DESIGN AND FABRICATION
OF RELIABILITY TEST FIXTURE
FOR SURFACE TREATMENT TEST AND PEEL OFF TEST

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JUDUL **DESIGN AND FABRICATION OF RELIABILITY TEST FIXTURE FOR SURFACE TEATMENT TEST AND PEEL OFF TEST**

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DESIGN AND FABRICATION OF RELIABILITY TEST FIXTURE FOR SURFACE TREATMENT TEST AND PEEL OFF TEST

SAZWAN BIN SAHAR

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

Faculty of Mechanical Engineering
University Malaysia Pahang

NOVEMBER 2009

SUPERVISOR DECLARATION

I hereby declare that I had read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the purpose of the granting of Bachelor of Mechanical Engineering.

Signature : ……

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Date : 1 DECEMBER 2009

AUTHOR DECLARATION

I declare that this thesis entitled "*Design and fabrication of reliability test fixture for surface treatment test and peel off test*" is the result of my own research except as cited in references. The thesis has not been accepted for any diploma and is not concurrently submitted in candidature of any other diploma.

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DEDICATION

To my beloved family and friends

ACKNOWLEDGEMENTS

Firstly, I want to thank Allah, for the blessings that allow me to finish this project and this thesis until the end. I am very grateful for all his help for me to finish this project successfully.

Next, I want to thank all my friends and study mate for the continuous support and knowledge that we shared together. Through the share we have done together, we could together make each of our project perfectly until the end. Also, not forgotten, all the member of faculty of mechanical engineering. From the assistant teaching engineer, teaching engineer, tutors, lecturers and proffessors for all the knowledge and technical support given. Without you, I will not come to this stage.

Last but not least I want to thank all the single person that have been involve in this project eventually or not. A big thanks form me.

ABSTRACT

In industry, the ability of a produced matter to stand for the outside force and other physical factor is the measurement for its quality. The same matter happened to printed labels which is exist on the structure of a product. These labels are exactly tested before the product could reach the market. The tests are, surface treatment test and the peel off tests, which is a sudden force is applied on the printed labels. In the mean time, the tests are tested by bare hands, which is without any help of machine. But, as we all know, tests which are conducted with bare hands, maybe will give effect to the result of the test which, the test have to bow on some disciple. This condition may cause an undesired result of test. So, the fabrication of the device will help the industry to overcome the problem of the limited ability of the human beings which will help in producing a test with good results

ABSTRAK

Di dalam industri, ketahanan sesuatu perkara ke atas daya dan pengaruh fizikal luar yang lain, menjadi ukuran kepada kualiti ketahanan produk tersebut.Hal yang sama berlaku kepada label label bercetak yang kebiasaannya terdapat pada struktur struktur sesuatu produk.kebolehan label label bercetak ini sebenarnya diuji terlebih dahulu sebelum, produk produk yang dibuat dengan ciri ini melengkapi binaannya, dibawa masuk ke pasaran. Ujian ujian tersebut adalah ujian rawatan permukaan (surface teatment test) dan ujian daya tahan bukaan (peel off test) yang mana, daya memgejut dikenakan secara tiba tiba pada label berkenaan. Untuk sekian lama, ujian ujian industri ini dilakukan secara manual dan fizikal, sedangkan sepatutnya, beberapa prinsip dan displin ujian perlu dipatuhi. Sedia maklum bahawa, di dalam menjalankan ujian, keputusan mungkin dipengaruhi oleh keterbatasan keupayaan fizikal manusia, dan kemungkinan besar akan menghasilkan keputusan ujian yang kurang jitu dan kurang memuaskan. Oleh itu, alat ujian ini dihasilkan bagi membantu industri di dalam memperbaiki cara ujian dijalankan, dan mengarah kepada satu ujian yang dihasilkan dengan cara yang paling baik dengan menghasilkan keputusan yang paling jitu. Alat ini akan membanatu di dalam membantu menapung keterbatasan keupayaan manusia di dalam menjalankan ujian ujian yang telah disebutkan.

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LIST OF SYMBOLS

N	Newton's
Kg	Kilogram
Cm	centimeter
M	Meter
F	Force
V	Volt

LIST OF ABBREVIATIONS

DIN	Deutsches Institut fur Normung eV (German Institute for Standardization)
ITO	Information Technology Outsourcing
UV	ultraviolet
Si	silicon
Ta	tantalum
MIL	Media Integration Layer

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter explains about the project background, project objective, project scope and the project flow that been conducted. It also consists of Gantt chart of my project which explains the overall procedure and how I distribute my time for this project.

1.1 Project background

Coatings with thickness from several nanometers to several micrometers play today a very important role for the fabrication of many products. The mechanical properties of such coatings are therefore for utmost importance, since their functionalities may be highly disturbed or even last if the coatings are deteriorated or fail. The mechanical properties are strongly dependent on their structure, microstructure,chemical composition,plus the incorporation of impurities and are therefore influenced by the production technology and the parameter chosen. The most relevant mechanical properties are stress,residual stress,hardness,elastic modulus,fracture toughness, abrasive resistance and adhesion(interfacial fracture toughness). To obtain data on these quantities, several techniques and related equipments, some of them highly sophisticated are today available.

Nowadays method of conducting a reliability test on the coatings on the product structure, which is being conducted manually conducted to a doubtful test result.

This chapter explained about the project statement, project objective, project scope that been conducted. Besides that, this chapter also covers project flow and the progress project are follows the flow chart and gantt chart duration of time.

1.2 Problem statement

i. No standard device in holding the phone when the structure is going through the specified test
ii. The tests are conducted manually by bare hands without any help of special device or machine and cause burden to one who conduct the test.

1.3 Objective

To design and fabricate the reliability test fixture for surface treatment test and peel off test

1.4 Scope

The scope for this project are:

i. Focus on the measurement of the Intergrated Telephone System for model PANASONIC KX-TS500
ii. Focus on the rubbing test and sustainability of the coatings/stamp that exist on the body structure of the study case after 200 cycles with specified force.
iii. Focus on the peel off test and sustainability of the coatings after being applied a sudden force through the removal of cellophane tape.

1.5 Project planning

Figure 1.1 shows the allover flow of the project from the first step until the end of the project

At first, the project title is finalizing the project title. The decision was being helped by the discussion with the supervisor. The main subject that were being discussed all through the session are the project background, the main mission of the project and what are the fabrication method that might be used all through the fabrication process. After the deep discussion, the final title was chosen.

From the discussion, which revealed the project background, the next step is to generate concepts which must be designed suitably to meet the needs of the test or the project background. the concept were first being sketched with rough sketching, and then were refined into the proper drawing through technical drawing software. These drawing will also then come with their advantages and disadvantages. Through the advantages and the disadvantages, then , these aspects will help in contributing into the finalizing of the final design through concept selection method

After the final design have been chosen, only then the fabrication process will be started. The fabrication process will fully base on the proper drawing which will be very useful in guiding the fabrication process. In this stage, the drawing will have to come with its bill of material, which will be useful in making sure all the equipment and the material that are important in the fabrication are exist and in desired amount.

Supervision onto the development of the project is important to ensure its quality and will not drifting away from its real needs and time extension will not occur. So do its quality.

