DEVELOPMENT OF AUTOMATIC INSERTING CHAIN/RING FOR KEYHOLDER

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for the award of the degree of

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SUPERVISOR DECLARATION

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of degree of Bachelor of Engineering (Hons) in Mechatronics

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Name of supervisor : Dr Zamzuri Hamedon

Position : Deputy Dean (research and innovation and post graduates)

Date :

STUDENT DECLARATION

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

Signature :

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Date :

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I would like to express my thanks to my parents for their moral and financial support for my study. I am really thankful for their sacrifice and patience to make my dream come true. They always inspired me to live my life to the fullest and they also constantly advising me in order to guide me to the right tract of life.

ABSTRACT

This thesis presents the development of automatic inserting ring for a key holder. The proper calculation and simulation of every component of the machine are important to avoid the failure of the machine. The suitable force and mechanism is required in order to insert the ring to the key holder. The parameter of this project is the material properties and the diameter of the wire that will formed to ring shape. The design of the project must meet the condition to able to withstand the shear force in every components. The project is fabricate using FANUC CNC Milling machine.

ABSTRAK

Thesis ini mempersembahkan tentang pembuatan mesin yang boleh memasukkan cincin untuk pemegang kunci secara automatik. Pengiraan dan simulasi kepada setiap mesin komponen perlu dibuat dengan baik untuk mengelak kerosakan kepada mesin. Daya dan mekanisma yg sesuai diperlukan bagi memasukkan cincin kepada pemegang kunci. Parameter untuk projek ini adalah sifat bahan dan diameter wayar yang akan membentuk cincin. Projek design mestilah memenuhi syarat yang ditetapkan agar setiap komponen mampu menampung daya yang terhasil. Projek ini akan dibuat menggunakan FUNUC CNC Milling machine.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This chapter will discuss about the project background, the problem statement of the project, the objective of the project and the scope of the project

1.2 PROJECT BACKGROUND

A key holder is a decorative material which is used to enhance the visual look on the key. It have various shape and design according to the customer preferences. Every key holder have its distinctive shape with a holes somewhere near the edge which is used to be connected to a chain or ring. The material used to make the key holder are depending on the customer needs. The material that are frequently used are glass, wood and stainless steel.

The ring used for the key holder are the most important part as it is the useful part of the key chain. The purpose of the ring is to hold the key and the key holder in one ring depending on the user needs. There are various type of ring shape and size at the market but

the common ring type used is split ring. The split ring is a helical shape ring that formed via forming and bending process. It have two ends which is used to hold the key by creating an opening to the one end and insert the ring end into the holes of the key and slide it all the way to the other end. Some of the key holder came with ring and chain and some with ring but without chain. The ring and chain are usually made of steel wire that have high tensile strength to retain the ring shape.

1.3 PROBLEM STATEMENT

The revolution age had introduce the world with machine and technologies that will help us to complete the task with ease and accurate. These machine were programmed to perform the task by mimicking the human ways to do that certain work by using the experience had by us when doing the task. Since the chipset was developed, the technologies become much reliable and efficient when doing a certain task. Hence, the automated machine was introduce where we can simply let the machine to do the task for us.

The process of inserting the chain or ring into the key holder always been made by manually by people. This is because the key holder and the ring are made separately. Hence, to make a complete key chain that have all the parts which is a key holder and a ring, we need to assemble it by hand. Since the ring is small and need some bending process just to assemble the key holder, it will developed some fatique and stress to the human hand and eyes due to making too much assembly. It is like putting a thread onto a needle where we need to be extra focus during the assembly process to make the product last longer.

The process of inserting the split ring to the key holder also creates problems to some people that have health problems. Since the split ring usually used by creates some gap between the split ring by using the nails before inserting the key holder. Hence people with

nail problems will have some issue to split the ring as it will create some force to the nails. Same with people that have arthritis which is a hand joint problem. They will have difficulties to do these simple task as it they need to hold the split ring and key holder with some force to do the assembly process.

1.4 OBJECTIVES

The objectives of the project are:

i. To design portable automated machine that can insert ring or chain to the key holder
ii. To make a simple and easy to use machine
iii. To make a simulation of the product

1.5 PROJECT SCOPE

The project scope of this project is to make a automated machine that can insert a metal wire into the holes of the key holder and form the wire into a ring shape by using bending process. The process should form the ring perfectly to ensure perfect seal to the key holder and the split ring.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will highlight the literature review which taken from related topic from the title of the project. The material for the literature review consist of journal, article and video related to the project which is the results of previous research of other people. The related topic that been selected as the literature review of this project are the automated machine concepts, the ring material properties and forming process and the machine available in industry that relate to the project.

2.2 AUTOMATED MACHINE

The Oxford dictionary have state that automatic words means a devices that can work without of little human control [1]. While machine is defined by Oxford dictionary as a sets of apparatus that work by using mechanical power which every parts have its own function in order to do a given task [2]. Hence, an automated machine is a sets of components that have

individual function which is needed to perform a task without or little human interference. The device will took over the human work function which will allow the machine to be done a several task with the minimum human intervention [3]. The automated system will allow only few people to operate it. The advantages of this automated machine is they will be able to do task continuously and can perform the task well even in hazardous environment [4]. This is due to the fact that human body is prone to injuries and fatigue. While the machine are much durable and sophisticated when doing the task.

2.3 RING MATERIAL PROPERTIES AND FROMING PROCESS

The ring used for the key holder is usually comes from jewelry crafting wire. It has several properties such as shiny surface, resistance to rust, tough, corrosion resistance and ductile material. These properties allow the material to be used for a long time while retain its properties. The material need to be able to held its shape but it need to be easily bended to the desire form [4]. The material that usually used to make the ring are stainless steel and copper alloy such as brass and bronze. The ring are formed using bending process which is a process that applied a constant force and pressure to the straight wire to bend and make a ring shape by deforming the ductile material and adding some residue force to the ring. This residue force will remain inside the ring and it keeps the ring shape until some greater force is applied to it.

2.4 THE MACHINES AVAILABLE IN THE INDUSTRY THAT RELATED TO THE PROJECT

There are several machines that have been made and useful to be study in order to obtain suitable method for the project. The first machine is a key ring assembly machine which is used a semi-automatic machine to insert the split ring into a key holder and another

split ring [5]. This machine mimicking the human hands which uses rotational force to the split ring by using motor and it begins to rotate as soon as the split ring is opened by the machine.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This chapter will show the methodology which involved in the project. The parameter of the project need to be determine before doing the any design of the project. The mechanical design of the project will be present and every component need to be design to meet the desired action in order to finish the task. The electrical circuit design also need to be done to show the connection between the electrical component and mechanical part to create some mechanical movement via conversion of electrical energy to the mechanical motion. The flowchart of the program will explain how the project works and a step-by-step procedure of the project will be shown.

3.2 PROJECT PARAMETER

The first parameter is to determine the specific length of wire needed to be calculated. Hence, these straight wire can be cut at the desired length and it can form the ring shape

perfectly. The suitable length of wire will be calculated by using the circumference formula of the outer diameter of the ring that will be formed. The formula of the circumference of a circle is shown in (E.q 3.1)

$$C = 2\pi r \tag{3.1}$$

Hence, straight wire can be bend to form a perfect ring shape as shown in Figure 3.1

