW	
	2.1 Introduction	5
	2.2 Comparison of Current Product	5
	2.2.1 Twister Fruit Picker	6
	2.2.2 Pole Fruit Picker	7
	2.2.3 Wolf Garten Fruit Picker	8
	2.3 Fabrication process	9
	2.3.1 Welding	9
	2.3.1.1 Introduction	9
	2.3.1.2 Arc Welding	10
	2.3.1.3 Metal Inert Gas	11

2.3.2 Drilling	12
2.3.2.1 Introduction	12
2.3.3 Angle Grinder	13
2.3.3.1 Introduction	13
2.3.4 EDM wire cut	14
2.3.4.1 Introduction	14
2.3.5 Rivet	15
2.3.5.1 Introduction	15

CHAPTER 3

METHODOLOGY

3.1 Introduction	16
3.2 Project Flow Diagram	17
3.3 Design	19
3.3.1 Introduction	19
3.3.2 Drawing	19
3.3.3 Sketching Drawing Selection	19
3.3.3.1 Concept A	20
3.3.3.2 Concept B	21
3.3.3.3 Concept C	22
3.3.3.4 Concept D	23
3.3.4 Result	24
3.3.5 Concept Generation & Evaluation	25
3.3.6 Product Design Specification	26
1. Main Blade	26
2. Blade Handle	26
3. Cutter	27
4. Pulley	27
5. Bucket	28
6. Handle	28
7. Puller	29

3.3.7 Engineering Drawing of Fruit Picker	30
1. Main Blade	31
2. Cutter	31
3. Blade Handle	32
4. Pulley	32
5. Bucket	33
6. Handle	33
7. Puller	34
8. Full Assembly	34
3.3.8 Processes Involves	35
1. Getting Material	35
2. Measuring & Marking	36
3. Cutting process	37
4. Joining Process	37
3.3.9 Summary	38

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction	39
4.2 Results	39
4.2.1 Introduction	40
4.2.2 Analysis	43
4.3 Discussion	44
4.3.1 Type of Defect	44
4.3.2 Problem In Progress	46

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction	47
5.2 Conclusion	47
5.3 Recommendation	48

REFERENCES

49

APPENDIX A-C

50

LIST OF TABLES

TABLE NO.	TITLE	PAGE
3.6	Pugh Concept	26

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
1.1	Gantt Chart	3
2.1	Twister Fruit Picker	6
2.2	Pole Fruit Picker	7
2.3	Wolf Garten Fruit Picker	8
2.4	Arc Welding	10
2.5	Metal Inert Gas	11
2.6	Drilling	12
2.7	Angle Grinder	13
2.8	EDM wire cut	14
2.9	Rivet	16
3.1	Flow Chart	19
3.2	Concept A	21
3.3	Concept B	22
3.4	Concept C	23
3.5	Concept D	24
3.7	Main Blade	27
3.8	Blade Handle	27
3.9	Cutter	28
3.10	Pulley	28
3.11	Bucket	29
3.12	Handle	29
3.13	Puller	30
3.14	Main Blade	32
3.15	Cutter	32
3.16	Blade Handle	33
3.17	Pulley	33
3.18	Bucket	34

3.19	Handle	34
3.20	Puller	35
3.21	Full Assembly	35
3.22	Raw Material	36
3.23	Measuring & Marking	37
3.24	Cutting Process	38
3.25	Joining Process	39
4.1	Isometric View	41
4.2	Front View	42
4.3	Right View	42
4.4	Left View	43
4.5	Distribution Load	44
4.6	Stress Distribution	44
4.7	Not Parallel	45
4.8	Bead	46

LIST OF APPENDICES

APPENDIX	TITLE
A	Detail Drawing
B	Completed Product
C	Machining Tool

CHAPTER 1

INTRODUCTION

1.1 PROJECT SYNOPSIS

Many trees with good grade fruits are hard to get because trees with this portions are high and rarely be able to climb, unless if you're willing to hurt yourself by falling from a tree branch. The purpose of the project is to design and fabricate mechanical part of fruit picker to get a grade A fruit and for general purpose to fulfill the requirement for home and market. This fruit picker would be different from another fruit picker that have in market. In this study, the new concept of fruit picker will be designed and fabricate and ensure these fruit picker comply with customer needs. As the Diploma final year project allocates the duration of 1 semester, this project is need skills to handle several machines such as EDM wire cut machine, bending machine, MIG, SMAW, drilling, grinder and others.

Title of this project is "Development of a mechanical Fruit Picker". This project involves the fabrication of fruit picker with a specification regarding strength, material and cost. With the newly designed and fabricated this fruit picker, tests are required to be conducted and to verify the design. Overall, this project will acquire the skill of design and fabrication.

1.2 PROBLEM STATEMENT

- 1.2.1** Difficult to pick fruit at the limited area
- 1.2.2** The fruit picker in market just have capability to pick certain fruits.
- 1.2.3** Cannot maintain the quality of the fruits.

1.3 PROJECT OBJECTIVES

The main objective of this project is to design the new mechanical fruit picker and fabricate the new mechanical fruit picker based on mechanical design method. Another objective is to develop a fruit picker able to achieve the product on customer need.

1.4 PROJECT SCOPES

Scopes of this project are:

- 1.4.1** To development of concept selection.
- 1.4.2** To determine about product specification.
- 1.4.3** To design using CAD software.
- 1.4.4** To produce a prototype home base method.
- 1.4.5** To produce or develop using process such as grinding, milling, lathe, bending and welding.

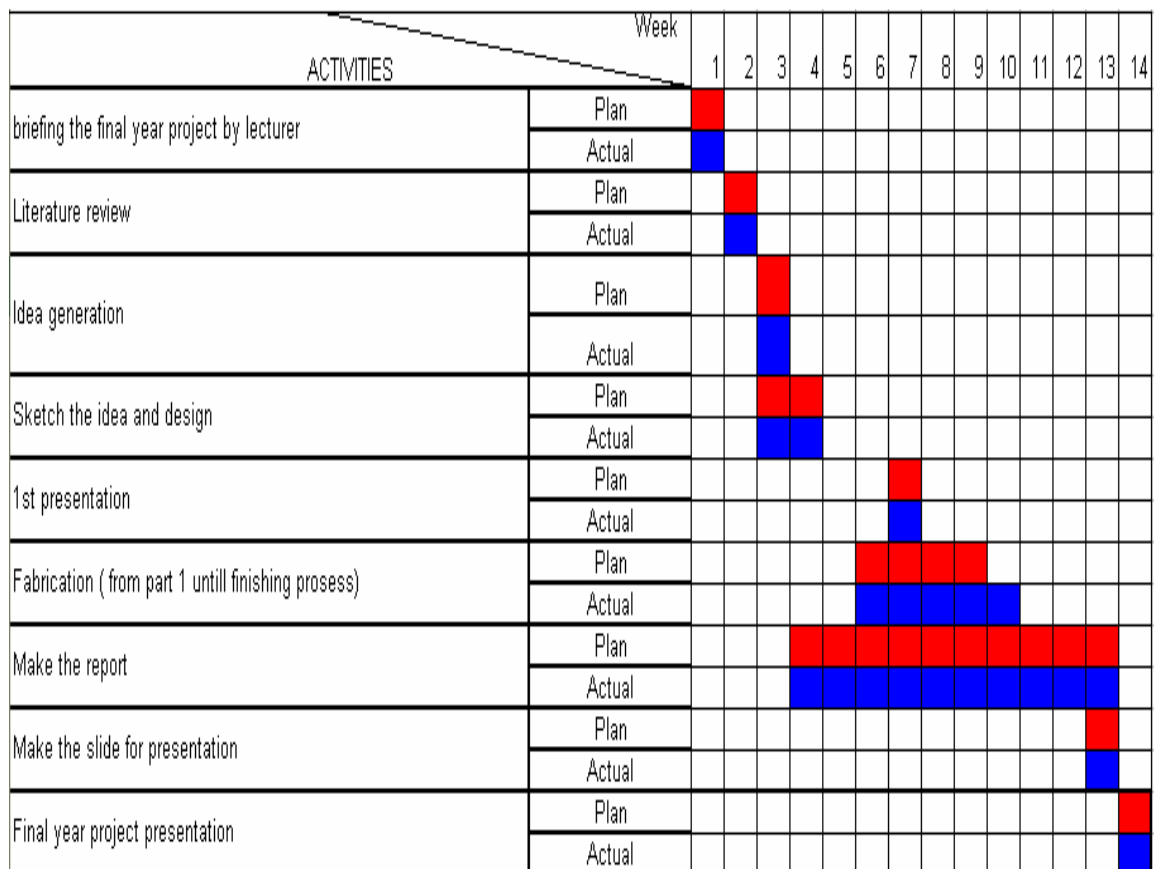


Figure 1.1: GANTT CHART

1.5 PLANNING PROJECT

According to the Gantt chart, project started by briefing by lecturer about final year project and include chooses the title of the project. After got the title, project briefing started followed by collecting literature review. These include gathering raw data via internet, book and other source. The literature review process taken 2 weeks.

After that, this project was continued with idea generation on week 3 then sketch and design process on week 3 and 4. This is started with sketching four types of fruit picker and all design identify the strength and weakness. The best concept that was be chosen and re-draw again using solidwork software with actual dimension.

After identifies finalized concept, finding a raw material to fabricate was started. Materials to be used must be suitable and easy to get. The criteria when selected the material is includes strength, durability and other. This is important for fabrication process. To easy in selecting raw material I use “Bill of material” concept, where we identify every part with raw material.

The fabrication was started after finish finding a raw material and cutting the material. According the Gantt chart, the fabrication process is from week 6 until week 12. After finish the fabrication, we get the result and also do the discussion or conclusion.