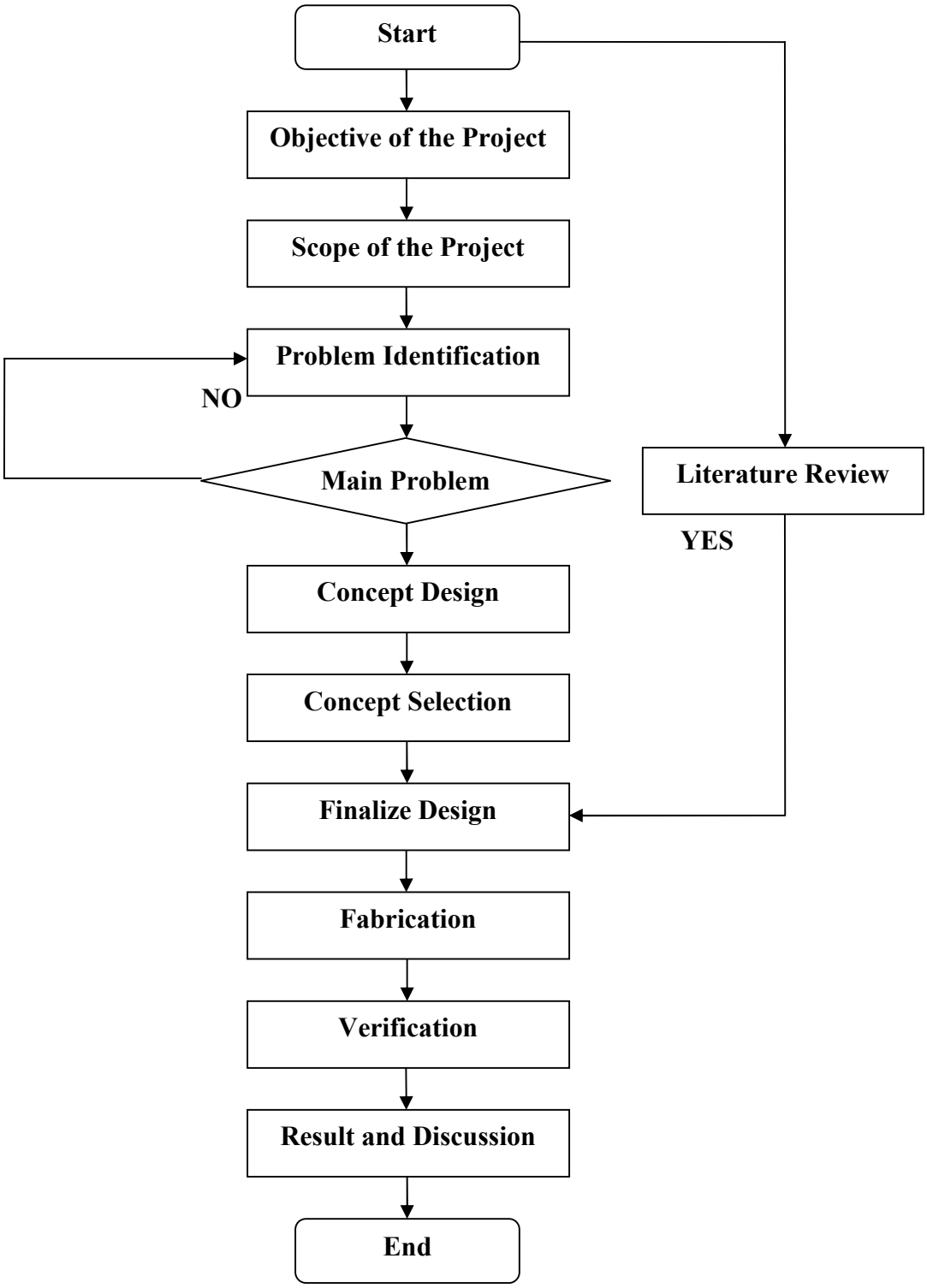

Figure 1.1: Project flow chart

Gantt chart of this project is shown in Appendix A. The Gantt chart will show the difference of the planning before and the actual development of the project. (please refer to appendix A)

In the first phase which is from the beginning of the project until the middle presentation, there are certain project development which are extended from the actual planning. They are, collecting data on base on the literature review of the test background and the phone structure itself. Also, process of collecting data on the phone model, finalizing on the last concept that should be chosen and research on the suitable material that are going to be used in the fabrication process. All this extended planning are mainly caused by the unclear information about the tests which are going to be conducted. Also, this extension is because of the problems which could be discovered at last moment which, the last concept has been chosen. In this scope, the problem related to the suitable material that are going to be used.

In the second phase, which is after the middle final year project presentation until the final presentation of the final year project. In this phase, extension occurred in the jig fabrication and improvement of the final year project structure. This extension occurred because of certain factor such as the lack of some material and machine that I have desired to use in the fabricating process.

1.6 Thesis organization

Chapter 1 is the introduction chapter of the project. It generally discuss about the introduction of the creation, the characteristics of the integrated telephone system, the problem statement,the scope and the time line in the making of the project.

Chapter 2 will discuss more detail on the project. In this chapter, will mainly discuss on the literature review that will reveal on the historical process of surface treatment and the pull off test. Also, will include in the brief introduction about the project and information related

Chapter 3 will discuss mainly on the design concepts that I have produced. There will be comparison between the concepts and will show what is the method used in selecting the final concepts.

Chapter 4 will discuss on the method used in the making of the project. It will mainly discuss on the material used to build the structure, process used in the making of the structure.

Chapter 5 will mainly discuss on the data and information gain from the fabrication process that have been applied to the project. This chapter will also reveal the problem faced during the fabrication process and the device features.

Chapter 6 is the last chapter and will discuss on the overall chapter in the project report. And through the report it will show the effectiveness of the project and will cover all the analysis of the project report. There will also include the recommendation for the future of the project, in minimizing the defect and uneffectiveness of the project and uprising the potential and the ability of the project.

1.7 Conclusion

The project must run smoothly. What lead to the smoothness is the deep understanding of the project. The main objective of this project is to increase the effectiveness of the project in improving the consistency of the force velocity applied and the consistency of the force applied in the high and sudden force. The objective is to overcome the traditional method of test before which is applied manually and of course manual method will lead to many unconsistency and uneven results as the performance of the manual method is manipulative. The smoothness will also lead by the good planning of the timeline scheduled.

CHAPTER 2

LITERATURE REVIEW

1.0 Introduction

This chapter is discussing on the test process required which are going to be applied on the test specimen/phone model. There will also brief information on the phone model and in relation of on what surface treatment test and peel off test are.

2.1 KX-TS500ML specification

The test specimen that is going to be used in the test is an Integrated Telephone System (ITS), Panasonic model KX-TS500 as shown in figure 2.1. The KX- TS500ML delivers the basic performance a company needs plus reliable Panasonic quality. Connect multiple KX-TS500 units to a Panasonic PBX (switchboard) to form a network for extension use throughout the working place or living place. It makes a good fit in any office décor.

This model comes with various colours that will fit various colours of rooms or workplace best. Important and will help one who make the style and image of a space as an important aspect.

It also is wall mountable. For the rooms that have less free space, especially on any flat surfaces in rooms or workplace, this telephone is specially designed that is can be mounted on the wall, that will decrease the space consuming.

With the features of the last number redial, this application helps dials the number which is most recently dialed. If users need to make a follow up call or line was busy at the first time, just press the redial button.

The time flash function which supports call waiting and PBX use, ensures that a caller is not accidentally out of while on hold.

Even in mid-conversation, the users can adjust the receiving volume of the handset to any of 6 levels.

The ringer volume can be set off, low, or high. Set it to off when the users is in an important occasion.

The KX TS500ML can be switched between tone (pushbutton) and pulse (rotary), ensuring that it will work on either type of telephone line. Appendix B will show the summary of the phone specification

Figure 2.1: Panasonic KX TS500

Source: Panasonic, 2009

2.2 Tests

According to research, there are no good references of any device for the surface treatment test and peel off test, as the current method (that is also practiced in the Pansonic phone manufacturing factory) is applied manually. But,there are good references on how the test is exactly applied.

2.2.1 Surface treatment test

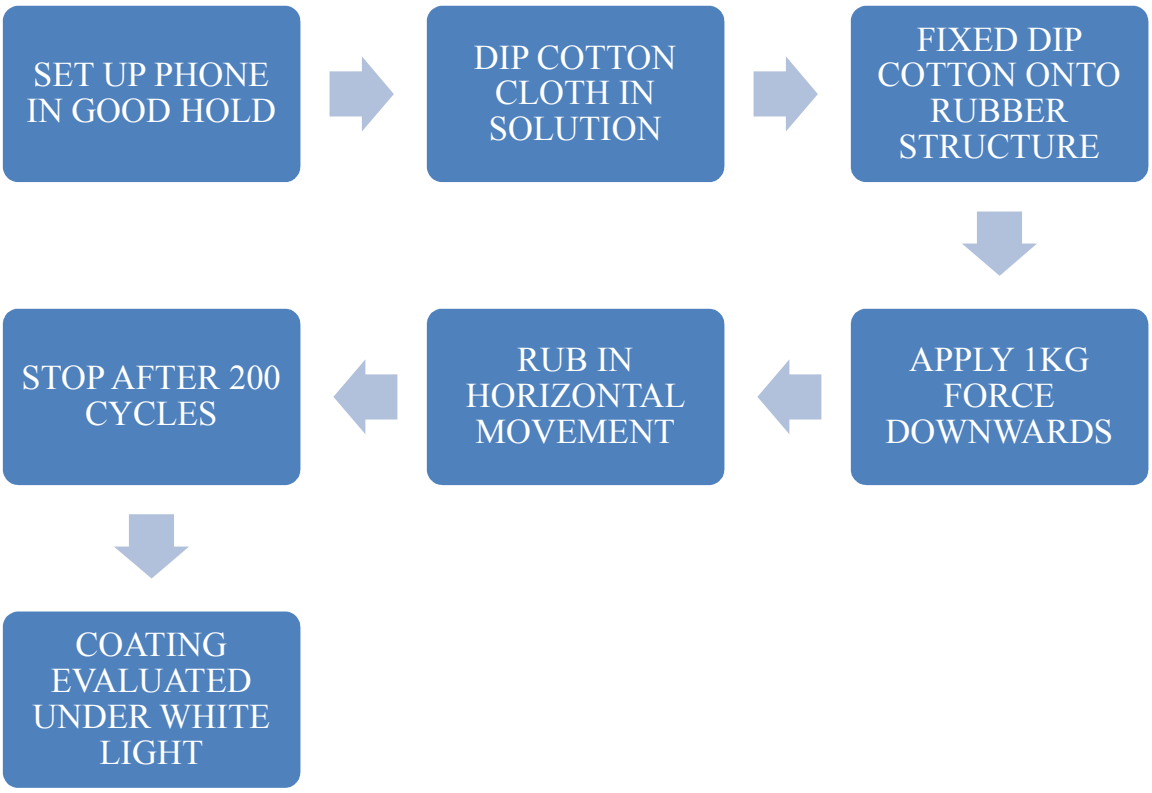

Figure 2.2: surface treatment test flow

Figure 2.2 shows the test flow of surface treatment. Surface treatment test is conducted with a cotton cloth or a hard rubber. A simple test to measure the resistance against abrasion of optical coatings is described in the DIN norm 58196 – 5. It consists of rubbing on the coating of a flat tsmapm of 10mm diameter covered with a 4 ply cotton

cloth (DIN 61631 PART 1), with a normal force of 4.5 N, along a minimum length of 20mm. the number of cycles are 25 or 50. The coating is then observed under white light, in reflection and transmission. The result is graded from H25-1 1OR H50-1, no damage, to H25-5 or h50-5,coating fully removed from the substrate.