Figure 3.1: The shape of ring after wire are bended

Source: http://www.smalley.com/custom-parts/ring-options

3.3 MECHANICAL DESIGN

The mechanical design of the project will be illustrate in Figure 3.2

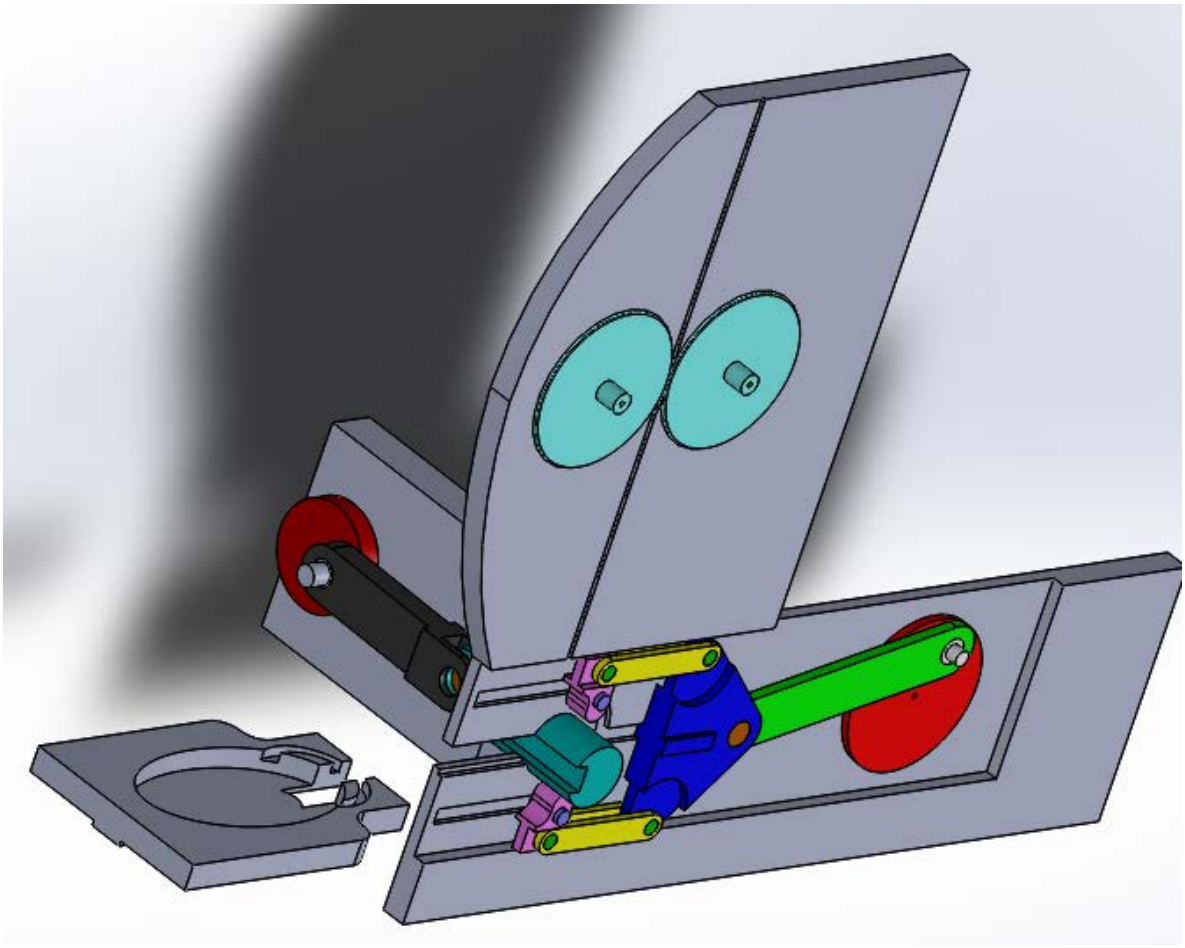

Figure 3.2: The mechanical design of the project

3.4 MECHANICAL PART SCHEMATIC DIAGRAM

This mechanical part schematic diagram will illustrate every unit in the part schematic diagram displayed in scale 1:1 and the unit used is millimeter