Next task is the final presentation preparation and report writing. The report writing occurs during the finalized concept and fabrication. (from week 5 until week 13). Then, for week 14 I must present my project and submit report writing.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter is present about literature review of fabrication process such as punching, bending, welding, drilling and other else. Before fabrication process, the material selection is crucial. The selection of joining process is also important to get a product with better strength and durability. Literature review about machine is also important. It is include guide to setup the machine, type of machine suitable for fabrication process and advantages using this machine.

2.2 COMPARISSON OF CURRENT PRODUCT

In this project, 3 current design of cabinet from market are selected to make the comparison.

2.2.1 Twister fruit picker



Figure 2.1: twister fruit picker

The Twister is small, smooth and light. It slips through your fruit tree like a bird. You open the fruit holders when it gets to the fruit. When you let the fruit holders close on the fruit, your two hands are free for a quick twist. No more struggling through the limbs and twigs as you do with a basket or a bag. The Twister is fast. You or Grandma can pick with the Twister, on average, more beautiful, undamaged fruit in five minutes than you can with a large clumsy bag or basket. And, most importantly, instead of frustration, you will be smiling. The Twister is made of aluminum and plastic in my hobby shop. I guarantee it to please you. The Twister comes complete with picker, rope, and bungee cord. The pole is not included because of shipping costs. If your tree is not over 12 feet tall, a 48 in. broom stick with threads on one end and a hole in the other, will work fine.

2.2.2 Pole Fruit Picker



Figure 2.2: pole fruit picker

This handy tool will allow you to pick those juicy peaches off your tree without climbing a ladder! Fruit picker has a metal basket with "fingers" which allow you to pick the fruit off its branch. The fruit then rolls into the bottom of the basket where a cushion breaks its fall. Comes with a 4' additional section of handle which easily attaches to the bottom of the upper 4' handle.

2.2.3 WOLF GARTEN Fruit Picker



Figure 2.3: wolf garten fruit picker

This handy tool will allow you to pick those juicy fruit off your tree without climbing a tree. Grabs the fruit stems without harming fruit. The fruit then rolls into the bottom of the basket where a cushion breaks its fall. It also comes with 180 degree adjustable head and replaceable knife blade cuts even the stubborn stem.

2.3 FABRICATION PROCESS

2.3.1 Welding

2.3.1.1 Introduction

Welding is a fabrication process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the workpieces and adding a filler material to form a pool of molten material (the weld puddle) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the workpieces to form a bond between them, without melting the workpieces

Many different energy sources can be used for welding, including a gas flame, an electric arc, a laser, an electron beam, friction, and ultrasound. While often an industrial process, welding can be done in many different environments, including open air, underwater and in outer space. Regardless of location, however, welding remains dangerous, and precautions must be taken to avoid burns, electric shock, eye damage, poisonous fumes, and overexposure to ultraviolet light.

2.3.1.2 Arc welding



Figure 2.4

Arc welding uses a welding power supply to can use either direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes. The welding region is sometimes protected by some type of inert or semi-inert gas, known as a shielding gas, and/or an evaporating filler material. The process of arc welding is widely used because of its low capital and running costs. create an electric arc between an electrode and the base material to melt the metals at the welding point.

2.3.1.3 Metal Inert Gas

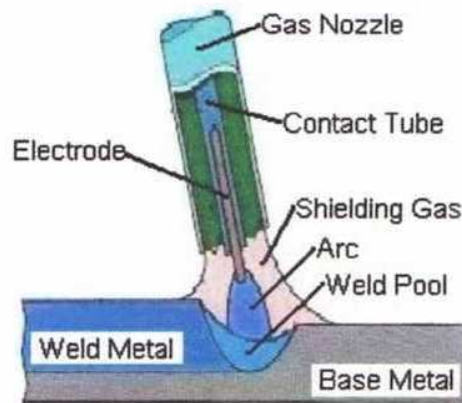


Figure 2.5

Gas metal arc welding (GMAW), sometimes referred to by its subtypes metal inert gas (MIG) welding or metal active gas (MAG) welding, is a semi-automatic or automatic arc welding process in which a continuous and consumable wire electrode and a shielding gas are fed through a welding gun. A constant voltage, direct current power source is most commonly used with GMAW, but constant current systems, as well as alternating current, can be used. There are four primary methods of metal transfer in GMAW, called globular, short-circuiting, spray, and pulsed-spray, each of which has distinct properties and corresponding advantages and limitations. The cost of inert gas limited its use in steels until several years later, when the use of semi-inert gases such as carbon dioxide became common. The automobile industry in particular uses GMAW welding almost exclusively. Unlike welding processes that do not employ a shielding gas, such as shielded metal arc welding, it is rarely used outdoors or in other areas of air volatility. A related process, flux cored arc welding, often does not utilize a shielding gas, instead employing a hollow electrode wire that is filled with flux on the inside.

2.3.2 Drilling

2.3.2.1 Introduction

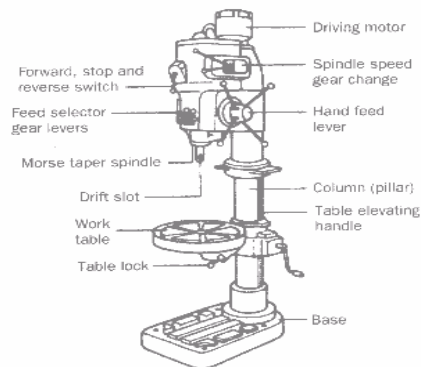


Figure 2.6

A drill press (also known as pedestal drill, pillar drill, or bench drill) is a fixed style of drill that may be mounted on a stand or bolted to the floor or workbench. A drill press consists of a base, column (or pillar), table, spindle (or quill), and drill head, usually driven by an induction motor. The head has a set of handles (usually 3) radiating from a central hub that, when turned, move the spindle and chuck vertically, parallel to the axis of the column. The table can be adjusted vertically and is generally moved by a rack and pinion; however, some older models rely on the operator to lift and re clamp the table in position. The table may also be offset from the spindle's axis and in some cases rotated to a position perpendicular to the column. The size of a drill press is typically measured in terms of *swing*. Swing is defined as twice the *throat distance*, which is the distance from the center of the spindle to the closest edge of the pillar. For example, a 16-inch drill press will have an 8-inch throat distance. Speed change is achieved by manually moving a belt across a stepped pulley arrangement. Some drill presses add a third stepped pulley to increase the speed range.

2.3.3 Angle grinders

2.3.3.1 Introduction



Figure 2.7

Angle grinders may be used both for removing excess material off a piece or simply cutting into a piece. There are myriad different kinds of discs that are used for various materials and tasks, such as cut-off discs (diamond blade), abrasive grinding discs, sanding discs, wire brush wheels and polishing pads. The angle grinder has large bearings to counter side forces generated during cutting, unlike a power drill, where the force is axial.

Angle grinders are widely used in metalworking and construction, as well as in emergency rescues. They are commonly found in workshops, service garages and auto body repair shops. There is a large variety of angle grinders to choose from when trying to find the right one for the job. The most important factors in choosing the right grinder are the disc size and how powerful the motor is. Other factors include power source (pneumatic or electric), rpm's, and arbor size. Generally disc size and power increase together. Disc size is usually measured in inches. Common disc sizes for angle grinders include 4, 4.5, 5, 6, and 7 inches. Discs for pneumatic grinders also come much smaller.

2.3.4 EDM wire cut

2.3.4.1 Introduction

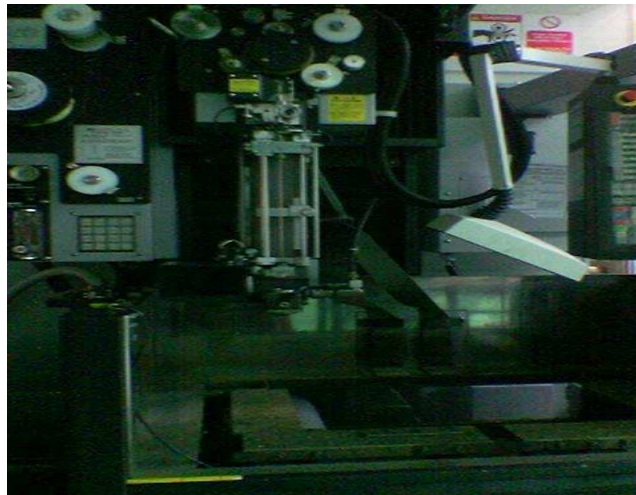


Figure 2.8

A variation of EDM is wire EDM or electrical-discharge wire cutting. In this process, which is similar to contour cutting with a bend saw, a slowly moving wire travels along a prescribed path, cutting the work piece. This process is used to cut plate as thick as 300mm and to make punches, tools, and dies from hard metals. It also can cut intricate components for the electronics industry. The wire usually is made of brass, copper, tungsten, or molybdenum; zinc- or brass-coated wires also are used. The wire diameter is typically about 0.30mm for roughing cut and 0.20mm for finishing cut. The wire should have high electrical conductivity and tensile strength.

2.3.5 Rivet

2.3.5.1 Introduction



Figure 2.9

A rivet is a mechanical fastener. Before it is installed it consists of a smooth cylindrical shaft with a head on one end. The end opposite the head is called the buck-tail. On installation the rivet is placed in a pre-drilled hole. Then the tail is "upset" (i.e. deformed) so that it expands to about 1.5 times the original shaft diameter and holds the rivet in place. To distinguish between the two ends of the rivet, the original head is called the factory head and the deformed end is called the shop head or buck-tail.

Because there is effectively a head on each end of an installed rivet it can support tension loads (loads parallel to the axis of the shaft); however, it is much more capable of supporting shear loads (loads perpendicular to the axis of the shaft). Bolts and screws are better suited for tension applications.

Fastenings used in traditional wooden boat building like copper nails and clinch bolts work on the principle of the rivet but they were in use long before the term rivet was invented. So, where they are remembered, they are usually classified among the nails and bolts respectively.

CHAPTER 3

3.1 INTRODUCTION

In this chapter will discuss about steps that we need to follow in completing final year project. .Beside that, this chapter also represent about methods and machining process that will be used to make the cabinet.