A similar but much more severe test is to rub a hard rubber eraser (shore a hardness of 75mm) of 7mm diameter, during 10 or 20 complete cylces, with a normal force of 10N, over a distance of 20mm. the physical damage is then observed visually (falking,feeling,cracking or blistering) and graded from G10-1 or G20-1 no damage, to G10-5 OR G20-5,coating fully removed from the substrate. A similar process is given in the MIL – C 675C norm. commercial equipments exist. To our knowledge, the use of of this simple test was only reported to characterize ITO nanocomposite (ITO = MPTS)coatings, deposited on plastic substarte and cured under UV light (Acgerter,2003). Graded H-25 class1 and G 10 class 1 as well as,interference Nanomer coatings graded with the value G20 class 1 (Mennig, 1999a). similar test have been realized to confirm the good scrath resistance of broadband antireflective coatings made of Ta and Si oxide-based layers, for amplifier blatstsshields of the French LIL laser (Prene, 2000)

2.2.2 Peel off test

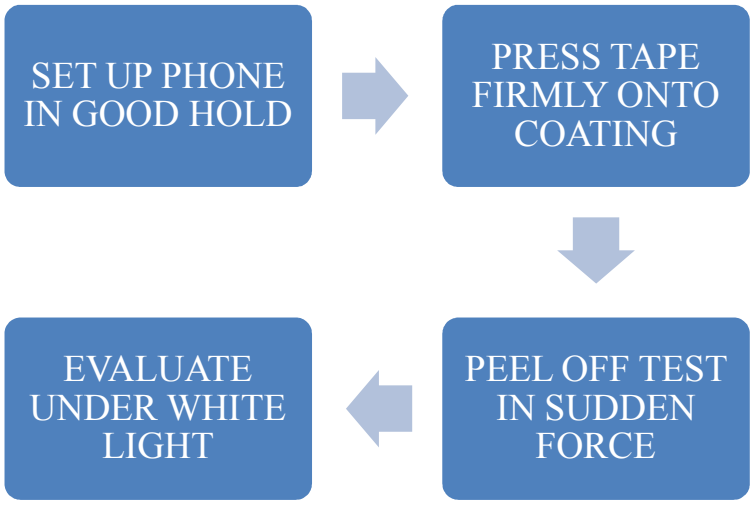

Figure 2.3: Peel off test flow

Figure 2.3 shows the flow of peel off test. The adhesion of coatings can be easily tested with a cheap and fast test, using a pressure-sensitive cellophane or cellulose acetate adhesive,pressed onto the surface of the coating. It is a standard test developed especially for optical components (DIN 58196a – part 6,L-T-90 (USA)). The tape is firmly pressed, at room temperature, against the coated substrate and is quickly removed at normal anglein about 1s or 2 to 3s. after theremoval of the tape, the coated surface is evaluated, prefentially by visual reflection under white light,for evidence of coating removal. This simple test does not give any scientific information, but is helpful; to screen the development of coatings for industrial use. Although very simple, this test has rarely been reported in the sol-gel scientific literature (Guglielmi, 1992; Winkler, 1999; Al Dahoudi,2002)

2.3 Fabrication method

In realizing the designing and fabricating this device, I used various type of fabricating method. The decision of using some of the method is to fit the condition of the material and to reduce the time consuming.

2.3.1 CNC machining

Numerical control (NC) refers to the automation of machine tools that are operated by abstractly programmed commands encoded on a storage medium, as opposed to manually controlled via handwheels or levers, or mechanically automated via cams alone. The first NC machines were built in the 1940s and '50s, based on existing tools that were modified with motors that moved the controls to follow points fed into the system on paper tape. These early servomechanisms were rapidly augmented with analog and digital computers, creating the modern computer numerical controlled (CNC) machine tools that have revolutionized the design process.

In modern CNC systems, as shown in figure 2.4, end-to-end component design is highly automated using CAD/CAM programs. The programs produce a computer file that

is interpreted to extract the commands needed to operate a particular machine, and then loaded into the CNC machines for production. Since any particular component might require the use of a number of different tools—drills, saws, etc.—modern machines often combine multiple tools into a single "cell". In other cases, a number of different machines are used with an external controller and human or robotic operators that move the component from machine to machine. In either case, the complex series of steps needed to produce any part is highly automated and produces a part that closely matches the original CAD design.

Figure 2.4: CNC machine

Source: Wikipedia, CNC 2009

2.3.2 Welding

Welding is a fabrication or sculptural 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 pool*) 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, under water and in outer space. Regardless of location, however, welding remains dangerous, and precautions are taken to avoid burns, electric shock, eye damage, poisonous fumes, and overexposure to ultraviolet light.

2.4.2.1 Shielded metal arc welding (SMAW)

Shielded metal arc welding (SMAW) as shown in figure 2.5 , also known as manual metal arc (MMA) welding or informally as stick welding, is a manual arc welding process that uses a consumable electrode coated in flux to lay the weld. An electric current, in the form of either alternating current or direct current from a welding power supply, is used to form an electric arc between the electrode and the metals to be joined. As the weld is laid, the flux coating of the electrode disintegrates, giving off vapors that serve as a shielding gas and providing a layer of slag, both of which protect the weld area from atmospheric contamination.

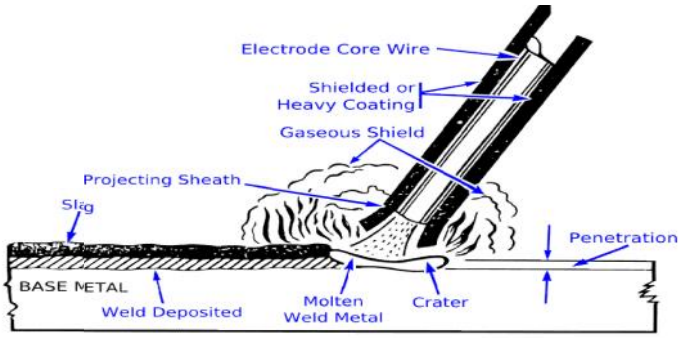

Figure 2.5: shielded metal arc welding

Source: Wikipedia, SMAW 2009

2.4.2.2 Gas metal arc welding (GMAW)

Gas metal arc welding (GMAW) as shown in figure 2.6 , 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 as shown in figure 2.7, is most commonly used with GMAW, but constant current systems, as well as alternating current, can be used.

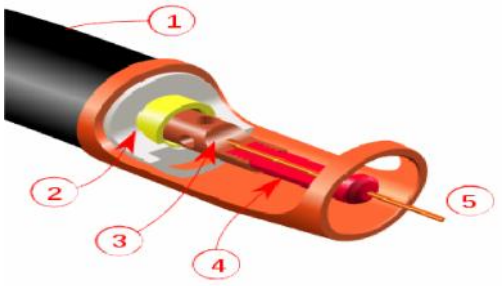

Figure 2.6: metal inert gas torch nozzle cutaway

Source: Wikipedia, GMAW 2009

Figure 2.7: metal inert gas fire unit

Source : Wikipedia, GMAW 2009

2.4.3 Drillling

Drilling is the cutting process of using a drill bit in a drill to cut or enlarge holes in solid materials, such as wood or metal. Different tools and methods are used for drilling depending on the type of material, the size of the hole, the number of holes, and the time to complete the operation.

Drilling is a cutting process in which a hole is originated or enlarged by means of a multipoint, fluted, end cutting tool. As the drill is rotated and advanced into the work piece, material is removed in the form of chips that move along the fluted shank of the drill. One study showed that drilling accounts for nearly 90% of all chips produced. Figure 2.8 shows the press drill machine, which is commonly used in drilling process.

Figure 2.8: Press drill machine

Source: Uerolimited, Drill press kit 2009

2.4.4 Grinding

Grinding is a machining process that uses an abrasive wheel as the cutting tool. A wide variety of machines are used for grinding. They include:

i. hand-cranked knife-sharpening stones;
ii. handheld power tools such as angle grinders and die grinders;

iii. various kinds of expensive industrial machine tools called grinding machines; and

iv. the bench grinders often found in residential garages and basements.

Grinding practice is a large and diverse area of manufacturing and toolmaking. It can produce very fine finishes and very accurate dimensions. Figure 2.9 shows a grinding machine.

Figure 2.9: Grinding machine

Source: Ultimatehandyman, Bosch grinder 2009

2.4.5 Cutting

Cutting, as shown in figure 2.10, is the separation of a physical object, or a portion of a physical object, into two portions, through the application of an acutely directed force. An implement commonly used for cutting is the knife or in medical cases the scalpel. However, any sufficiently sharp object is capable of cutting if it has a hardness sufficiently larger than the object being cut, and if it is applied with sufficient force. Cutting also describes the action of a saw which removes material in the process of cutting.