3.4.1 BASE

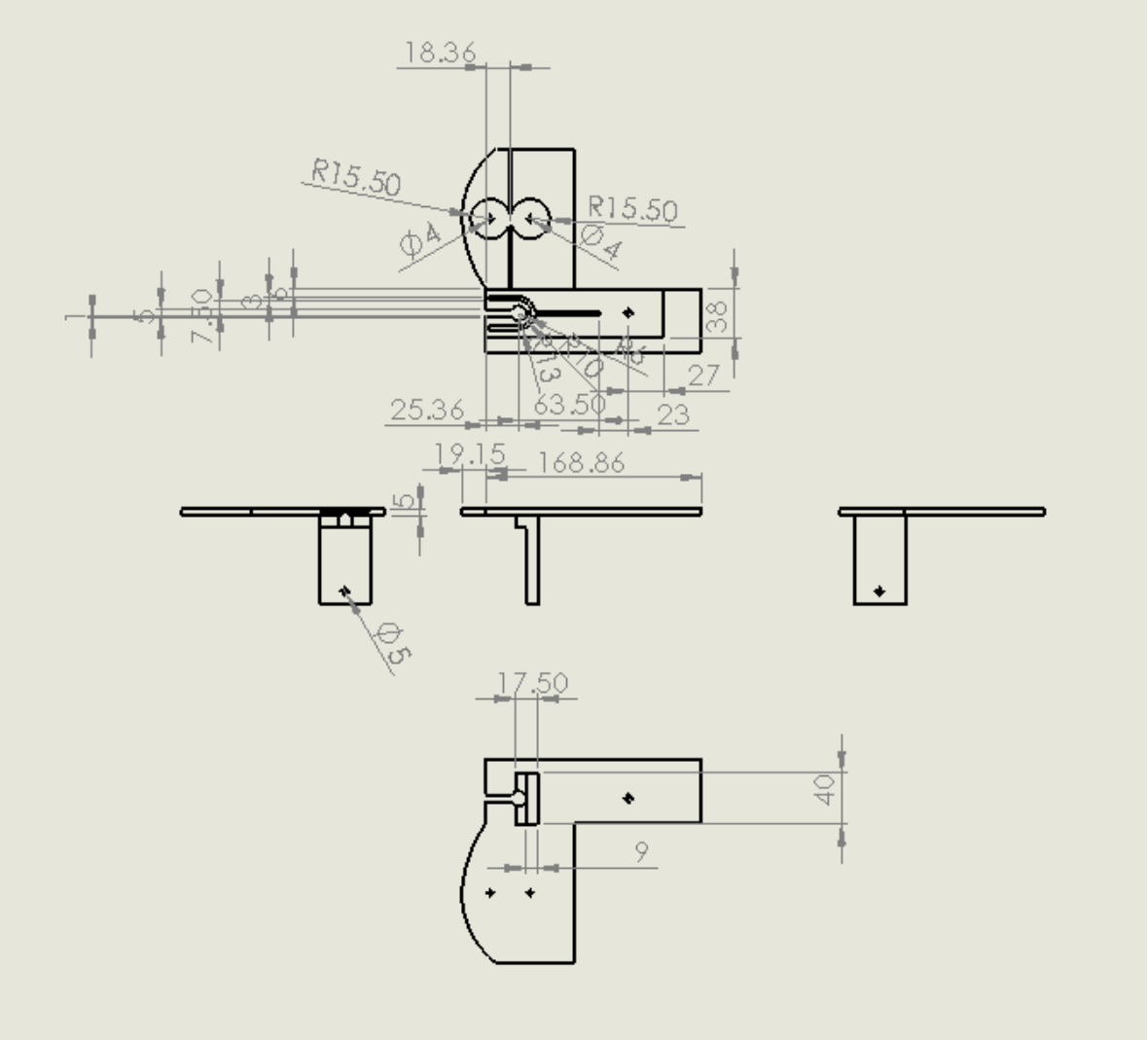

Figure 3.3: The schematic diagram of the base of the project

3.4.2 BENDING SHAFT

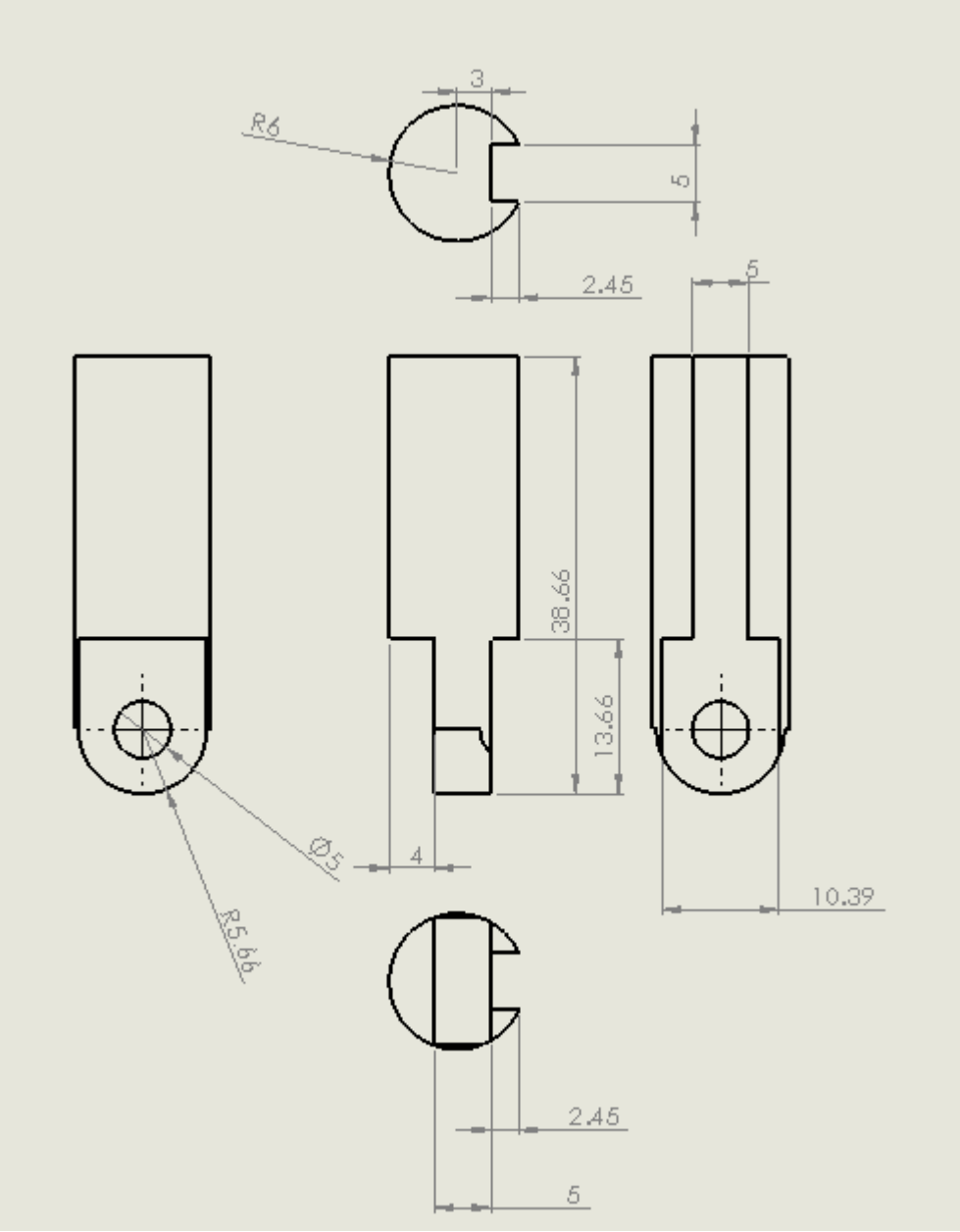

Figure 3.4: The schematic diagram of the bending shaft of the project

3.4.2 CONNECTOR 1

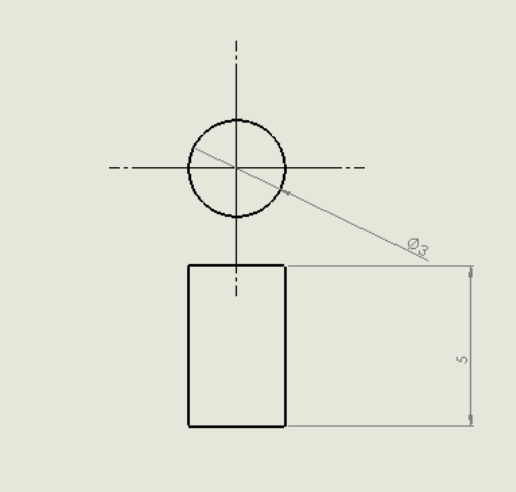

Figure 3.5: The schematic diagram of the connector 1 of the project

3.4.3 CONNECTOR 2

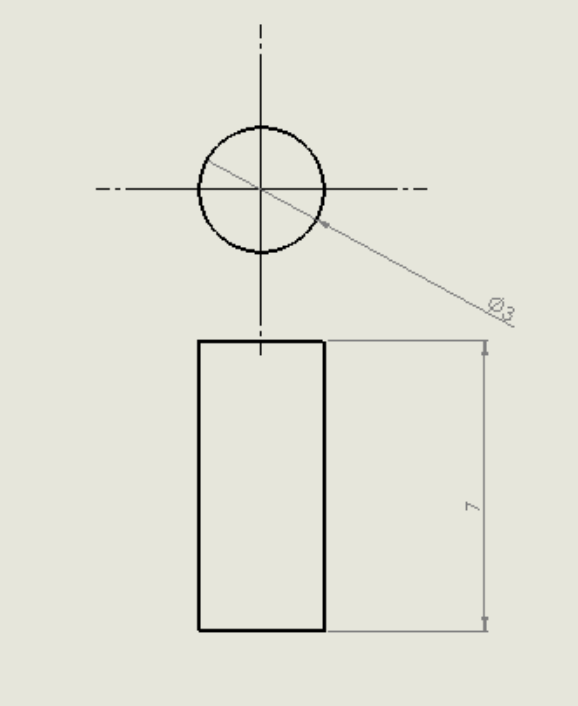