3.2 Project flow diagram

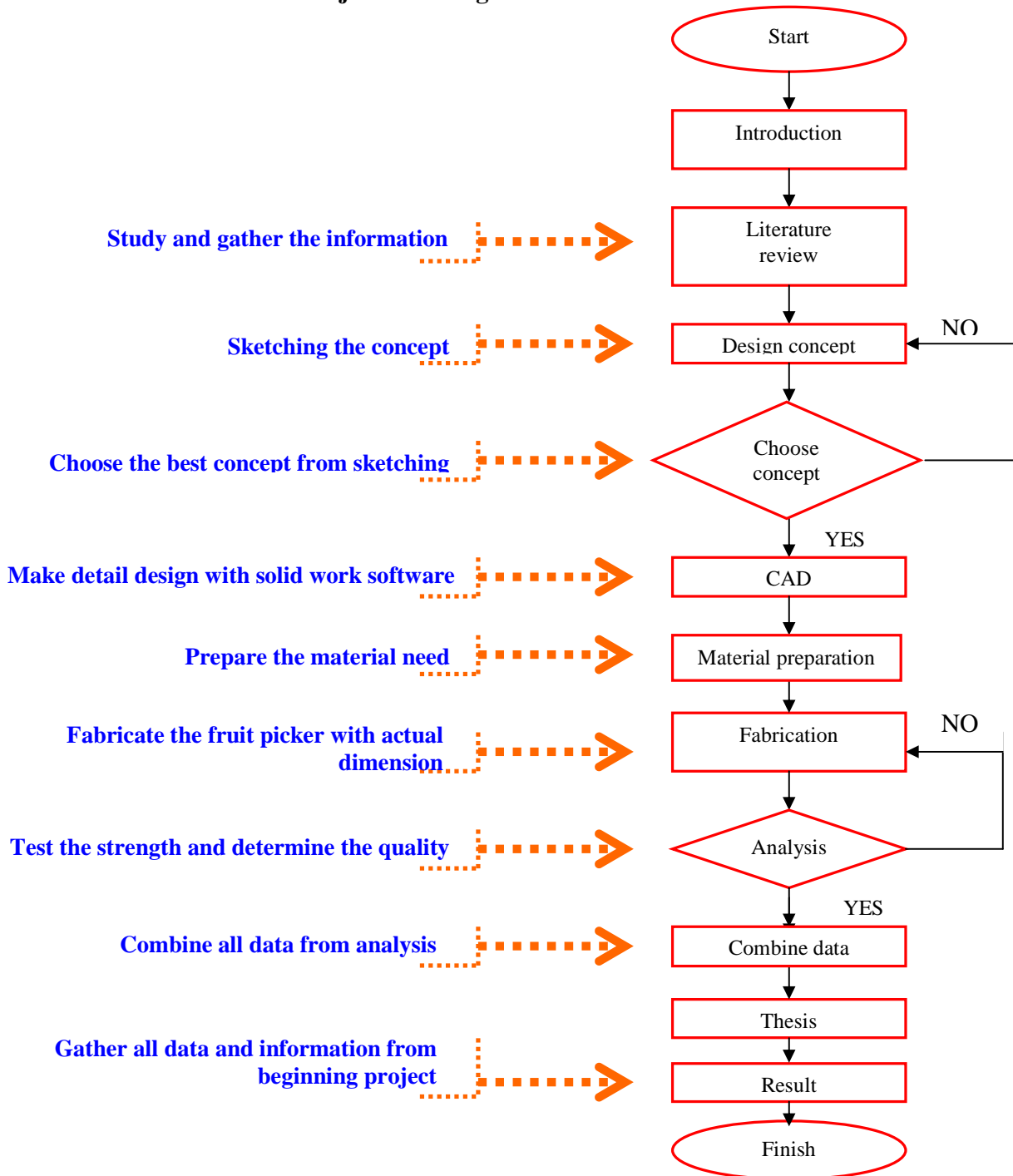


Figure 3.1:Flow Chart

From the flow chart above, this project was start with define the product title that the product is mechanical fruit picker. Then, collect the raw data from via internet, book and other source. After get the data, make a study and make a lot of research about fruit picker. This includes a study about concept to pick the fruit, process to fabricate, and material to use

Then the information gathered and the project is continued with the design process. It is important to make a best design for the project. After several design sketched, the best concept have been chosen for finalized concept design. The selected design is then transferred to detail drawing using Solid work software.

After all the part drawing finished, prepare the material need for the fabrication. Then, the fabrication process will start with actual dimension. The manufacturing processes include in this process are welding, cutting, drilling, bending and others.

Next step is the analysis stage. The evaluation considering the strength, durability, safety, quality and combine all data from the analysis.

Then after all processes that mentioned above done, gather all data and information from beginning project.

3.3 DESIGN

3.3.1 Introduction

The design and fabrication of mechanical fruit picker must be compliance to several aspects. The design consideration must be done carefully in order that design can be fabricated and all parts are functioning. The aspects must be considered in designing the fruit picker such as the bucket strength. The bucket needs to have certain strength to ensure that it can load the fruit. The second thing is material. Usually use the available material is one of aspects that have been considered. The materials used depend on their purpose and their function. Then another factor must be consider is cost. The cost of whole system must be not exceeding from budget and reasonable. It should reduce the cost to the minimum. Besides that the ergonomic factors also need to be considered. The fruit picker must be user friendly and give a pride to people to have it.

3.3.2 Drawing

The drawings are divided into two categories, which are:

- i. Sketching – all the ideas for the recycle bin fabrication are sketched on the paper first to ensure that idea selection can be produce.
- ii. Solid Works software – the selected design or concept sketched is transfer to solid modeling and engineering drawing using Solid Works software.

3.3.3 Sketching drawing selection

From the existing ideas, several sketching had been chosen to be considered to find the best design as the final ideas, which are:

Concept A

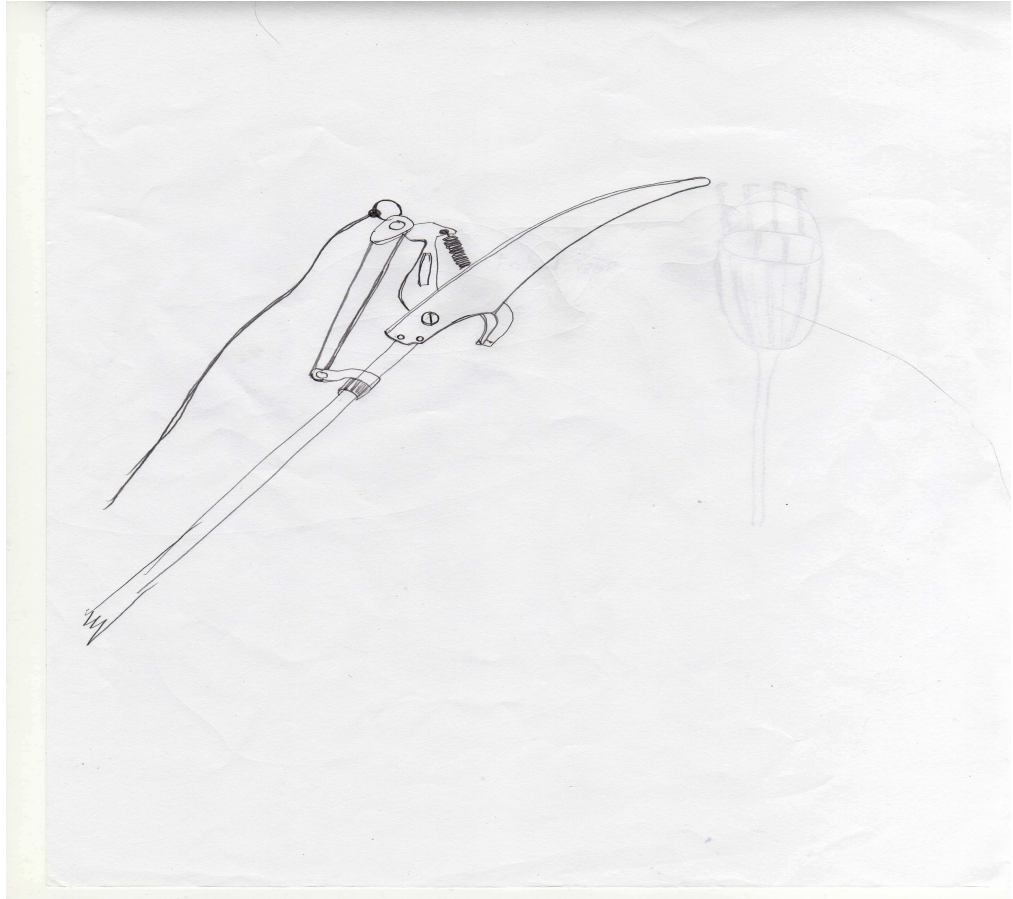


Figure 3.2: concept design A

This is the concept A. It have simple design and easy to pick any kind of fruit. But the problem of this design is it not a portable product. The process that will use is welding, bending, rivet, punching and others.