Figure 2.10: Metal cutting

Source: Archer USA, Speedcut 2009

2.4.6 Measuring

In science, measurement is the process of obtaining the magnitude of a quantity, such as length or mass, relative to a unit of measurement, such as a meter or a kilogram. The term can also be used to refer to the result obtained after performing the process. Figure 2.11 shows a measuring apparatus.

Figure 2.11: measuring apparatus

Source: J.Morgan, Measuring 2009

2.5 Conclusion

For the conclusion, this chapter is the full review chapter that is important in showing the what the test that is going to be conducted using the device is all about and the fabrication method that are going to be used in fabricating the device.

CHAPTER 3

DESIGN CONCEPTS AND SELECTION

3.0 Introduction

The production of product have to undergo step by step process before it is going to be realize. In the production of the jig, the methodology of producing it, really depends and base on the function of the jig itself. Also, related with the literature review, that is showing what the function of the jig itself (base on the test procedure and how to undergo it). After everything satisfy the specification, there will be process of sketching of the ideas of the products. These sketches will then be refined into proper drawing with proper dimension, satisfies the dimension of the product. There will be various of ideas, and only one of the ideas will be selected, and all of them will undergo concept selection process using several parameters. Only when a final concept is being selected, there will be product fabrication. Which, will be built using right materials. Then, there will be an improvement stage of the product for it to meet its real function, satisfies and will help in producing a good result of test.

3.1 Process Flow Chart

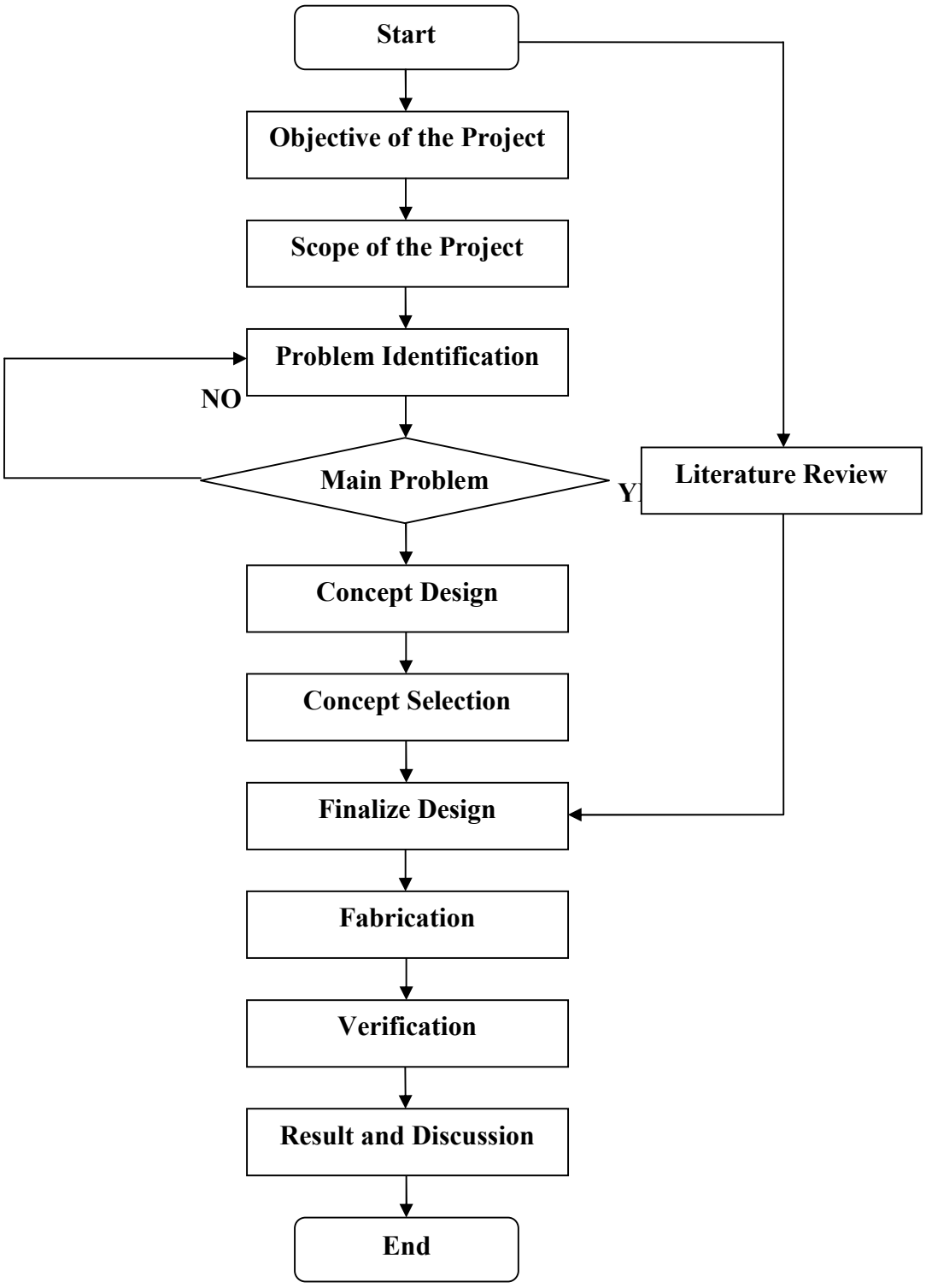

Figure 3.1: Process flow chart

3.2 Design

The sketches for the design of the jig have been undergo a brainstorming session. There were various of sketches before it is being refines into a proper drawing. The sketches is being made through several parameters. the design have to meet its specification, by meaning is really satisfies for what its function is. This is also based on the literature review, for what really the test that is going to be conducted by the jig is all about. Only then, the sketches will be realized. Then, the sketches will also help in the making of proper drawing where, starts from the sketches, the measurements of the structure could be determined. Also, it have to meet the satisfactory of the user who uses it. the measurement is going to be ensure will not burden the user and the person who are going to fabricate it. cost is also an important parameter in realizing the fabrication. Cost is being ensured not to exceed highly, which is related to the material used and the measurement of the device

Here are drawings of that were generated from the sketches of previously. All of this concepts drawing are being drawn using GOOGLE SKETCH software.

3.2.1 Design 1

This design is based on the concept of a holding box. All the structure is made of mild steel. This design is still implying a manually operated concept. Where it is still manually operated in the rubbing process, and manually operated of peel off test. This design is has a weakness of excessive mass due to the design, material used. And also, weaknesses in the due time to fabricate, due to the design of the all over structure need to be milled. The method of the test being conducted also not improve a lot accept of the way the phone structure is being hold. Figure 3.2 to figure 3.5 shows the design from different perspectives.

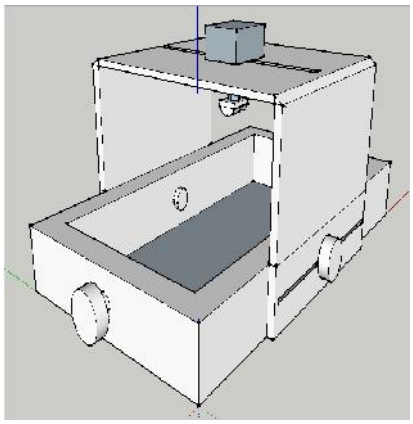

Figure 3.2: Concept 1(isometric)

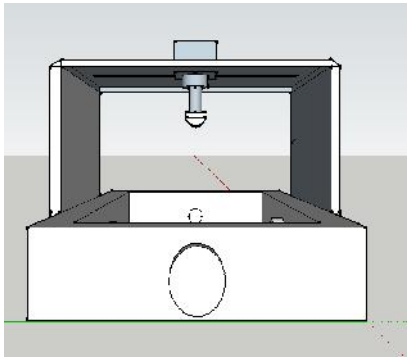

Figure 3.3: concept 1 (front view)

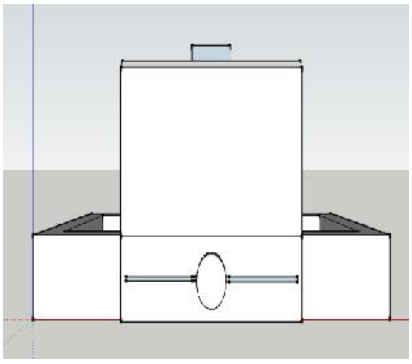

Figure 3.4: concept 1 (side view)

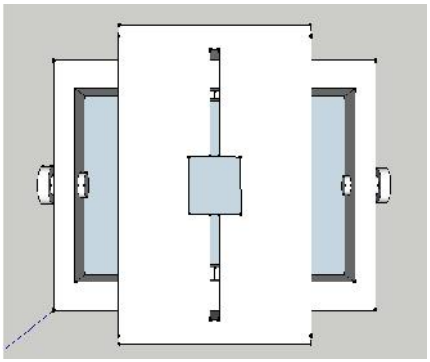

Figure 3.5 : concept 1(top view)

Table 3.1: Advantages and Disadvantages of Design 1

Advantages	**Disadvantages**
Low cost	Heavy
Ease of fabricating	All test are still have to be conducted manually
High level of stability	

Table 3.1 shows the advantages and disadvantages of Design 1. It has a good level of stability, but in conjunction of the stability, it causes the device to have a massive weight and the test is still have to be conducted manually. This design, basically only provide a best hold among all design, but not in application.