Figure 3.6: The schematic diagram of the connector 2 of the project

3.4.4 CONNECTOR 3

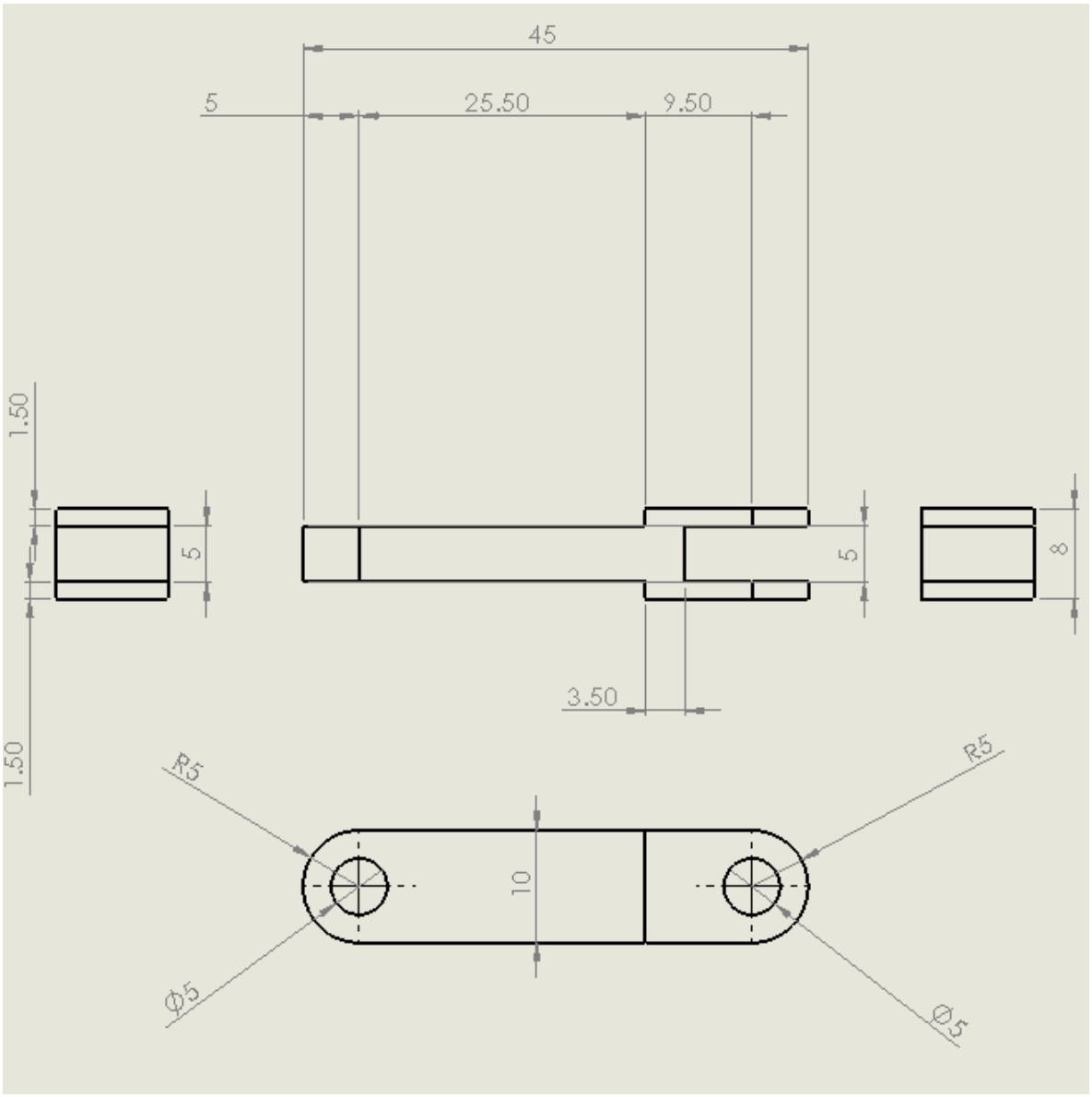

Figure 3.7: The schematic diagram of the connector 3 of the project

3.4.5 CONNECTOR 4

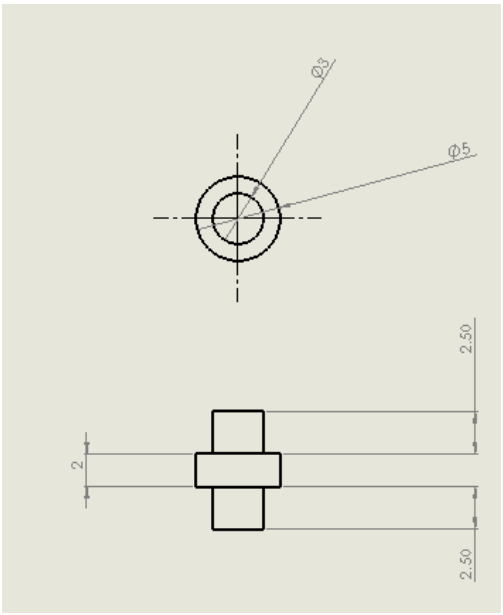

Figure 3.8: The schematic diagram of the connector 4 of the project

3.4.6 CONNECTOR 5

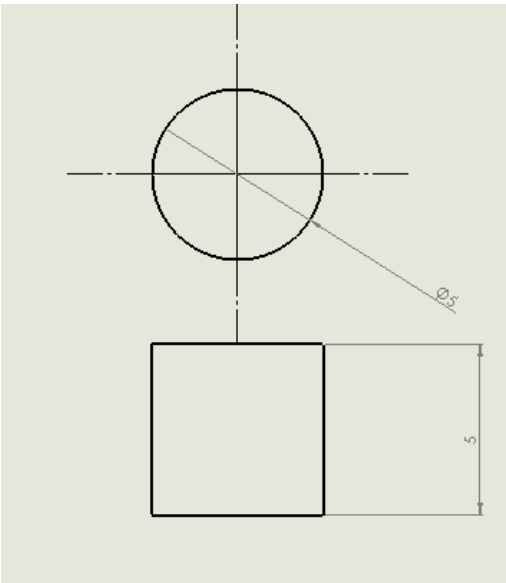