Concept B

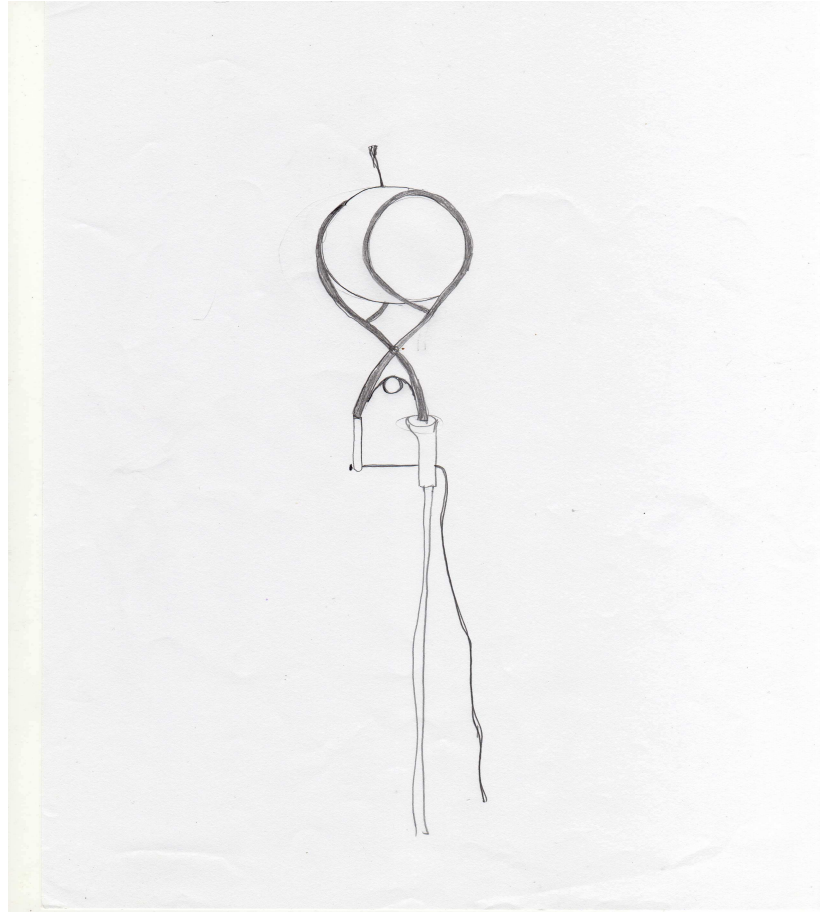


Figure 3.3: concept design B

This is concept B. It also a simple design. Beside that it is a portable product. But the problem of this product is it not really suitable to pick any kind of fruit. It just can pick the fruit such as apple and pear. This fruit picker will use manufacturing a lot of processes such as bending, punching, welding, rivet and others.

Concept C

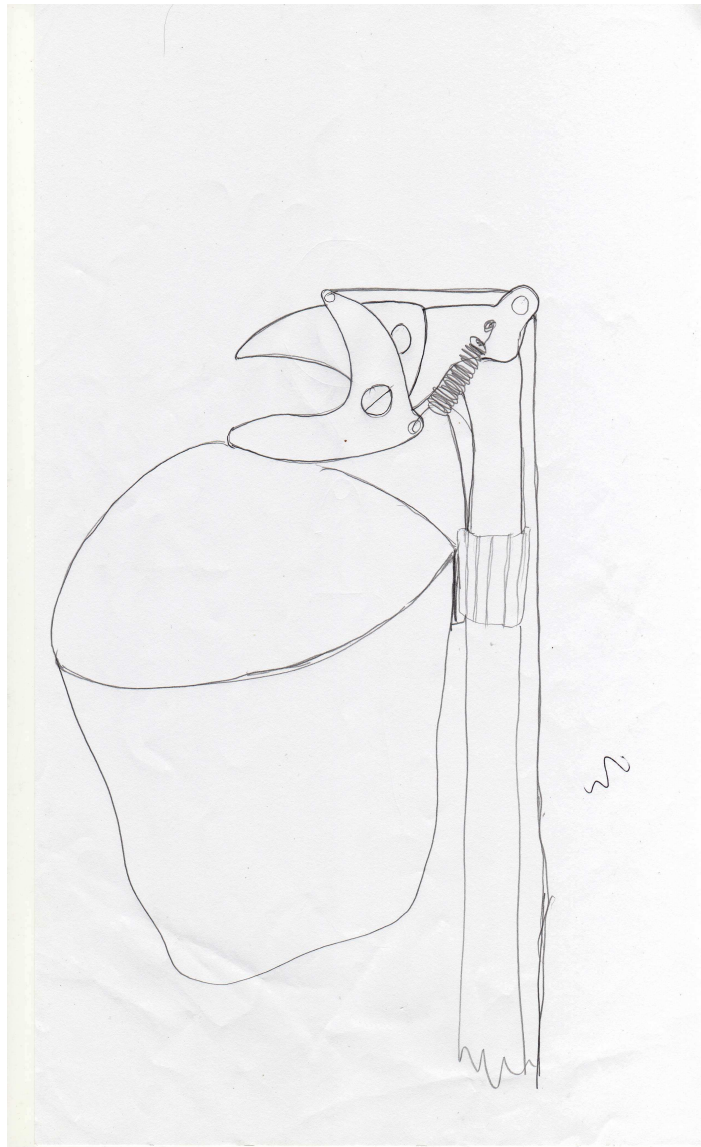


Figure 3.4: concept design C

This is design C. The advantages of this product are it a portable design. This design also have the bucket to make sure the fruit not damage when picked. But the disadvantage of this design is it difficult to cut the big fruit stem because it blade not to sharp. This design will use some processes like bending, punching, welding, drilling and other

Concept D



Figure 3.5: concept design D

This is design D. This design is modification of design C. These designs have more advantages compared to the design before. This is a portable design and easy to cut off the fruit stem. Beside that, it also has a portable holder and bucket. To fabricate this design it will be use a lot of manufacturing processes such as welding, bending, punching, sheering and others.

3.3.4 Result

From the design sketch, one of the best designs will be selected. It can be evaluated through several section criteria for its function.

The first criteria are customer needs. It is important to know what customers want about this product. It is easier when a product enters the market. Next criteria is easy to use.

Beside that, easy to manufacture also be an important criteria to select the design. It includes the process to fabricate the concept, the material that will use, the capability of the machine at FKM lab to fabricate the design and others

After that, cost of manufacture also has been considered as selection material. When the concept enters a market, cost is very important to attract customer to buy it. Lastly the selection criteria the strength of the product. The strength of the product can be known through the analysis.

According to the criteria above, the concept D has been selected as the best design. It is because the concept D can fulfill the criteria and have some advantages compared to design A, design B, and design C.

3.3.5 Concept Generation and Evaluation

Table 3.6: Pugh concept

Selection Criteria	Concept A	Concept B	Concept C	Concept D	Datum
Easy to handling	(-)	(-)	(+)	(+)	0
Capability	(+)	(+)	(+)	(+)	0
Strength	(-)	(+)	(+)	(+)	0
Have bucket	(-)	(-)	(0)	(0)	0
Weight	(+)	(+)	(-)	(-)	0
Function	0	0	(0)	(+)	0
Σ^+	2	3	3	4	0
Σ^0	1	1	2	1	6
Σ^-	3	2	1	1	0
Net score	-1	1	2	3	0
Rank	5	4	3	1	2

Notes :

+ = Better than

- = Worse than

0 = Same as

Study the concept selection table shows that concept D score the highest positive signs.

There is one negative sign in concept D. Therefore, concept D is the best concept to be produce. The selection concept, it shows that concept D is the best concept and must be fabricated. The product design specification is like below:

3.3.6 Product Design Specification

1 Main Blade

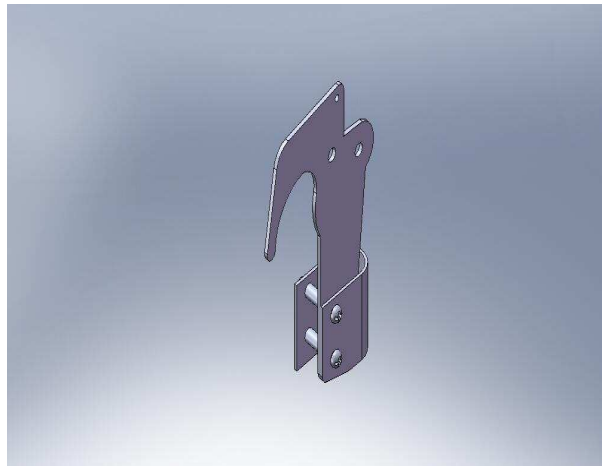


Figure 3.7: main blade

The material use is stainless steel 3mm. Using EDM wire cut and milling fabricate this part

2 Blade handle

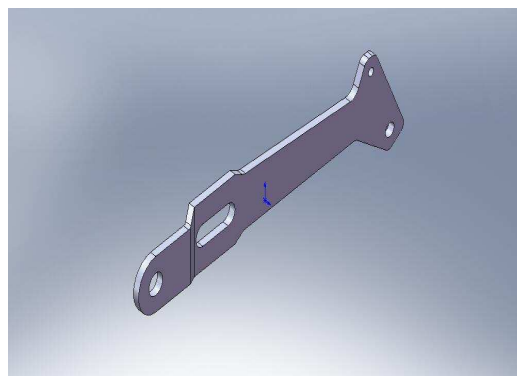


Figure 3.8: blade handle

The material for this part is stainless steel metal 3mm. Using bending machine, wire cut and milling to fabricate this part.