3.2.2 Design 2

This concept is an improvement of concept 1. The improvement that have been made in this concept is it uses motor for the application of surface treatment test, and, the structure of all over body have been minimize its mass, due to the holes that exist on all over the jig structure. But anyhow, the peel off test is still manually operated. Figure 3.6 to figure 3.11 shows the design from different perspectives.

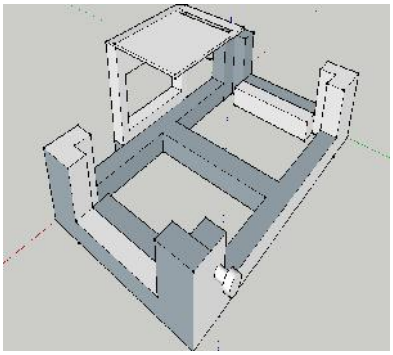

Figure 3.6: Concept 2 (isometric)

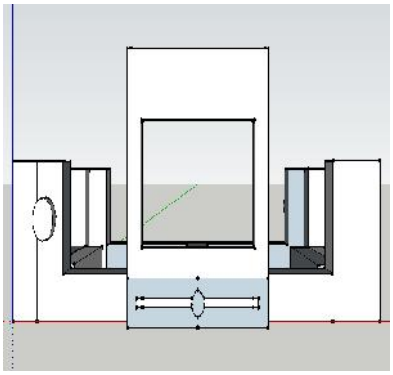

Figure 3.7: side view

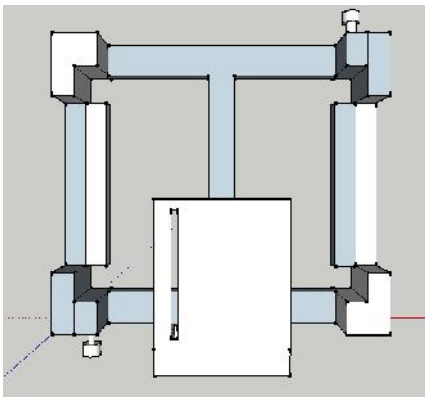

Figure 3.8: top view

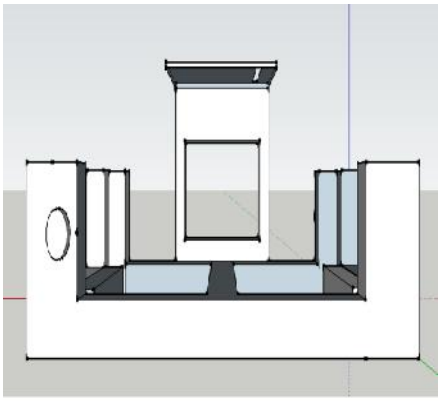

Figure 3.9: side view

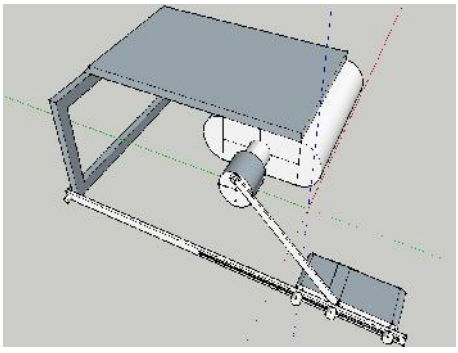

Figure 3.10: motor (iso view)

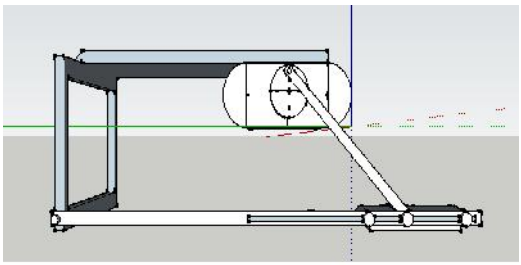

Figure 3.11: motor (front view)

Table 3.2: Advantages and Disadvantages of Design 2

Advantages	**Disadvantages**
Electronically operated	More complex in design
Lighter weight	Peel off test is still manually operated
Still on low cost	

Table 3.2 shows the advantages and disadvantages of Design 2. Compare to design 1, this design is an improvement of design 1. But, the disadvantages are the ability of the device to help meet the test disciple and the peel off test is still manually operated.

3.2.3 Design 3

This concept is going to made a big gap with the two former design, which is this design is described as a better design. The whole structure is exactly are a combination of blocks and shafts. It is not going to be a difficult design to fabricate. This also lead to the big percent of mass reduce, bigger than 2 former design. The surface treatment test and the peel off test which is going to be conducted also will not being conducted manually, but by the help of air piston. This concept is going to apply a concepts of pneumatic in its operation. The surface treatment test will be helped by the application of the air piston at

1 side of the device, which will apply a repeated horizontal movement in x axis(to left and right), which is going to satisfy the requirement of the test which want the horizontal movement to be applied 200 times , in same distance and same velocity. Furthermore, this concepts has an advantage in the aspect of adjustment. The height of the rubber and the height of the peel off test device can be adjusted. This supported by the adjustable positioning (left and right) of the telephone structure holder. All over, this concepts is the best in its operation effectiveness. Figure 3.12 to figure 3.15 shows the design from different perspectives.

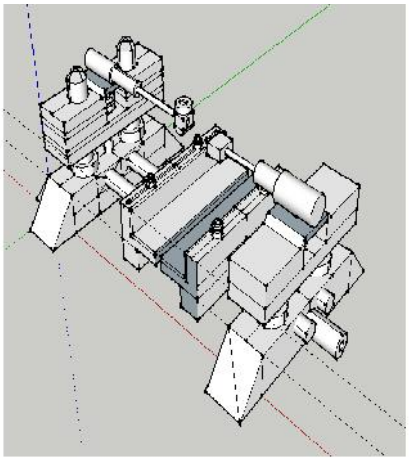

Figure 3.12: Concept 3

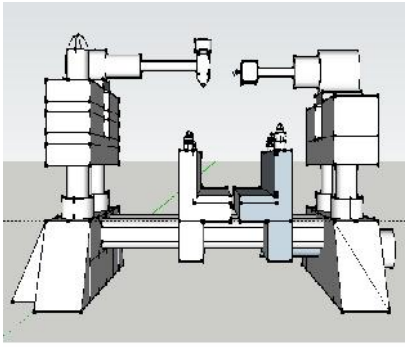

Figure 3.13: front view

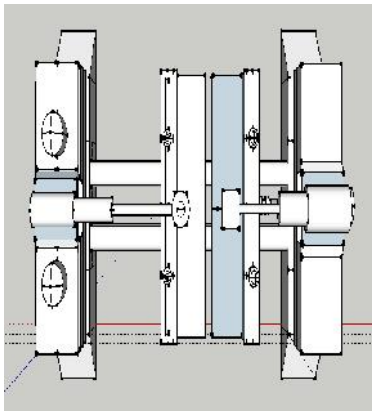

Figure 3.14: top view

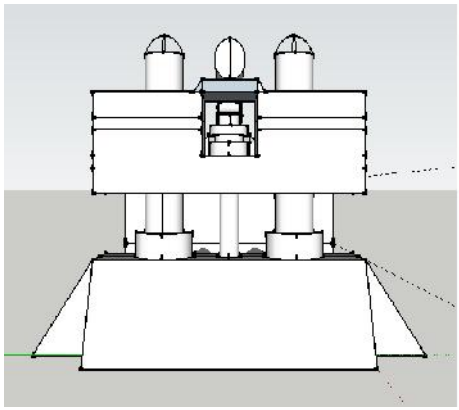

Figure 3.15: side view

Table 3.3: Advantages and Disadvantages of Design 3

Advantages	**Disadvantages**
Operate effectively	Fabricating cost hike up
User friendly	Most complex in design and fabricating process

Table 3.3 shows the advantages and disadvantages of Design 3. The best in meeting test desire, but the disadvantages are it is complex in fabricating process and the cost is the most expensive.

3.3.4 Design 4

At first, concepts 3 seems to be the best concept, among all the concept being made. But, due to this factor, it has to be improved from the design which is related in the way of the device is going to be fabricated.

i. **Structure**

   It is a complicated due to almost overall of its structure is made of mild steel and need to be milled which will disturbed the process of manufacturing timeline

ii. **Lack of equipment**

   Due to lack of equipment, which the fabrication process need the milling machine and lathe machine, which the machine are not ready in the lab yet

iii. **Time**

   The problem is detected on the 7^{th} week, and it is going to reach the 15^{th} week really soon.

Based on concept 3, there are no much different than the former design. Concept 4 can be observed in figure 3.16.What improvements that have been made are:

i. **The usage of hollow shaft and hollow bar**

   The usage of hollow bar is in purpose of reducing the weight of he overall structure, making the fabrication process become more easy,and reducing the time in fabricating

ii. The usage of aluminium block in several part

As can be observed, all the block structures in the device are made of aluminium. This is on purpose of reducing the time to fabricate; to mill the aluminium take less time, more than applying milling process on mild steel.

iii. The usage of single air piston

Even there are single piston in use, the effectiveness is still the same. It could be manipulative. Can be used in conducting the surface treatment test and peel off test.