Figure 3.9: The schematic diagram of the connector 5 of the project

3.4.7 BENDING CUTTER

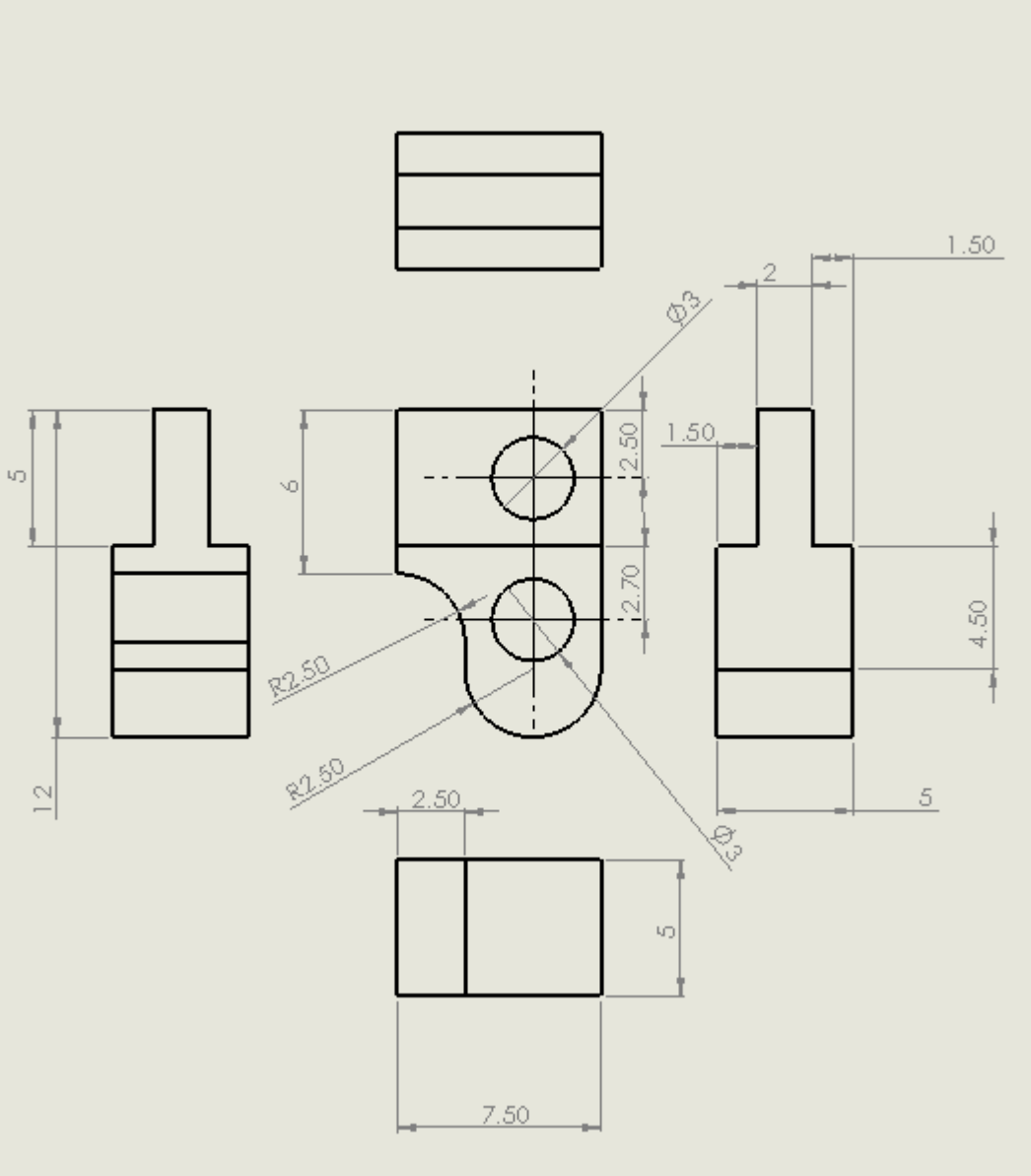

Figure 3.10: The schematic diagram of the bending cutter of the project

3.4.8 CONNECTOR 6

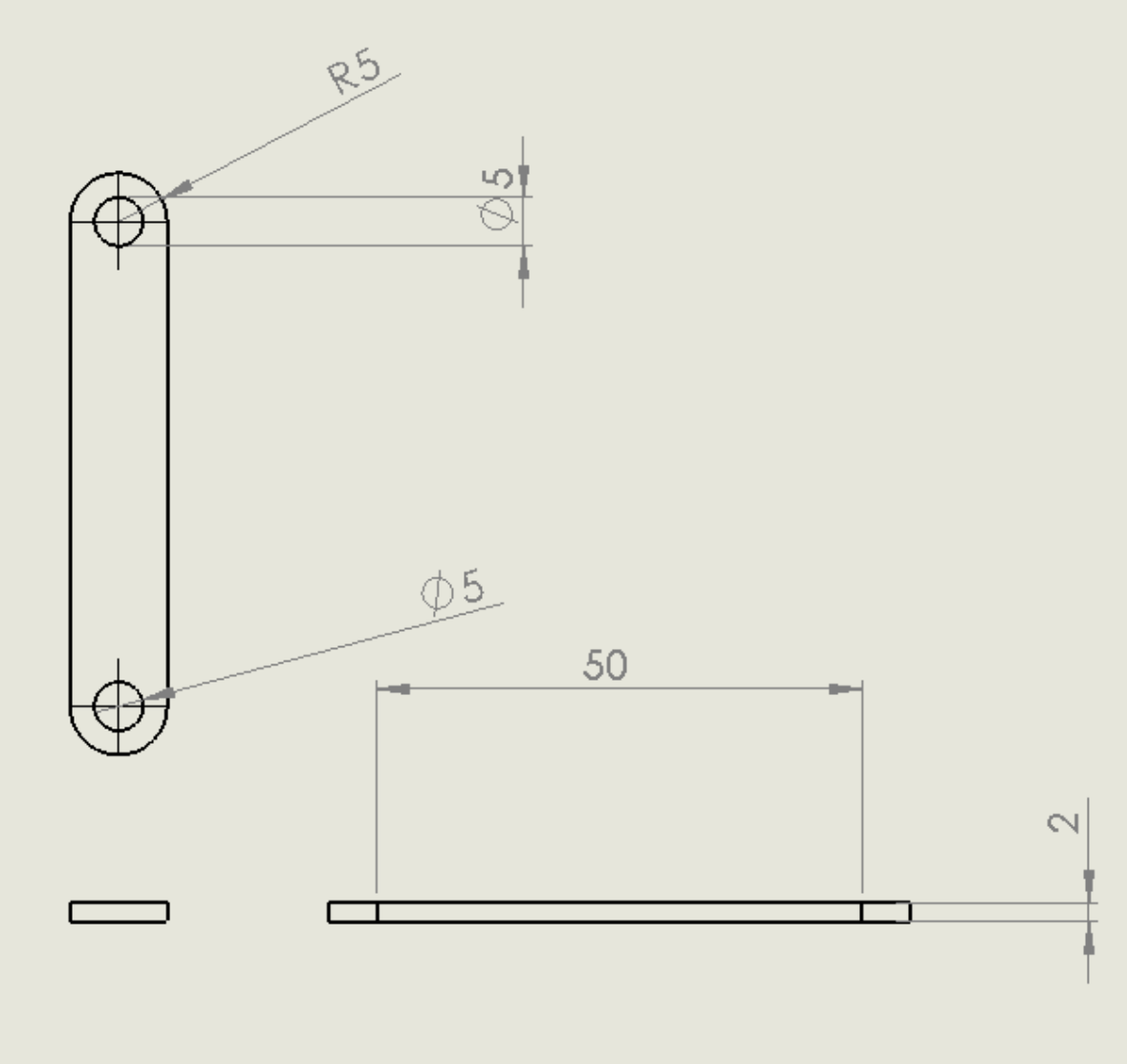

Figure 3.11: The schematic diagram of the connector 6 of the project

3.4.9 CONNECTOR 7

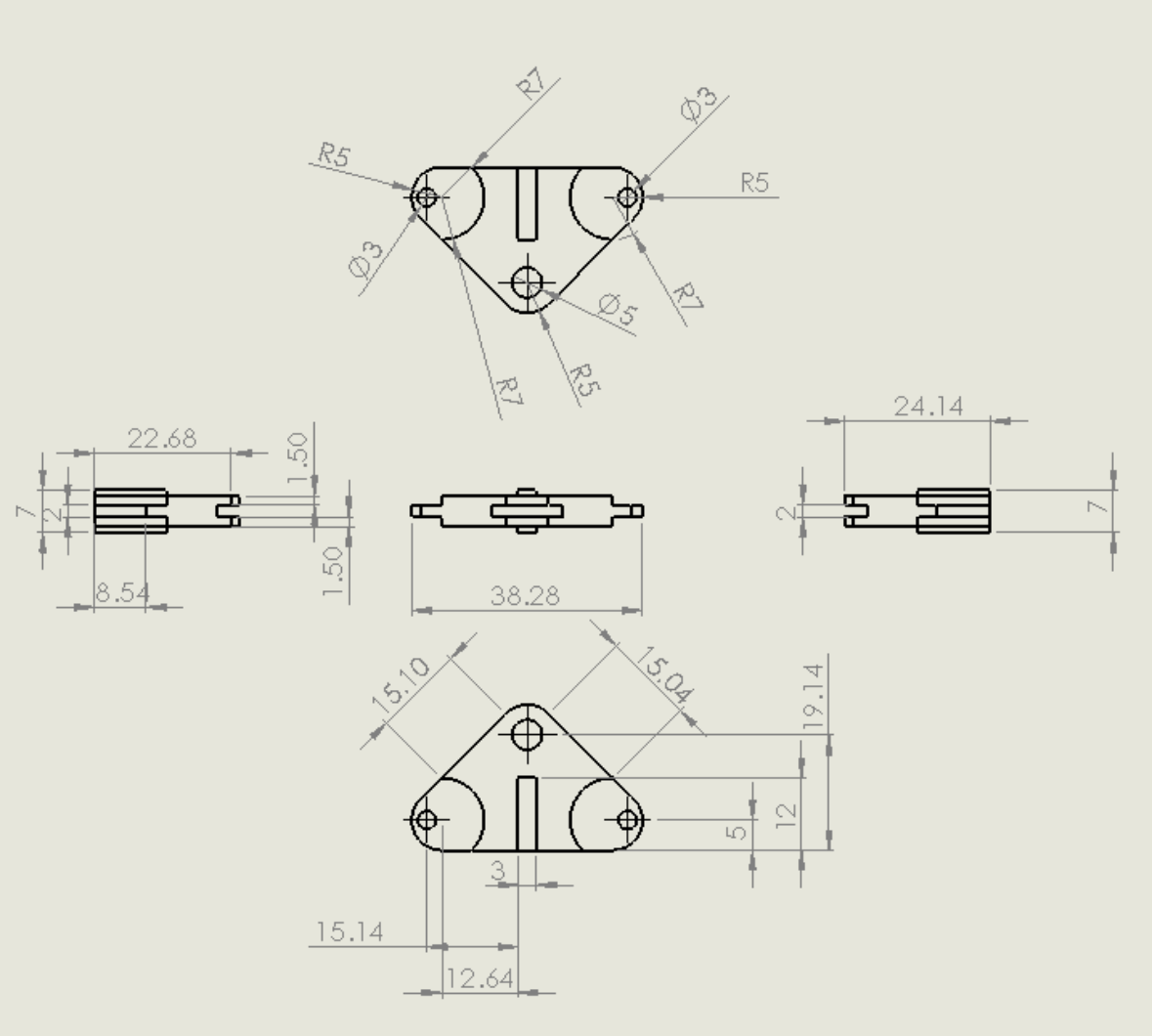

Figure 3.12: The schematic diagram of the connector 7 of the project