3 cutter

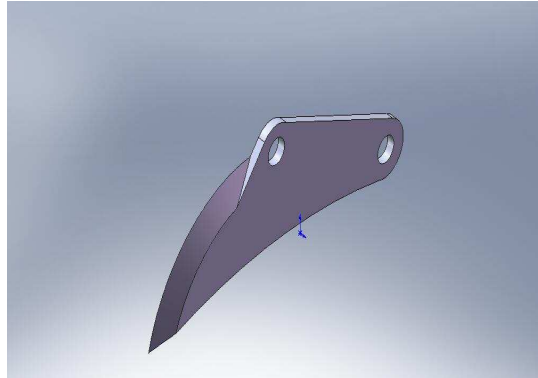


Figure 3.9: cutter

The material use is stainless steel 3mm. Using EDM wire cut and milling to fabricate this part

4 Pulley

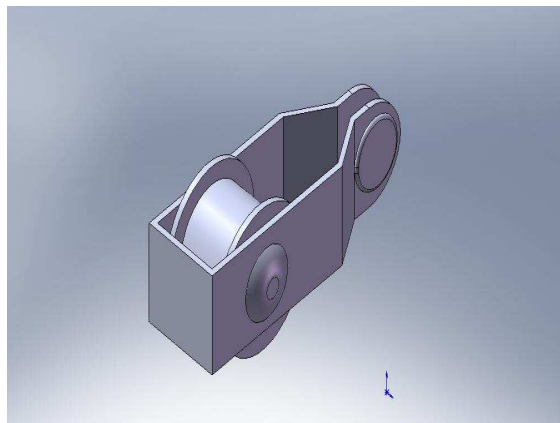


Figure 3.10: pulley

The material use is stainless steel 1mm. Using rivet and bending machine to fabricate this part

5 Bucket

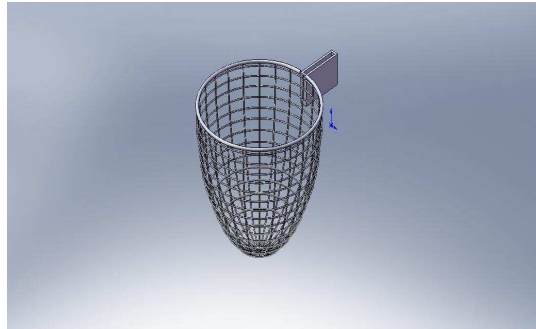


Figure 3.11: bucket

Material use is carbon steel and nylon net

6 Handle

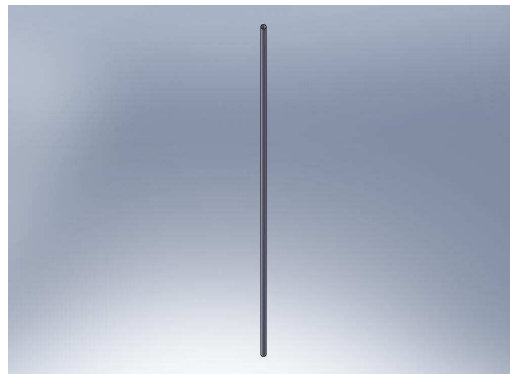


Figure 3.12: handle

The material use for this part are 40mm and 42mm hollow circular nickel.

7. Puller



Figure 3.13: puller

Material use to produce this part is stainless steel

3.3.7 Engineering Drawing of the Fruit Picker

After a design has been selected, the next step in the designing the process is dimensioning. The design is separated into part by part and the dimensioning process is firstly sketched on paper.

After dimensioning, the engineering drawing of the design is drawn using Solidwork software. At this stage solid modeling method is used. Part by part solid modeling created according to the dimension done before after all part created, the 3D model is assembled with each other based on design. All part is converted to orthographic view to get its engineering drawing detail after assembly process is done.

i. Main blade

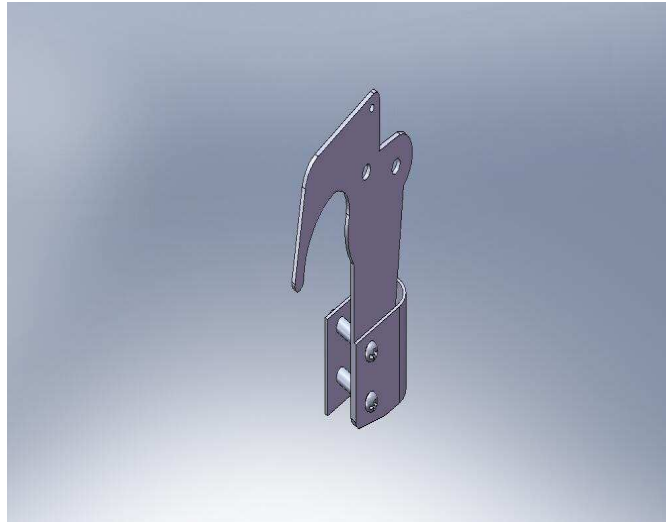


Figure 3.14: main blade

ii. Cutter

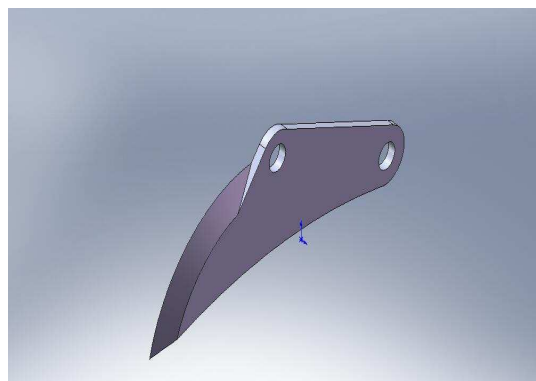


Figure 3.15: cutter

iii. Blade handle

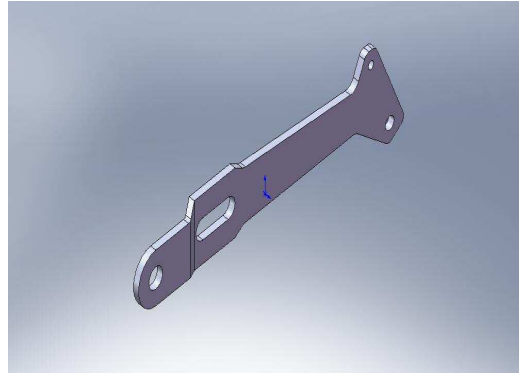


Figure 3.16: blade handle

iv. Pulley

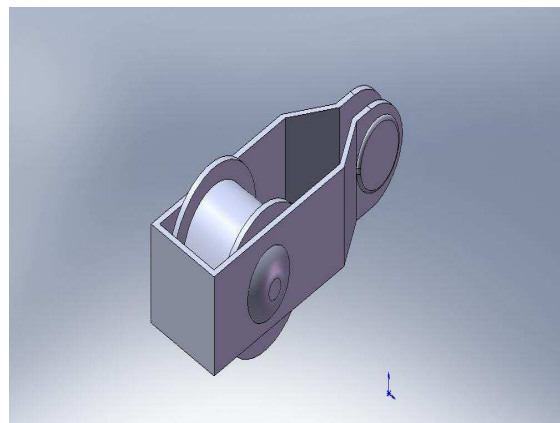


Figure 3.17: pulley

v. Bucket

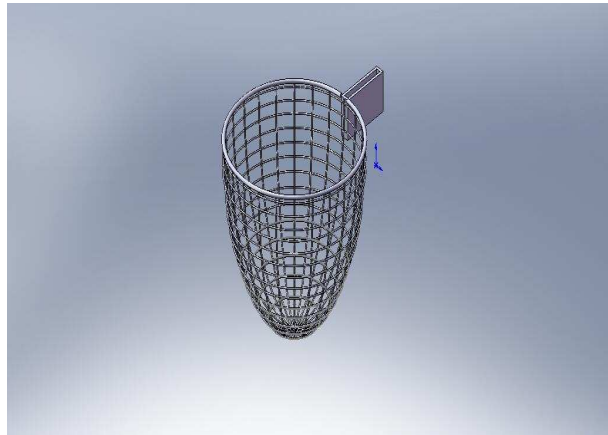


Figure 3.18: bucket

vi. Handle



Figure 3.19: handle

vii. Puller



Figure 3.20: puller

viii. Full assembly



Figure 3.21: full assembly

3.3.8 Processes Involves

In order to make the design come reality, fabrication process needs to be done first .The fabrication process start from dimensioning the raw material until it is finish as a desire product .The processes that involve are:

i) Getting material

Figure 3.22 introduces the material have in UMP mechanical laboratory .This rack have more type of steel like rectangular hollow, hollow cylinder and etc.



Figure 3.22: Raw material

ii. Measuring and Marking

After get the material, next step is measuring and making material like Figure 3.23. The equipment used in this process is measuring tape and marker pen. The scale is from solid works software and this scale is the true.



Figure 3.23: Marking and measuring process

iii. Cutting process

Figure 3.24 introduce the process cutting the material using floor cutter disc after measurement and making process.

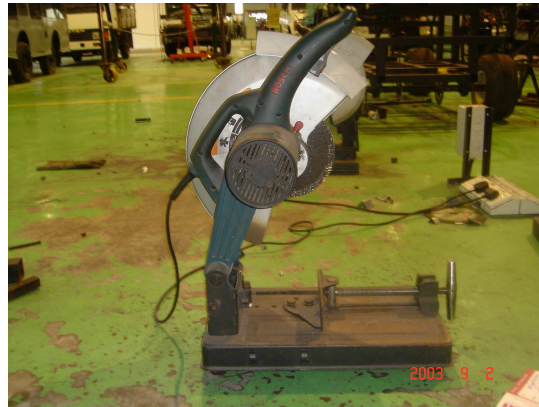


Figure 3.24: Cutting process

IV. Joining Process

Figure 3.25 introduce about joining method using MIG welding .This process is used to joining the main blade and blade holder part.



Figure 3.25: Joining process by using MIG weld

3.3.9 Summary

This chapter has been discussed generally about project methodology, how to manage flow work and process involve. Throughout this project have learned how to design start with sketching, design concept , concept selection and drawing until fabricate and assemble structure with step by step .This project can be developed the skill to manage the machine such as shear machine ,drill, hand grinding and welding

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

This chapter will discuss about the completed fabrication, types of defects, product specification and cause of problem in this project. The analysis also was helped to give improvement of the fruit picker

4.2 RESULT

4.2.1 Introduction

After finish fabrication process, the product has been analyzed. At this stage, all information about this product is collected and gathered. It is important to classify the product before it can use. The complete fabrication of the product is like below.