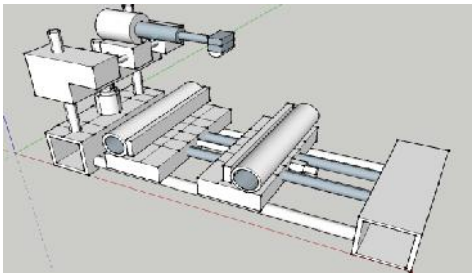

Figure 3.16: concept 4 (isometric)

Table 3.3: Advantages and Disadvantages of Design 4

Advantages	**Disadvantages**
Operate effectively	Fabricating cost is still expensive
User friendly	
Cheaper cost	
High level of fabrication ease	

Above is the advantages and the disadvantage of concept 4. Concept 4 have some criteria that is almost similar to concept 3. So that, the disadvantages is similar to concept 3. But, the fabricating cost will still be expensive due to the usage of the air piston.

3.3 Concept selection

In choosing among the 4 concept to be the final concept, there are parameter have been used, and the selection is being conducted using CONCEPT SELECTION method which is related on the selection criteria as shown in figure 3.17.

		CONCEPT VARIANS			
SELECTION CRITERIA		A	B	C	D
FABRICATING EASE		-	-	-	+
MOBILITY		-	+	+	+
EASY OPERATING		+	-	+	+
EFFECTIVENESS		-	-	+	+
STABILITY		+	+	+	+
	PLUSES	2	2	4	5
	SAMES	0	0	0	0
	MINUSES	3	3	0	0
	NET	0	0	0	0
	RANK	3	3	2	1
	CONTINUE	NO	NO	N0	YES

Figure 3.17: concept selection

Based on the result from the method used, concept 4 have been chosen as the prime concept and will be proceed to be developed and manufactured. Design 4 satisfy all factors of the test needs. From the factor of the design, and the other important factor that is costing involved in the fabrication process.

3.4 Conclusion

As the conclusion, this chapter is focus mainly on the concepts selection. The concepts selection are important in making sure that the concepts that is going to be build is the best concepts, will need all the needs, will satisfy the user and will not burden one who fabricate it.

CHAPTER 4

FABRICATION PROCESS

4.0 Introduction

After the middle presentation of the project, the design was approved and was allowed to undergo the fabrication process. In this chapter, will mainly reporting on the adjustment that have been made onto the structure of the device. The adjustment was made due to some difficulty faced and due to some constraints. This chapter will also reporting on the fabrication of the device during the real process was made by showing the real visual on the process.

4.1 Current design

Due to some circumstances, there are some adjustment done on the former design that will be discussed further in chapter 5. The figure 4.1 shows the current design.

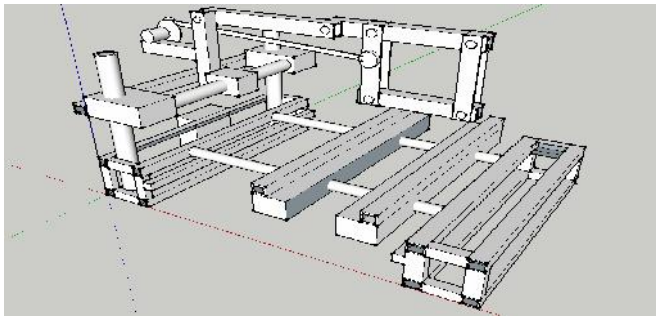

Figure 4.1: Current design

After the adjustment, this is the current design which I have produce and was fabricated. There are some aspects of the design which I have change.

4.2 Material

In the fabrication of the device, I do not use various types of material. Mainly, I used a lot of metal. The table below are the bill of material which show the material and the dimension used in the fabrication. The material used are:

i. Aluminium solid bar
ii. Stainless steel hollow shaft
iii. Hollow steel rod
iv. Aluminium plate

The bill of material, can be referred to appendix C.

4.3 Fabrication process

In the fabrication of the device, I applied various fabrication process which I have learnt since the first semester until the 4th semester through the Mechanical Laboratory subject. The process flow is shown in figure 4.2. The method which I have used are stated as below:

i. Measuring

The raw material used are measured into the desired measurement required by the design

ii. Marking

Marking were done on the raw material structure right after measuring, to ease the cutting process afterwards

iii. Cutting

In this project cutting were done by several way that are using band saw and using the cnc machine

iv. Milling

In this project, milling process were conducted on several solid parts using the CNC machine

v. Welding

Welding were used in joining some parts on the structure

vi. Soldering

Soldering were done on the electronic components which are used in the electronic circuit

vii. Drilling

Drilling were done for the purpose of nuts and bolts placing purpose

viii. Joining

Joining were done after all the fabrication processes above were finished. Joining were done by placing nuts and bolts and welding method

ix. Finishing

All rough surfaces grinded in terms on minimizing risk during the device usage

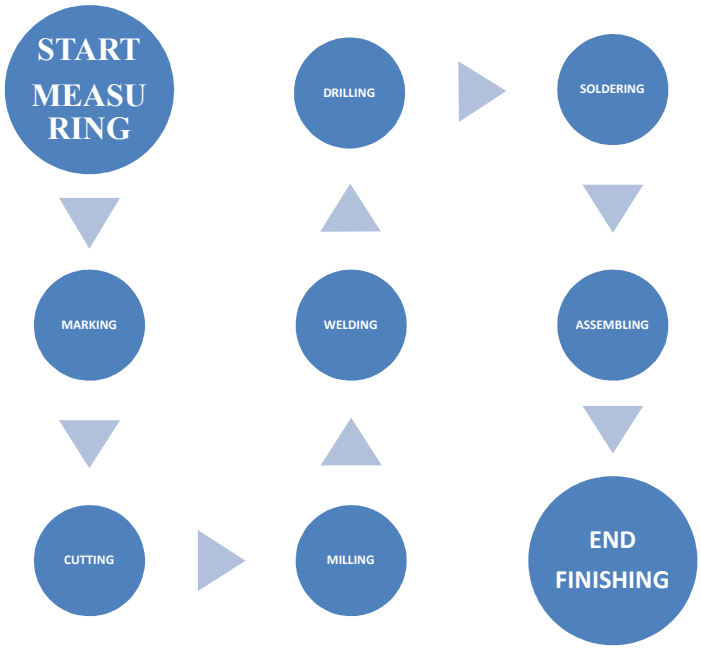

Figure 4.2: process flow

4.4 Fabrication process steps

4.4.1 Measuring

From the proper drawing that have been made, the dimension of the material is taken, and the measuring process is conducted onto the material to get the desired dimension that is suitable to the project. The measuring of the material were done using apparatus like measuring tape and steel ruler. The measuring process is shown in figure 4.3.

Figure 4.3: measuring

4.4.2 Marking

In association with the measuring process, the marking process was also done. The marking process is going to help to drive the cutting tool in the next process which is the cutting process. The marking process is shown in figure 4.4.

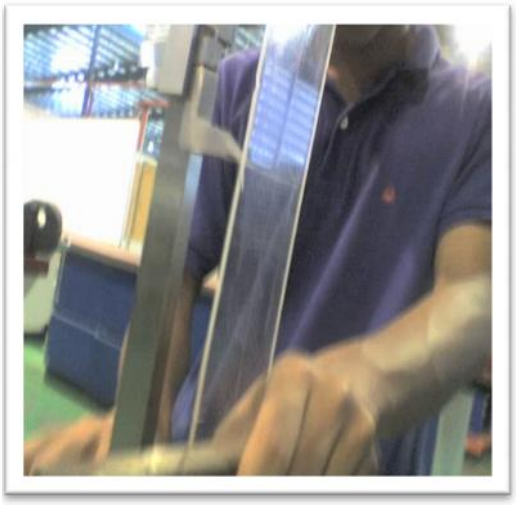

Figure 4.4: marking

4.4.3 Cutting process

The cutting process is done to get the desired dimension of the material that we want and suit the project. The cutting process is also known as a process in reducing the dimension of the material. In this project, I use a lot of metal, and the cutting apparatus that I mainly used are metal saw as shown in figure 4.6.

Figure 4.6: cutting

4.4.4 Milling process

Milling process is a process that also can be used in reducing the meta dimension. I used milling process because, some part I used is solid metal, and the milling machine is the most suit able machine that can be used. For milling machine, I used CNC milling machine.

For the milling process I have used the CNC machine, FANUC ROBODRILL α – T14 ΙEe, as shown in figure 4.7, which I have used in conducting the milling process on certain parts as shown in figure 4.8 to figure 4.9.