3.4.10 CONNECTOR 8

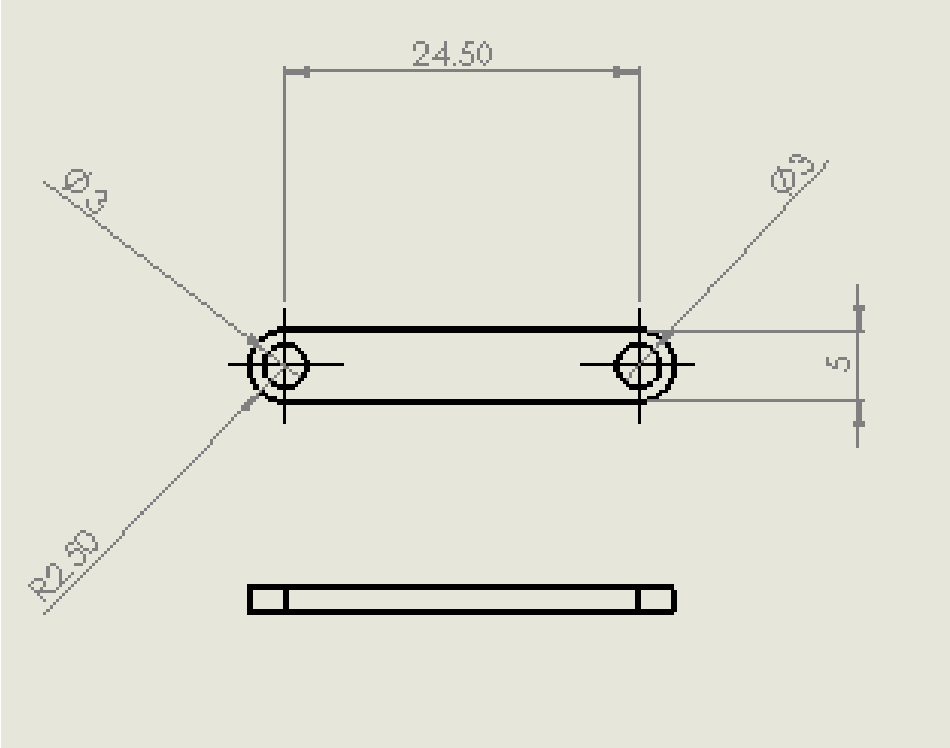

Figure 3.13: The schematic diagram of the connector 8 of the project

3.4.11 ROLLER 1

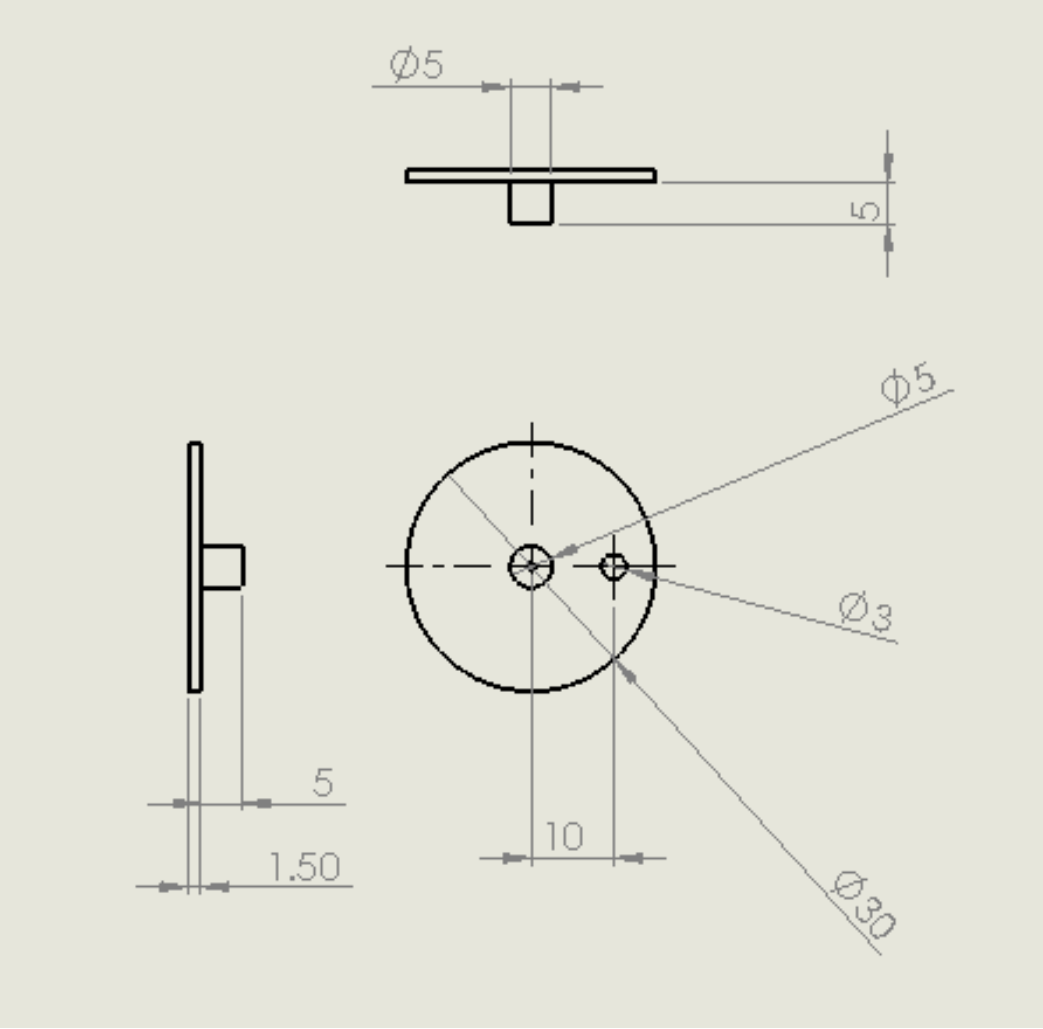

Figure 3.14: The schematic diagram of the roller 1 of the project

3.4.12 ROLLER 2

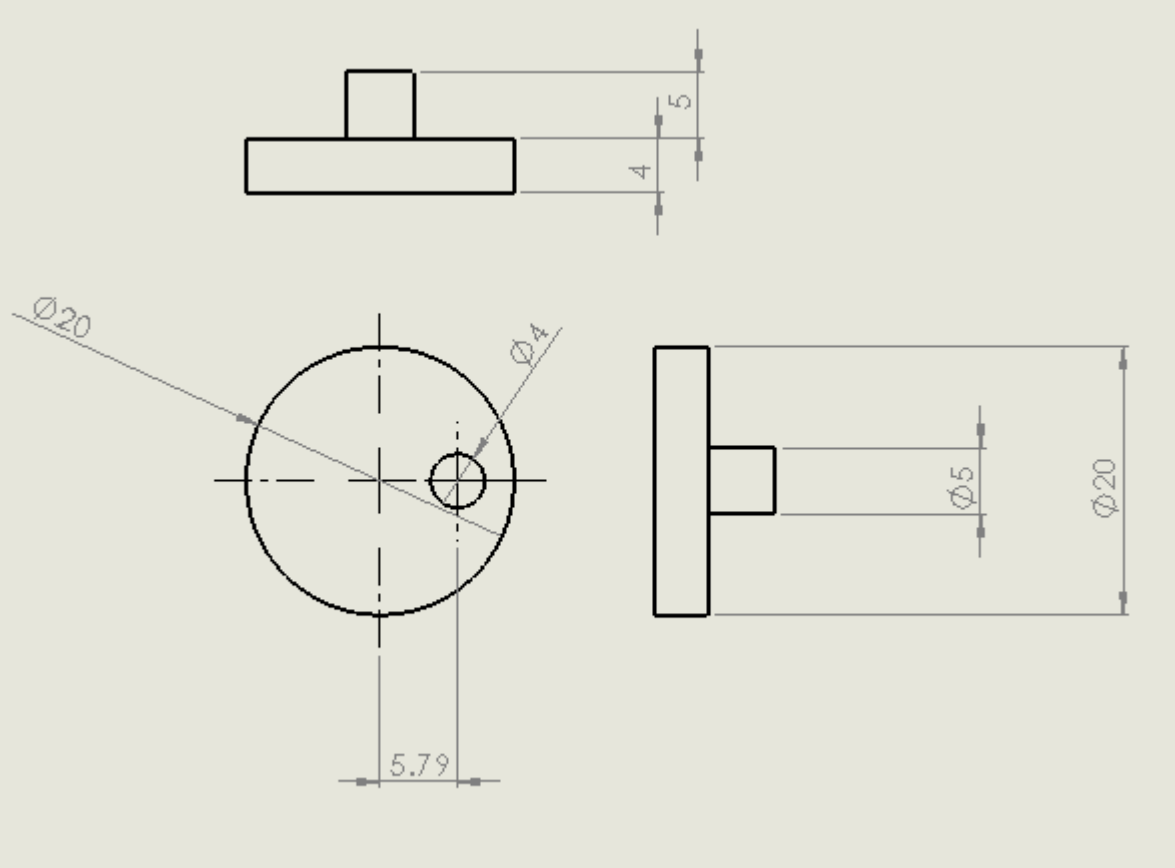

Figure 3.15: The schematic diagram of the roller 2 of the project

3.4.13 ROLLER 3

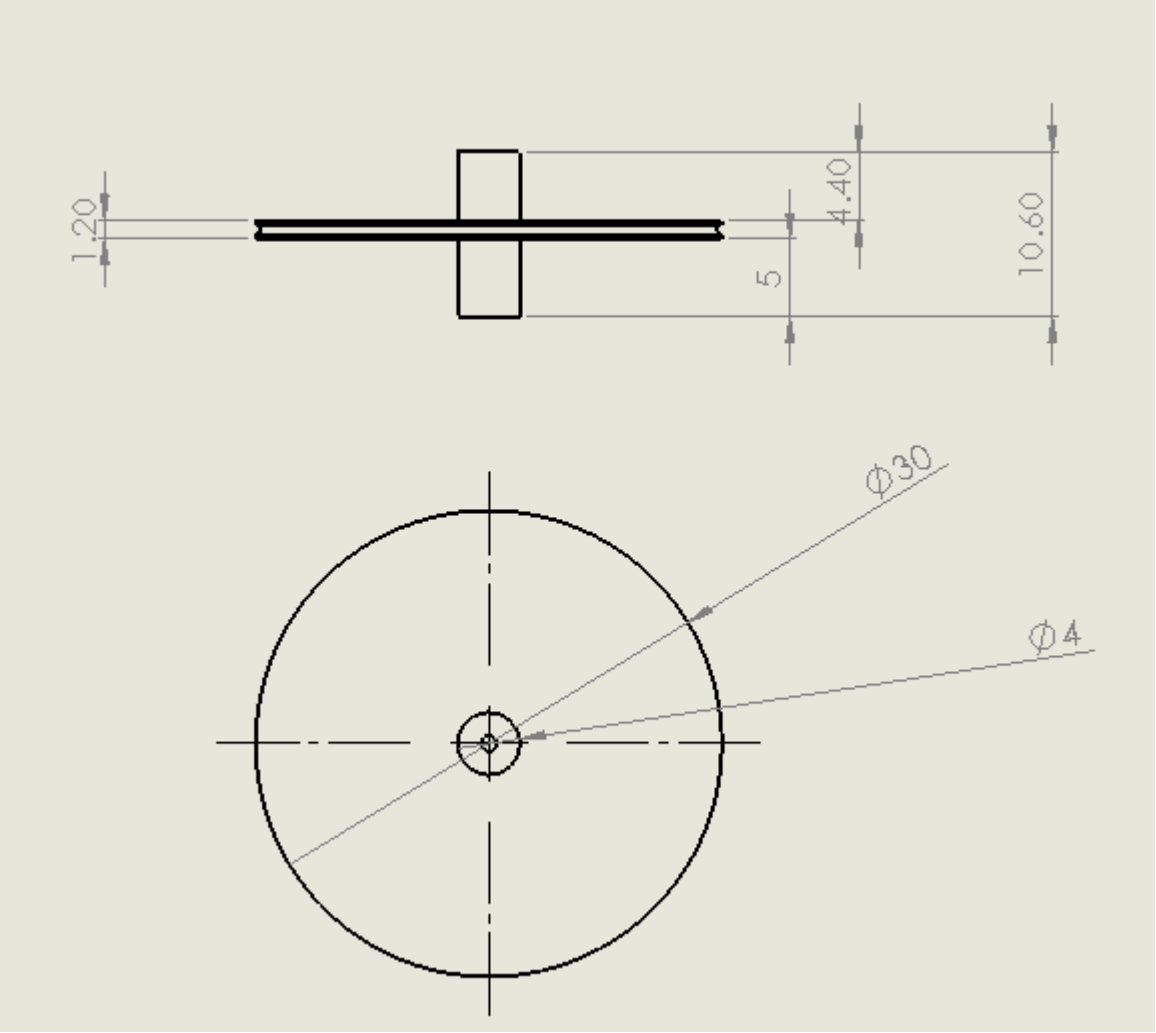