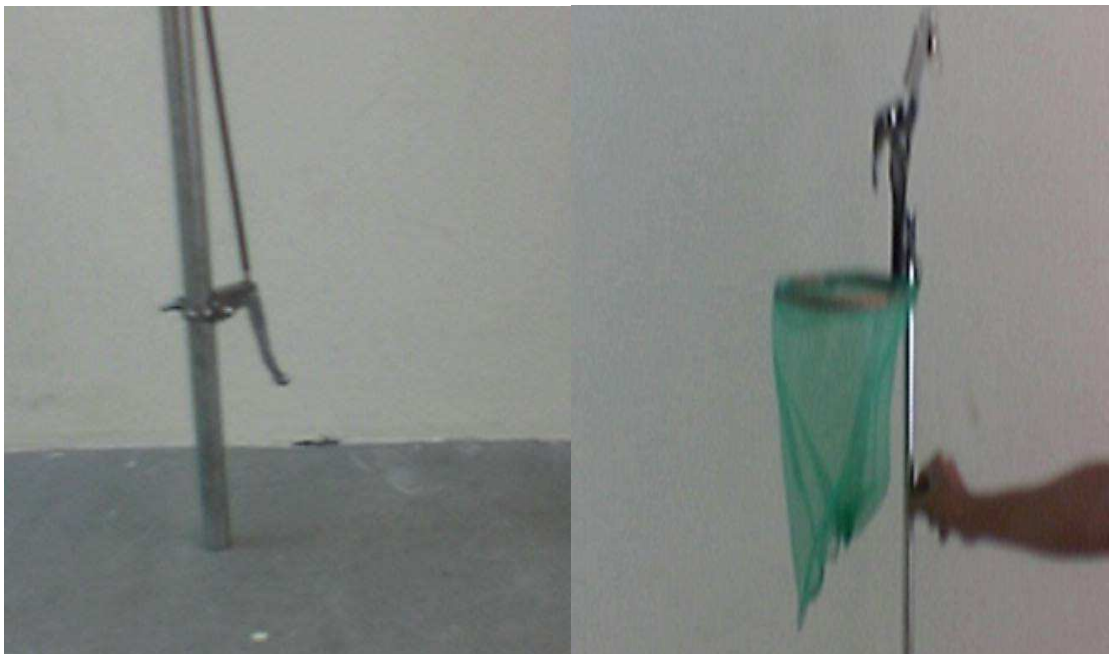


Figure 4.1: Isometric view



Figure 4.2: Front view



Figure 4.3: Right view



Figure 4.4: Left view

4.2.2 Analysis

COSMOS is one of example for analysis process. The analysis is like below.

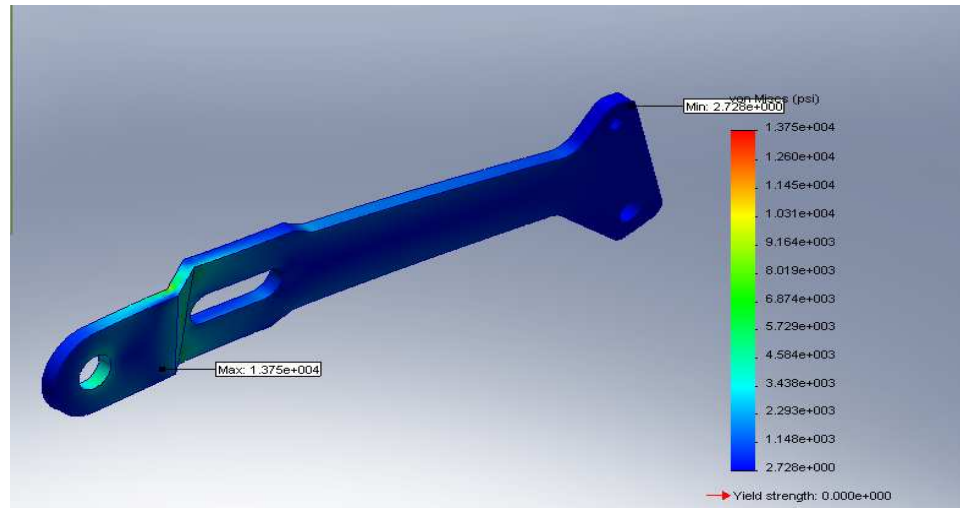


Figure 4.5

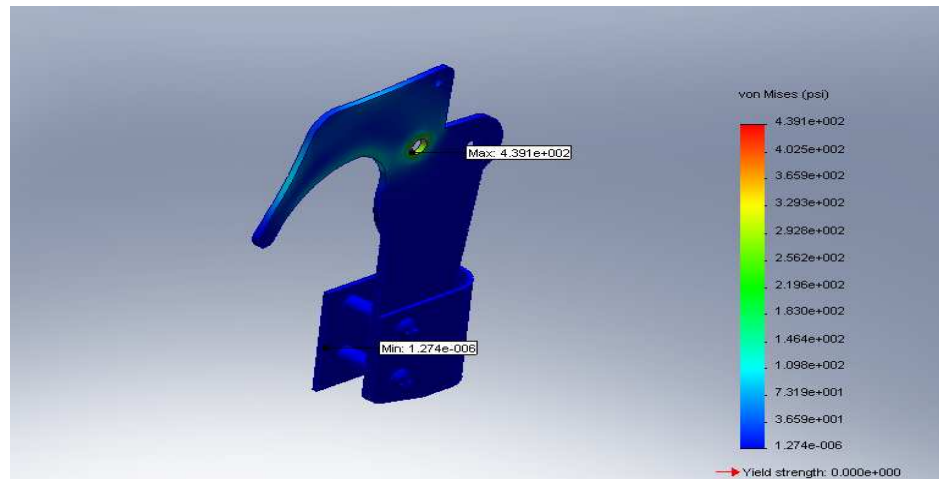


Figure 4.6

4.3 Discussion

Discussion is diving by two parts. Firstly is discussion about type of defect on the final product .Second, is about the problem in progress start with literature review until fabricate and finish this product.

4.3.1 Type of Defect

After finish fabrication process, many type of defect was existed. It happened from fabrication process and weakness during using several machine and tools. Type of defects is like below.

i. Not parallel

This defect happen cause by less skill when using bending process and during assemble the pulley. When the calculation and the marking wrong, the pulley will not parallel upper and lower.

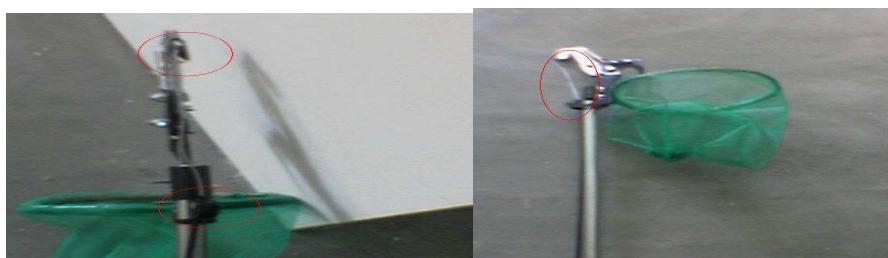


Figure 4.7: Pulley not parallel

ii. Bead

Figure 4.8 is example a defect on holder of the picker .The bead is not trim from welding process. The voltage when welding process is not suitable for this material. Insufficient experience to handle also caused of the defected.



Figure 4.8: Bead on the holder

4.3.2 Problem in progress

Many problems occur in progress to design and fabrication of this table such as gather raw data, design and fabrication. The problem in progress just like below.

i Design Problem

The problem also occurs at this step. The problem came during decision making to design that suitable with available machine in UMP mechanical lab .During this period many concept design have been find out when to choose one design that have all criteria needed by specification is can proceed and running machine such as EDM wire-cut machine .After a design is selected , another problem encountered is detail dimensioning ,the dimension should suitable with scope of the project and after consider all part and material use the dimensional was suitable with project scope.

ii Fabrication Problem

Problem during this stage is very critical that make the actual progress not follow project planning schedule. First , the problem is to find material that suitable for the title of the project .The suggestion material to produce mechanical fruit picker is not available such as mild steel sheet metal was finish .After consider all problem about material available design for the project was change follow material available .

The problem also come during fabrication process ,mainly is hard to fabricate the material with the design was change in order to be easy in machining process such as about used shearing machine.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

For the final chapter it present about conclusion and recommendation for the project. The important things for this chapter are about the problems encountered during the whole project carried out. The problem are included the process planning that have been done. These project problems also make the student to think more creative to solve the problem. This chapter also discuss about the conclusion of the project that is concluding all the process involved. Beside that, this chapter also contains recommendation about project. This is very important to make some improvement about the project for future work.

5.2 CONCLUSION

As the conclusion, the objective of the project was achieved. The mechanical fruit picker is the best way to pick the high and difficult fruit. This new product also designed with the bucket to make sure fruit not damage when picked. Beside that, it is using mechanical part on the holder. The part like bicycle brake concept, it can make the picker not have to use many strength for pull the string. . This fruit picker also provide better ergonomic factor for the comfortable situation when using it. It also was introduced new concept of the table that suitable with costumer specification.

5.3 Recommendation

After the project finished, several recommendation to improve this product still needed for future final year project. First, the handle for the fruit picker must change to adjustable handle to make it multi function. Beside that, the improvement also can make to the bucket. From net bucket, it can change to the bucket with the cushion. This changed can reduce the harmed of fruit.