Figure 4.7 : Milling machine

Figure 4.8(a):parts on CNC machining

Figure 4.8(b):parts on CNC machining

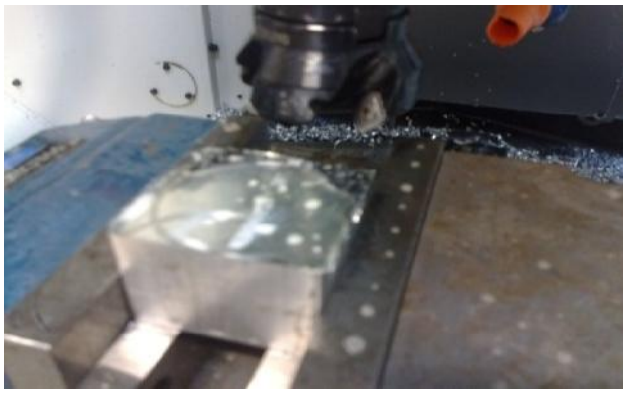

Figure 4.8(c):parts on CNC machining

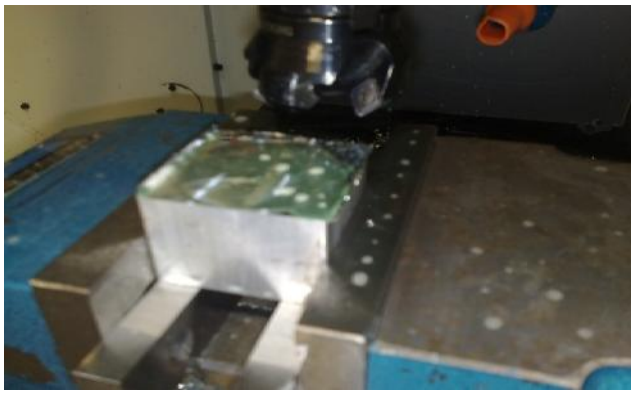

Figure 4.9(a):part after CNC machining

Figure 4.9 (b): part after CNC machining

4.4.5 Welding

As known, most of the material I used in the project are metals. The basic structure is build using metal. The most suitable process to be used in joining the parts are welding. This give good results in the toughness of the whole basic structure. Figure 4.10 shows the welding process in progress.

Figure 4.10: welding

4.4.6 Drilling

Drilling process as shown in figure 4.11 is being used to make holes on some parts of the structure. The machine that have been used is press drill machine.

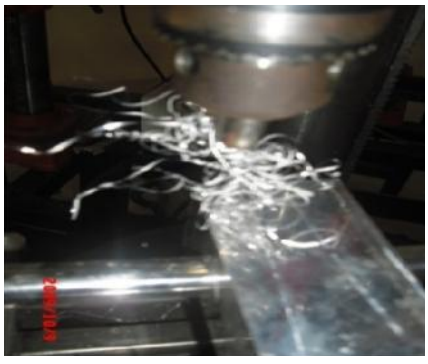

Figure 4.11 : drilling

4.4.7 Assemble

Assembling is being done after the parts have gone through the fabricating process as stated above. In this process, all the parts have been gathered and being assembled. The parts on pre assemble are shown in figure 4.12 to figure 4.14(e).

Figure 4.12: assembly

Figure 4.13 (a) : pre assemble 1

Figure 4.13 (b) : pre assemble 1

Figure 4.13 (c) : pre assemble 1

Figure 4.13 (d) : pre assemble 1

Figure 4.13 (e): pre assemble

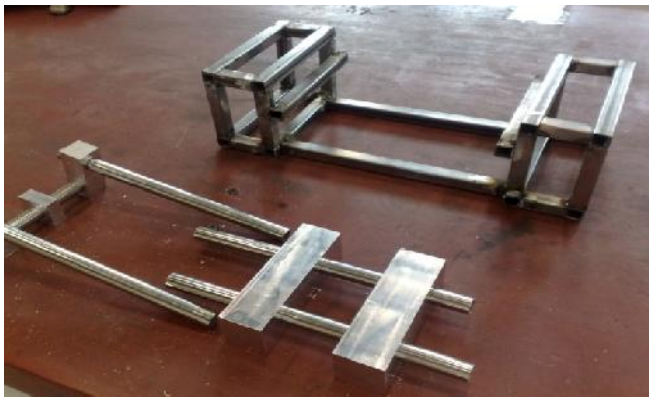

Figure 4.14(a) : pre assemble 2

Figure 4.141(b) : pre assemble 2

Figure 4.14(c) : pre assemble 2

Figure 4.14(d) : pre assemble 2

Figure 4.14(e) : pre assemble 2

4.4.8 Grinding

Grinding is the finishing steps that is important in rising up the safety leve of the fabricated device to ensure that there are no sharp edges. The grinding process is being done only on metal parts as shown in figure 4.15.

Figure 4.15: Finishing (grinding)

4.5 Conclusion

As the conclusion, this chapter have been explaining and show that various types of fabricating process were used in realizing the fabrication process. The processes used are suitable due to the condition of the material and due to the circumstances faced.

CHAPTER 5

RESULTS AND DISCUSSION

5.0 Introduction

The device operation is the combination of the mechanical concept and the electronic concept. In achieving the mission of obtaining the improvement on how the test is being conducted, or in the other way, how to achieve and overcome all the problems faced when the test is conducted manually or by bare hands. The choice of using the electronic system in powering the device is observed as the best way, even, it was a bit complicated where there need a lot of adjustments and synchronizing among all the powering components. In this chapter will mainly focus on the discussion of the device structure itself.

5.1 Problem faced

Due to some constraints and difficulties faced before and during the fabrication process, I have made a big adjustment onto the design, material used and some addition on the fabrication process. I faced some problems as stated below, and the problem have gave me no choice of action, except doing some changes. The problem which I have faced are:

5.1.1 The lack of raw material

There were some of material which force me to change some of the raw material used on the structure. On some parts which in the design I have proposed before, I have planned to use the big hollow bar on the base structure. Due to the lack of the raw material, I have change the material that are going to be used to the hollow steel rod.

5.1.2 Difficulties in obtaining the important components

As proposed in the last design of the device, I proposed on the usage of the air piston which is very effective in producing a horizontal movement to the left and right (on x axis). But, a disappointment for me, I have manage to get the air piston in Kuantan, but the result is negative. i have to replace the usage of the air piston with other component.

5.1.3 The limited usage/ service of some machine in the mechanical lab/ workplace

In my device design, there are some parts of the device which I have plan to use aluminium solid bar. Those bar wanted me to do milling on them which in terms of obtaining a desired dimension which is suitable for my design. I have planned in using the conventional lathe machine which is located in the general lab workplace. Unfortunately, those machines which I wanted to use was not in good condition and are not ready for any serious operation. This condition wanted me to find other alternative method of machining.

5.1.4 Allover cost predicted to hike up

On the previous proposal, I was proposing on the use of air piston. And some research conducted on the allover project price, and the price of the air piston will cause the all over cost of my project hike up and will burden my ability on purchasing some of the components. This cause me to do some adjustments.

5.2 Adjustments

Due to the constraints and obstacle faced by me, I was doing some adjustments on some aspects of the fabrication of the device that will allow me to keep on proceeding with my project and the project itself will be able to finish before or on the duetime. Some adjustments that have been made by me are:

5.2.1 Adjustments on the raw material used

On some parts that cause me difficulties in obtaining the raw material; either the difficulties in obtaining it or, the raw material price itself which burden me, I have done some adjustment and redesign on the allover structure. For example, for the use of big hollow bar on the base structure, I have replaced the use of that material to the use of combination of hollow steel rod. This have helped me save my time from keep searching for the real material which I have desired to use.

5.2.2 Replacing the hard- to- get components with the alternative components

This point is focusing on the difficulty faced by me in obtaining an air piston. So, to replace the use of the components, I have taken an alternative in replacing the usage of those particular component into the use of electronic components. This components will be discussed further on the other chapter.

5.2.3 Alternatively using the CNC machine

From the lack of the service of some machine that are available in the mechanical lab, which ive mention before, I have to use the conventional milling machine to mill some of my device parts. And due to the unavailability, I have to change the machine that I have to use to the Computer Numerical Control machine (CNC). This machine give more advantage on the fabrication of my device which helps me to do my process more faster. Thus, the machine helps to do more precise works.

5.2.4 Changing the use of some components into the use of other components.

In the previous design, I have mention that I am going to use the air piston to produce the horizontal movement (on x axis). But due to the allover price hike up, I have done a change, that I will replace the use of the air piston into the electronic component. Which is going to combine the use of the ic timer circuit and the use of motor speed controller. This helps to reduce the project cost in a big percentage.

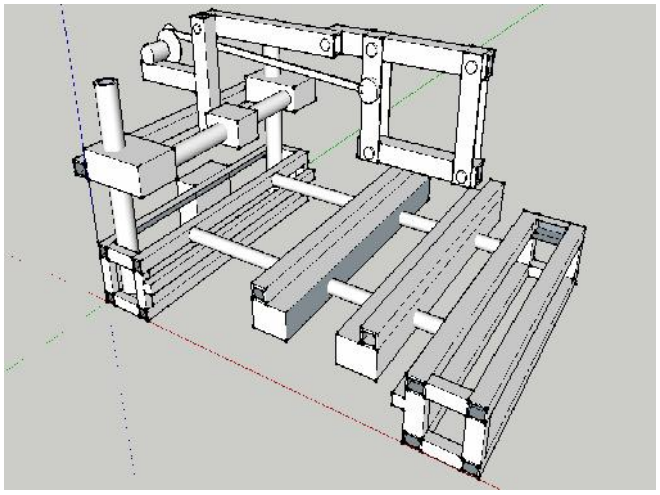

Figure 5.1 : Current design

After the adjustment, figure 5.1 shows the current design which I have produce and was fabricated.

There are some aspects of the design which I have change.