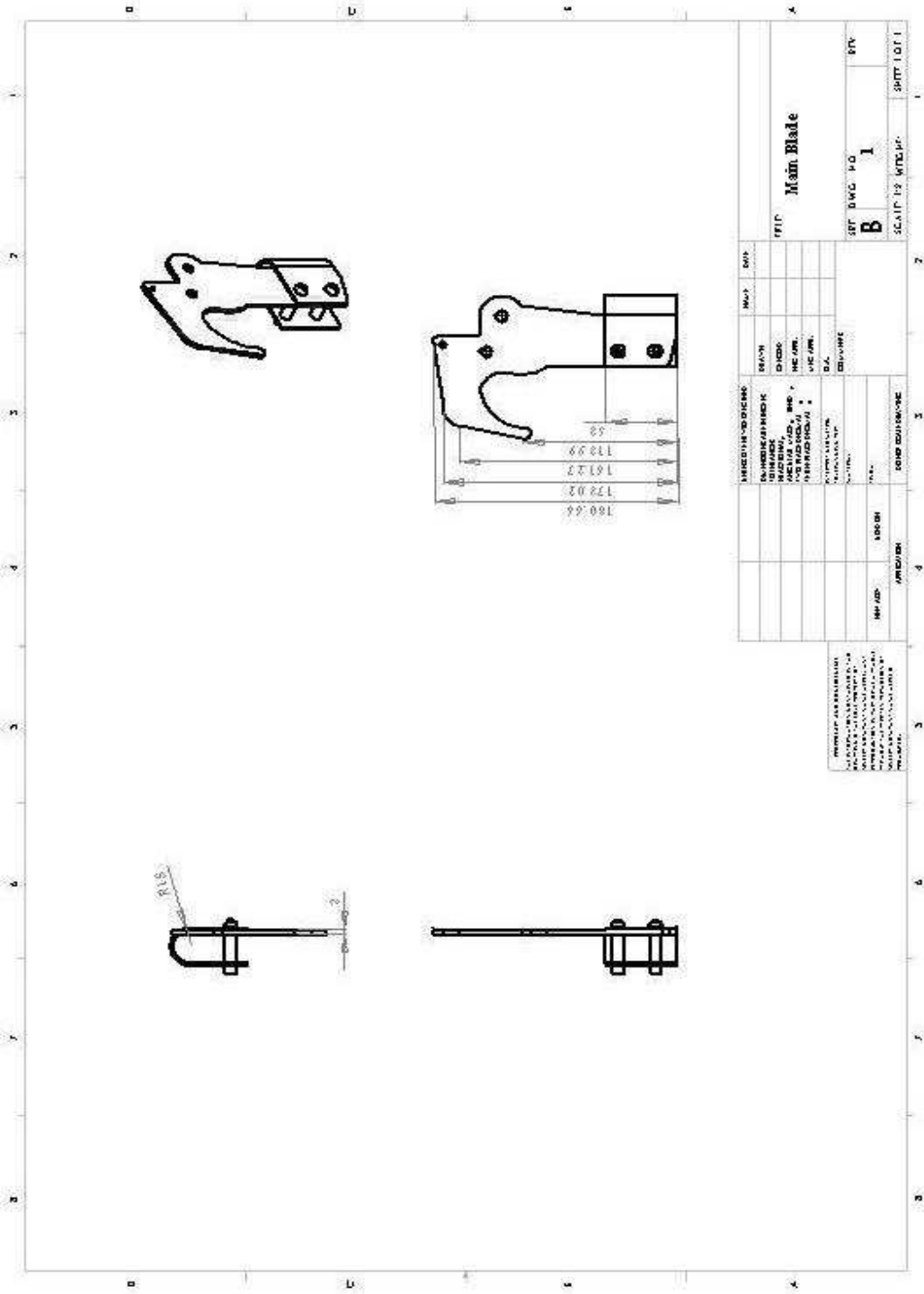
Beside that, more time given to the project, it includes statement the final year student should more focus on final year project. This could make the result of project finish on time and have better result.

At the last all machines and equipments at FKM LAB always should be in good condition. This situation can help student to complete their project on time.

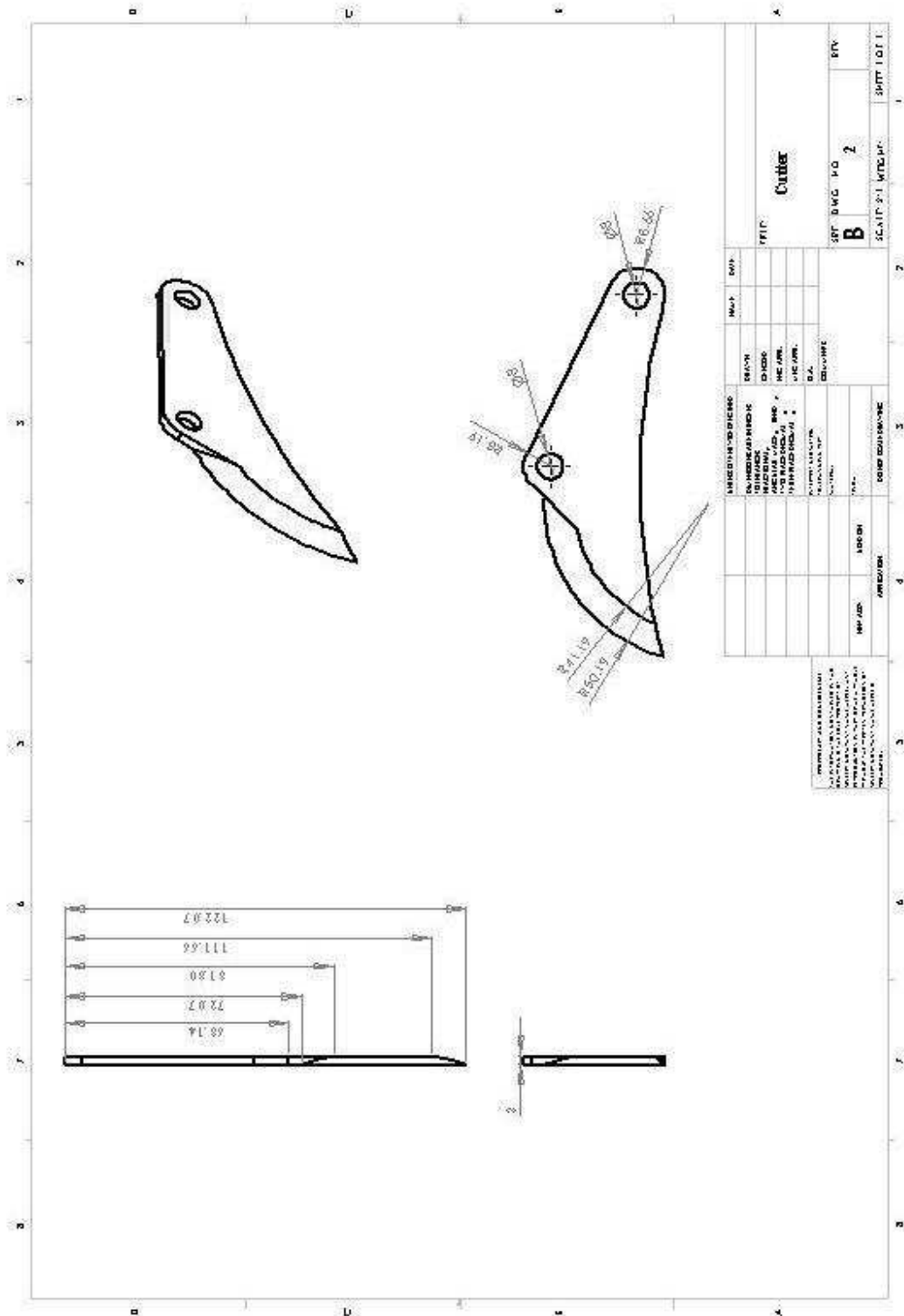
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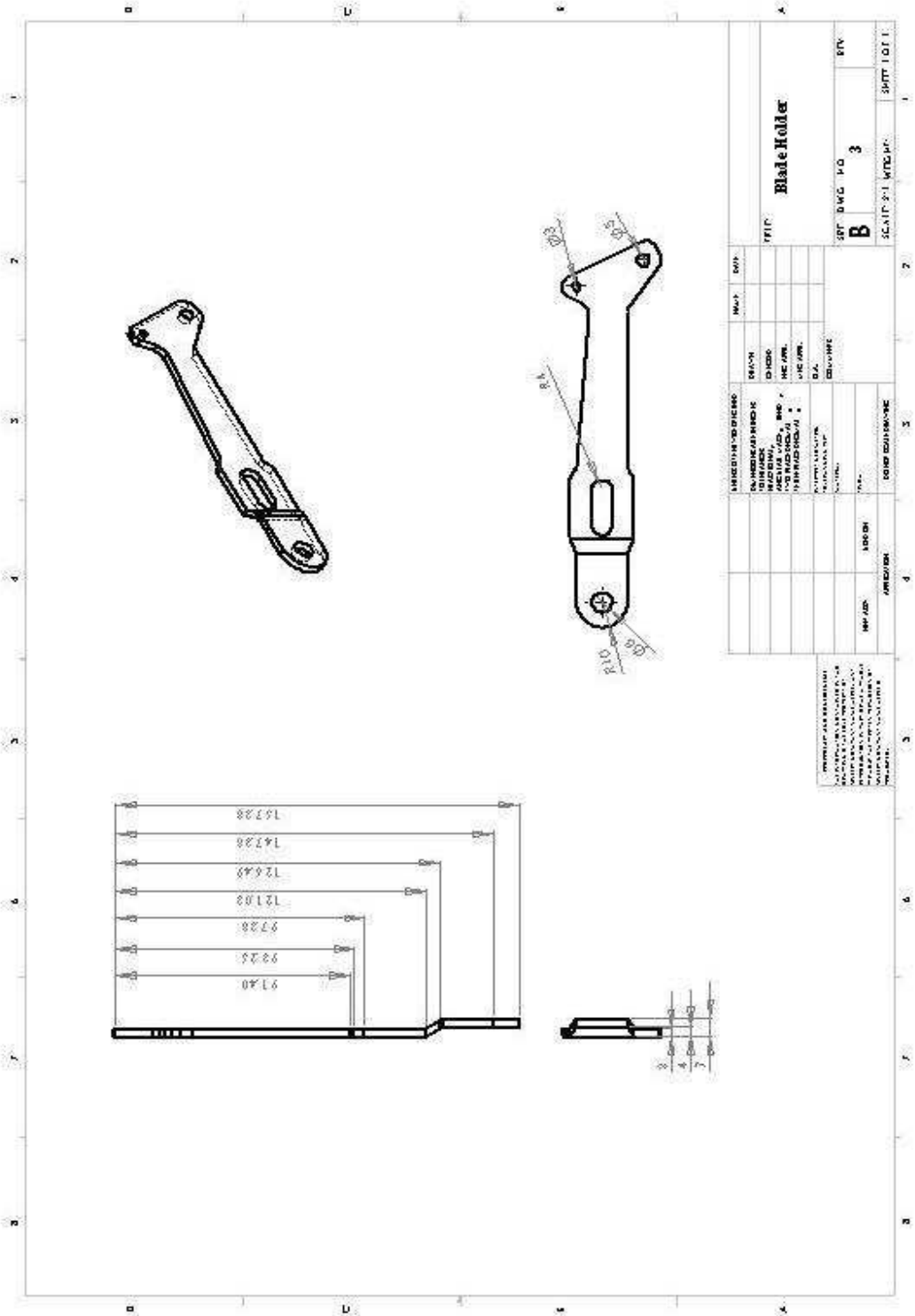
APPENDIX A1



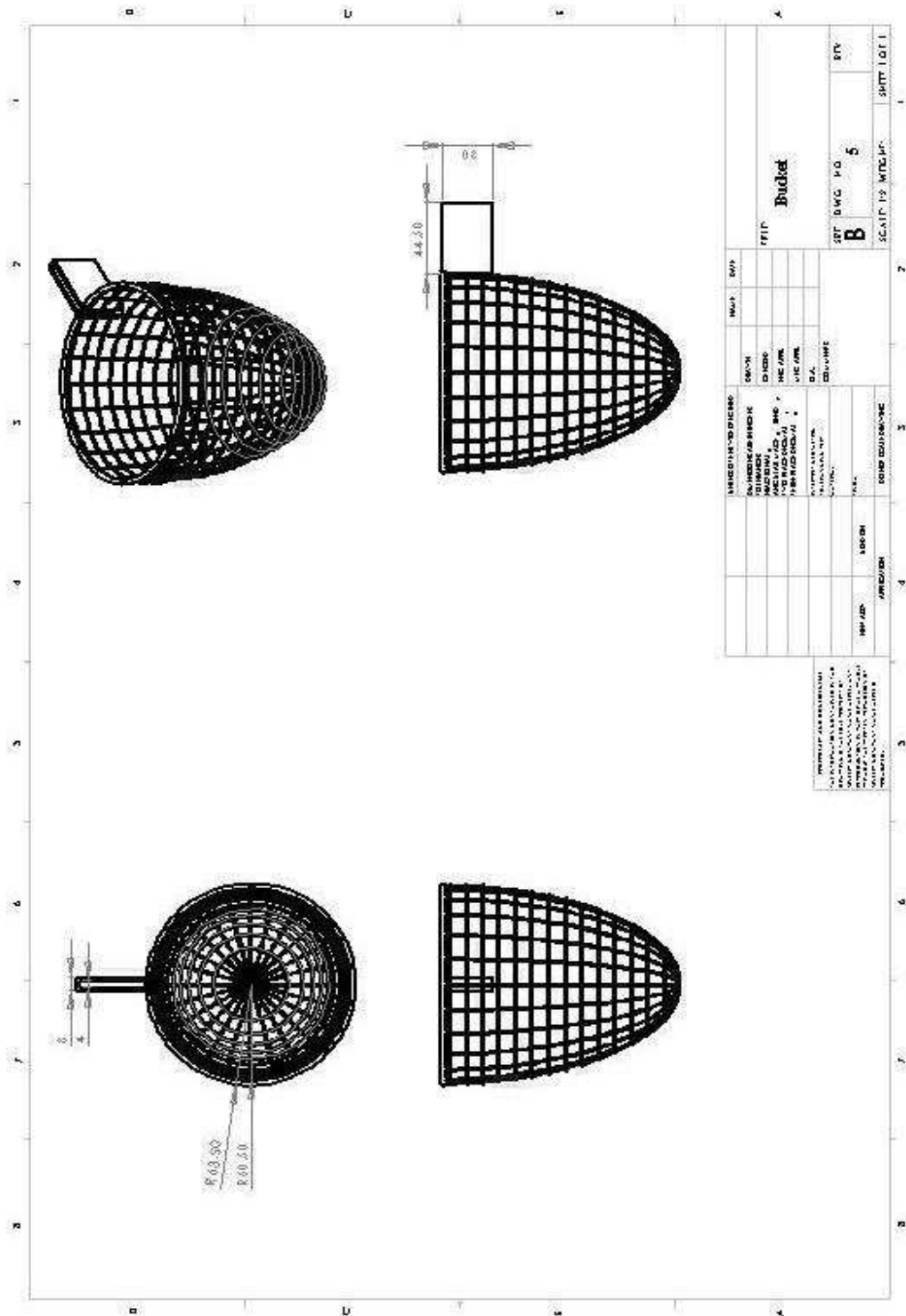
APPENDIX A2



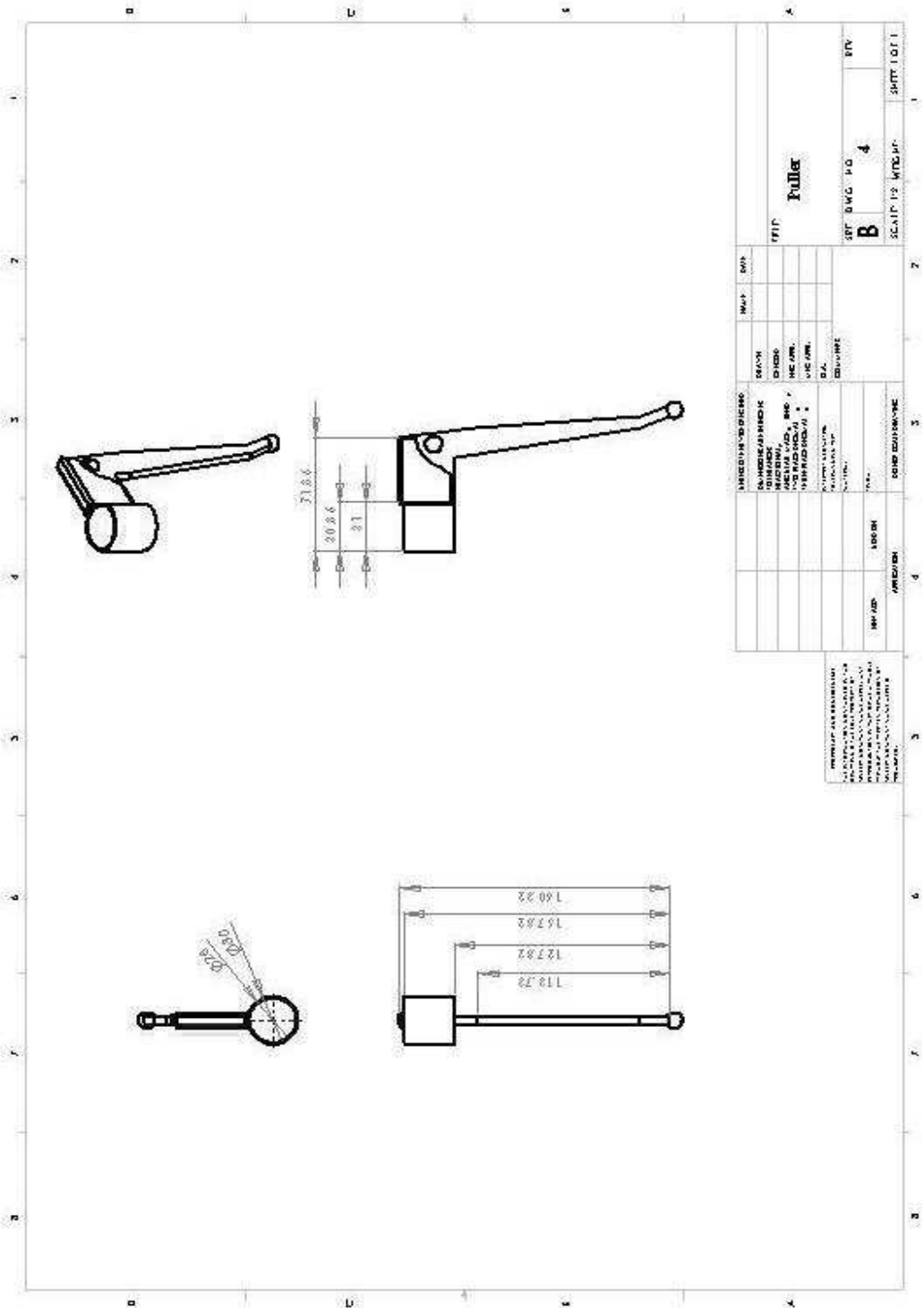
APPENDIX A3



APPENDIX A4

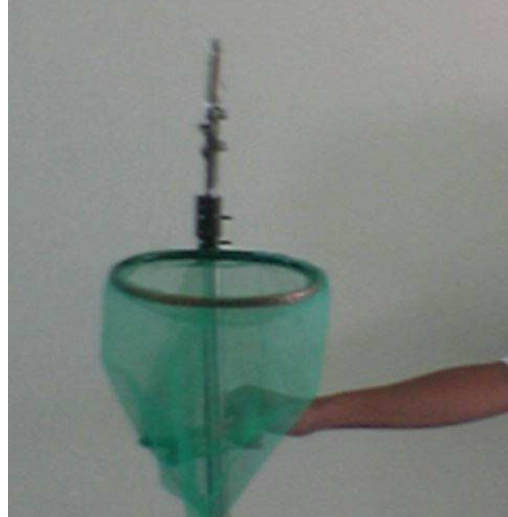


APPENDIX A5



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APPENDIX B



APPENDIX C1

MACHINE TOOL AND EQUIPMENT



MIG Welding Machine



Abrasive Cutter



Measuring Tape



Hand Grinding

APPENDIX C2



Personal Protection Equipment (PPE):
Visor, Goggle, Glove & Apron



Hand Drill



Rivet Pop