5.3 The altered aspects

In the current design, there are some altered aspects which I have done on the structure. They are:

i. Electronic application replacing the pneumatic system

ii. Usage of smaller hollow rod replacing the bigger size of hollow bar (base structure)
iii. Modification in the ITS holding method
iv. Usage of the arm application in rubbing method (fulcrum)
v. Usage of the application of the combination of movement of piston and crankshaft in engine blocks.

These can be observed in the current device design diagram (please refer to appendix D)

5.4 Advantages and disadvantages

The advantages of current design are:

i. Lower costing required
ii. Simpler on fabricating
iii. Less on weight and more user friendly
iv. Realistic

The disadvantages of the current design are:

i. Weaknesses on conducting the specified test
ii. The outcome may not satisfy how the way the test should be conducted
iii. More complicated design

And due to the adjustments, here are the most highlighted parts on the new device. The visual of the device features are the adjustments that are mentioned before. And the rest of the structure are as the same as the previous design. The parts are shown in figure 5.2 to figure 5.8.

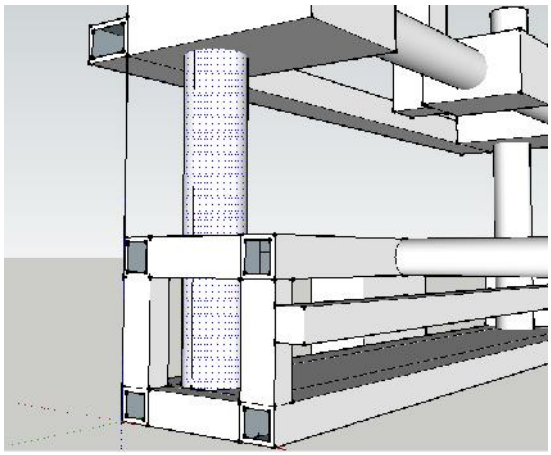

Figure 5.2 : smaller hollow parts on left base structure

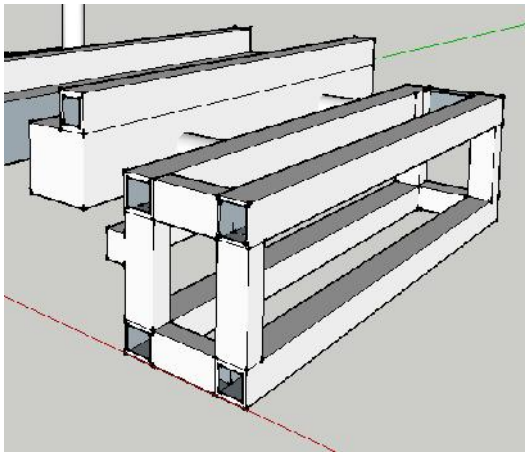

Figure 5.3: smaller hollow parts on right base structure

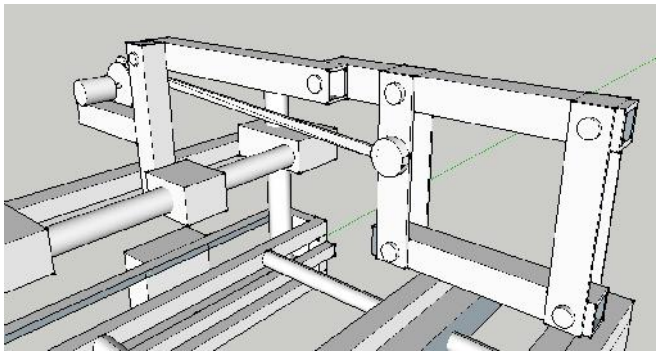

Figure 5.4 : free arm structure

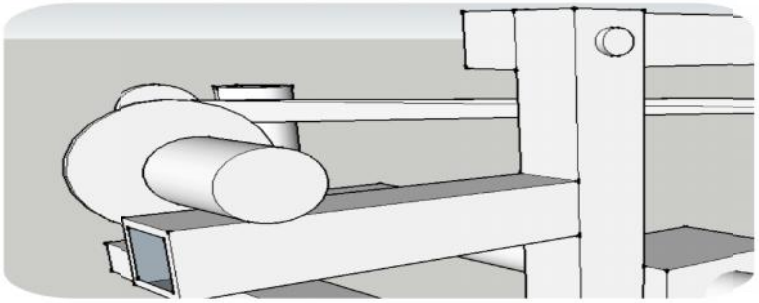

Figure 5.5 : motor (device powered by motor)

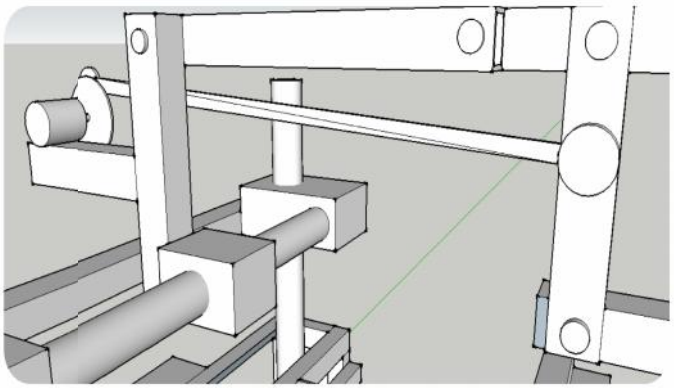

Figure 5.6: Fulcrum application

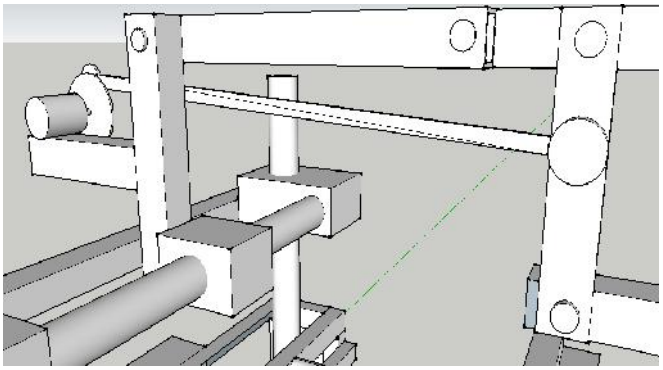

Figure 5.7 : connecting rod

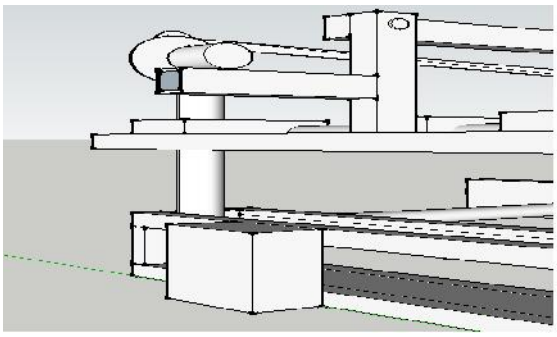

Figure 5.8 : circuit box

5.5 Operation system

There are explanations on how the device works and operate. As given, the device is a combination of the electronic and mechanical concepts.

5.5.1 Mechanical concepts

On the mechanical concepts, it will touch mainly on the free arm structure. The free arm structure are the main part on the device as this part is exactly helps in producing the horizontal movement on the x axis to move the rubber to conduct the surface treatment test. This free arm is powered by the motor. And the concept of moving the free arm is taken from the movement of the piston which is moved by the crankshaft and the connecting rod.

This movement then is being applied in producing the movement in the free arm and so that the mechanism can seriously operated. The rubbing movement can be made, and the 200 cycles which is a must in the disciple in the surface treatment test can be fulfilled.

5.5.2 Electronic concepts

The electronic circuit are the source of power which helps to move the free arm. On the electronic concepts, the circuit are the combination of two circuits. They are:

i. IC timer circuit
ii. Motor speed controller circuit

This two circuits will help producing the 200 cycles of the free arm.

5.5.3 Operation of the electronic circuits

The electronic circuits used are the combination of two electronic circuits

i. IC timer electronic circuit
   The IC timer electronic circuit is a circuit that functions to stop any circuit in the interval of 200 seconds. The disconnection is cause by the IC, the components which helps to disconnect the circuit.
ii. Motor speed controller circuit

The motor speed controller are the circuit that will help in slowing or making the motor speed become more faster. The speed control is manipulative and were controlled by the resistor.

However, in producing the 200 cycles of horizontal movement are not that easy because the electronic circuit is the combination of two circuits. So, in producing the 200 cycles, there need some countings. In producing the 200 cycles of the horizontal movement.

i. The RPM of the motor could be decreased by using the resistor.
ii. The IC timer functioning by disconnecting the circuit after 200 seconds.

iii. on the motor, the complete movement of the point on the circle is equal to 1 complete cycle of horizontal movement.
iv. Using the resistor, the revolution of the motor should produce a complete circle on the connector
v. 1 second movement = 1 complete circle
vi. 200 seconds = 200 complete circle = 200 complete horizontal movement
vii. Satisfying the surface treatment test needs

5.6 Operation system of the peel off test

Due to the modification on the device operation system and the how its powered, the peel off test will still be done manually but, the device itself still serving a good service by producing a good hold of the ITS. Satisfying several aspects on improving the way the test being conducted

5.8 Conclusion

For the conclusion, this chapter reveal how I step up the problem I have faced and the brief explanation on how the device works and operate. Creatively, the device faced can be solved if there are more than one plan created, so that any problem faced regarding our former idea can be replaced quickly.