Figure 3.16: The schematic diagram of the roller 3 of the project

3.4.14 CONNECTOR 9

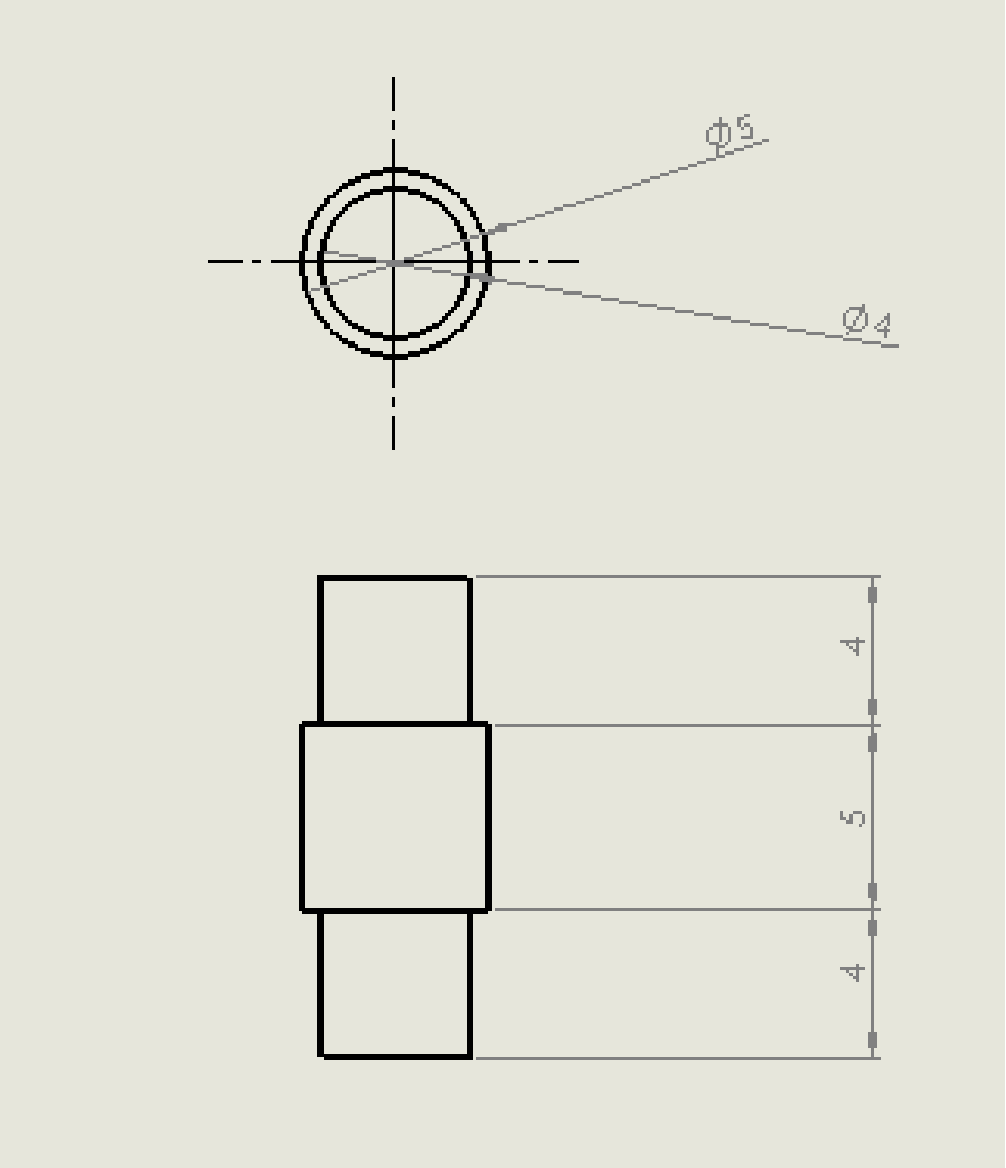

Figure 3.17: The schematic diagram of the connector 9 of the project

3.4.15 KEYHOLER SLOT

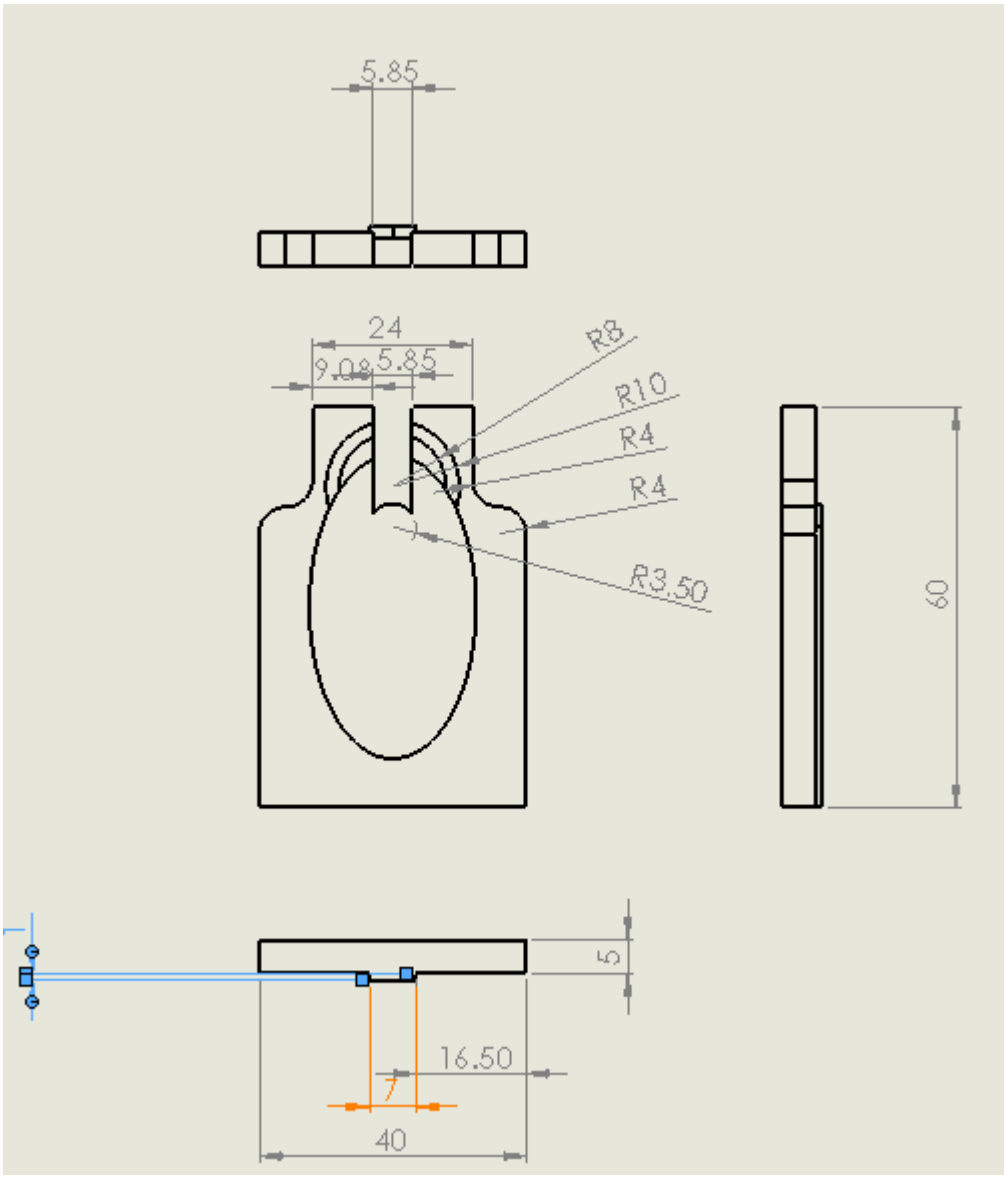

Figure 3.18: The schematic diagram of the keyholder slot of the project

3.5 WORKING PRINCIPLE

There are three method used in the systems which are:

1. The linear wire formation

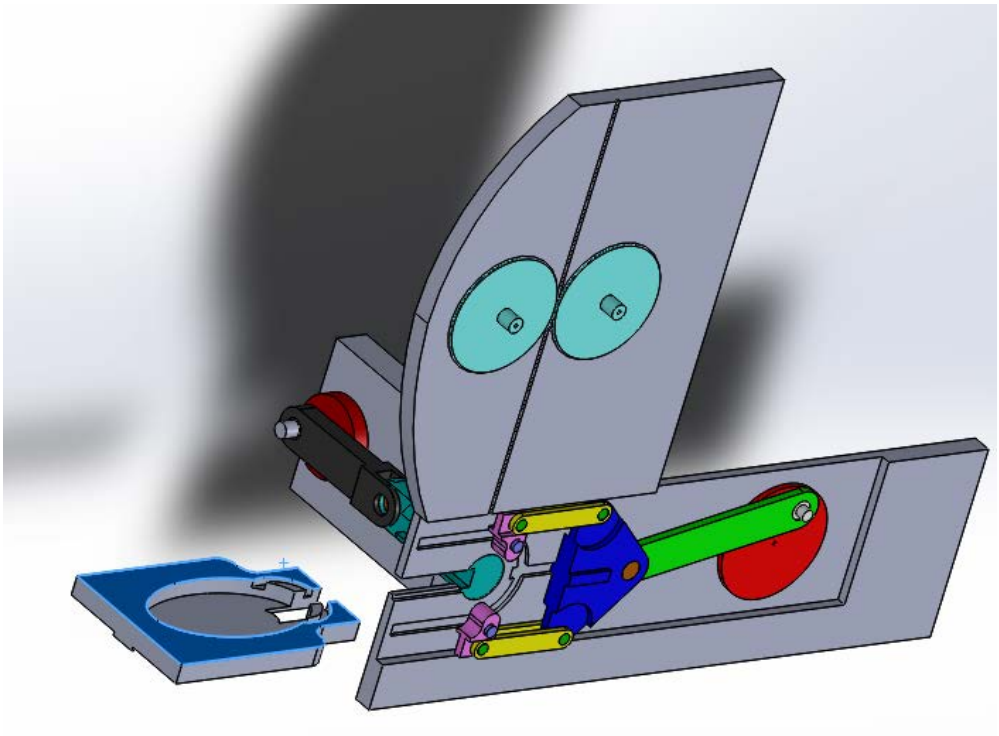

Figure 3.19: Initial condition of the system

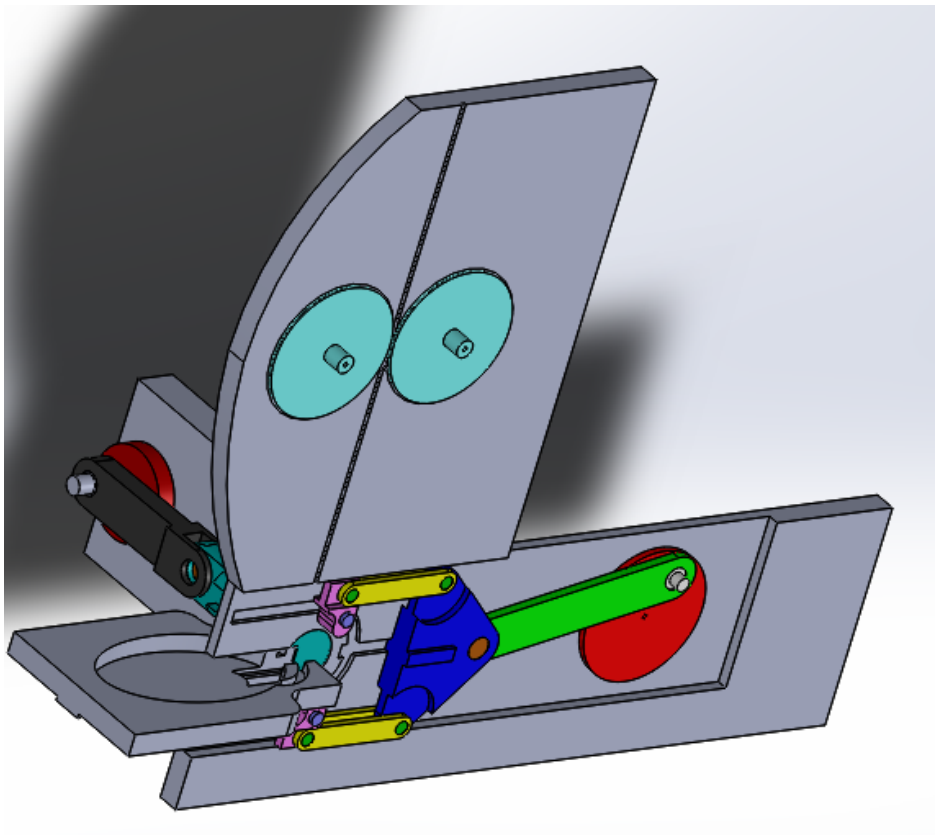

Figure 3.20: the slot insertion to the machine

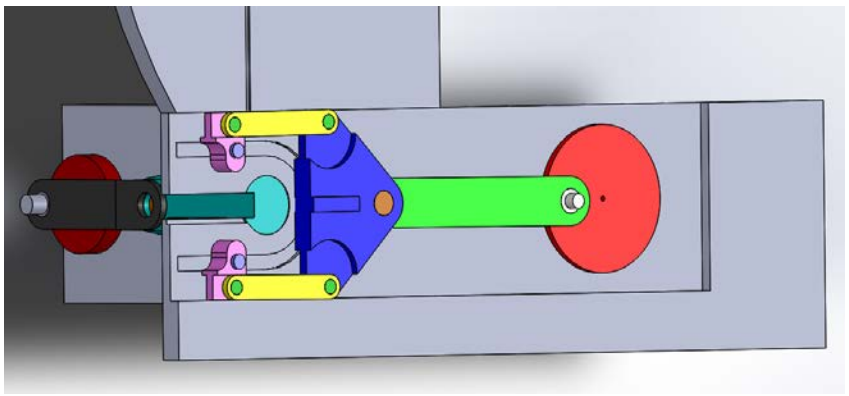

Figure 3.21: the shaft initial position

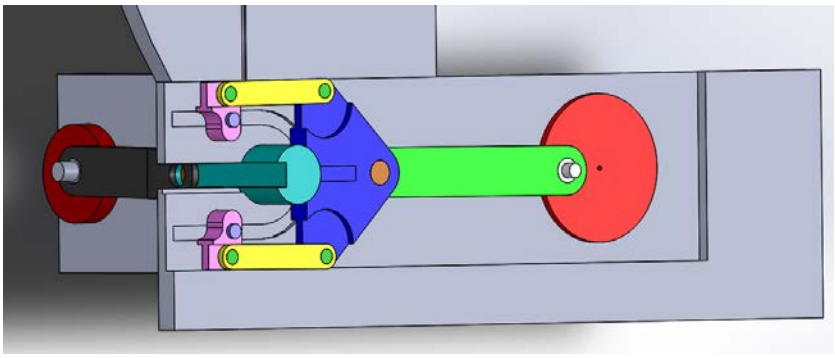

Figure 3.22: the shaft final position

The wire initially stored in a coil which have irregular curves. The end of one wire will enter the wire feeding mechanism which user will manually insert the wire to the passage line of the wire feeding mechanism. As the wire pass through the linear passage, two roller will further eliminate the small curves and set the wire on motion during the whole process. The straight wire produce will ease the process of inserting the wire through the key holder and the split ring later. The straight wire come out at the wire feeding mechanism and pass through the key holder hole and split ring hole until it trigger the sensor. Then the motor will stop the motion of the wire

2. The wire cutting process

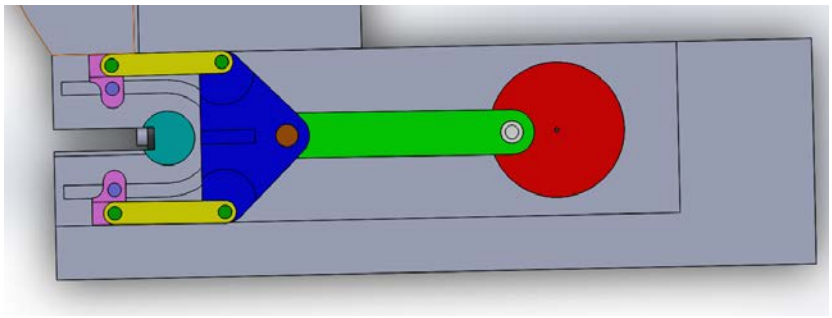

Figure 3.23: the bending arm initial position

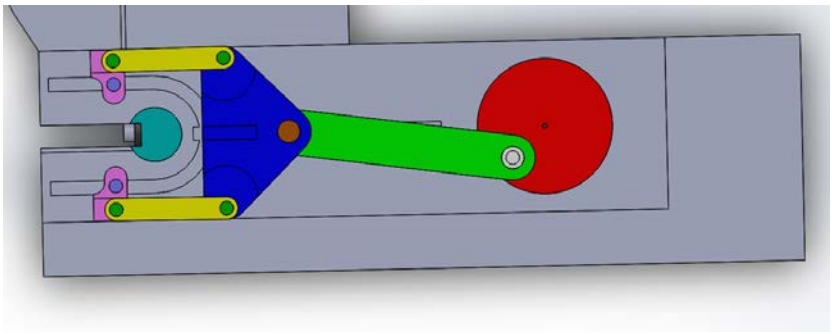

Figure 3.24: the cutting of wire process

The cutting process will begin at the end tip of the wire feeding mechanism. The second motor will pull the cutter head perpendicular to the direction of the linear passage and creating shear stress to the wire until the wire snap into two

3. The ring forming process

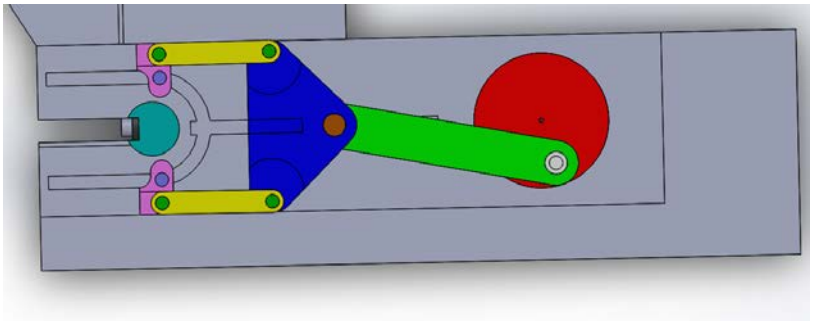

Figure 3.25: the ring formation step 1

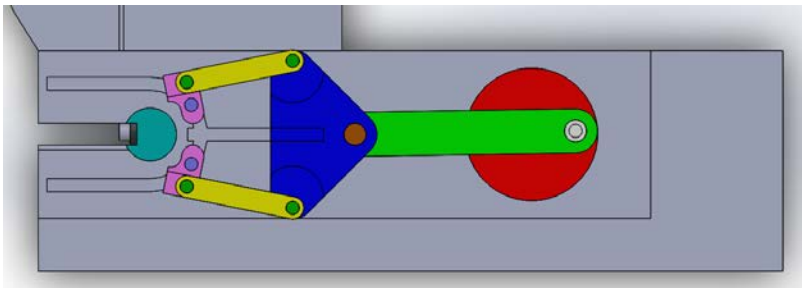

Figure 3.26: the ring formation step 2

The ring is formed from two roller that presses against the wall of the circular rod in the middle. The motor will rotate and move the bending roller backward and forward until it complete one cycle and trigger the sensor once again. Then the bending shaft will return to its original position and the user can take the assembled product

3.6 ELECTRICAL DESIGN

The electrical circuit were simulate using Proteus 8 and the result of the circuit configuration are shown in Figure 3.27

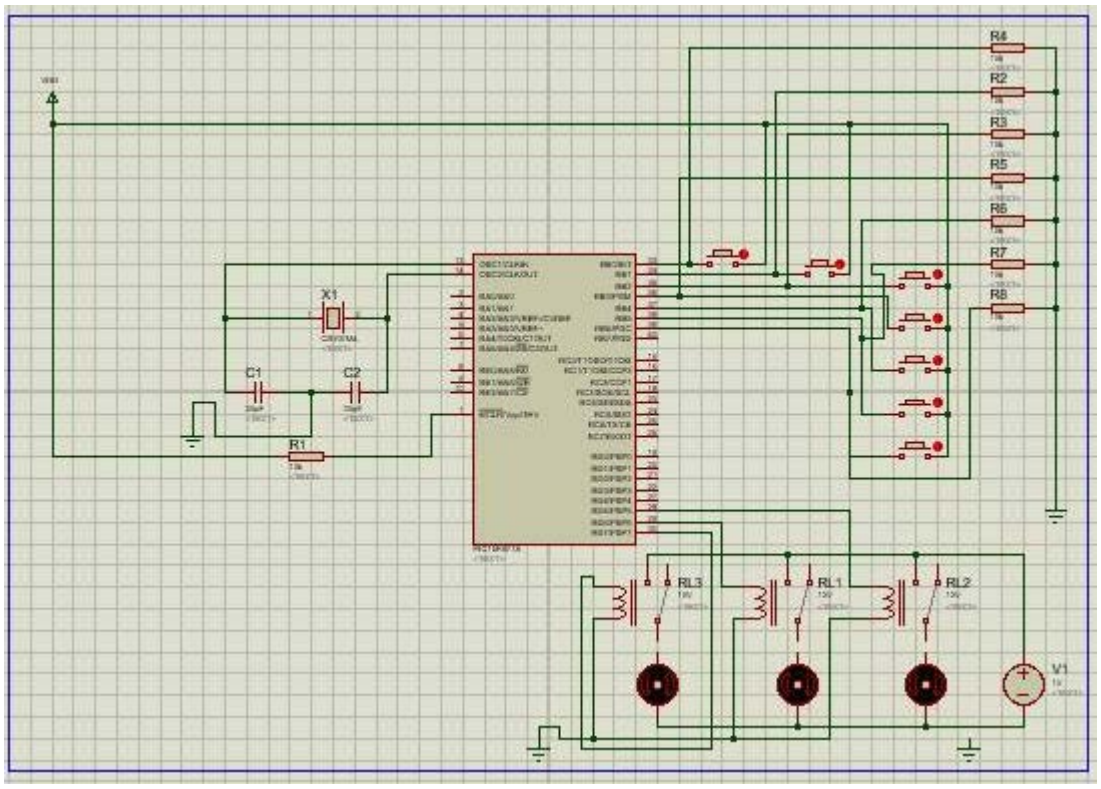

Figure 3.27: Circuit diagram of the project using Proteus

3.7 PROGRAM FLOWCHART

The program flowchart are made to show the sequence of action that will done by the machine to do the task given. The flowchart are shown in Figure 3.28 to Figure 3.30

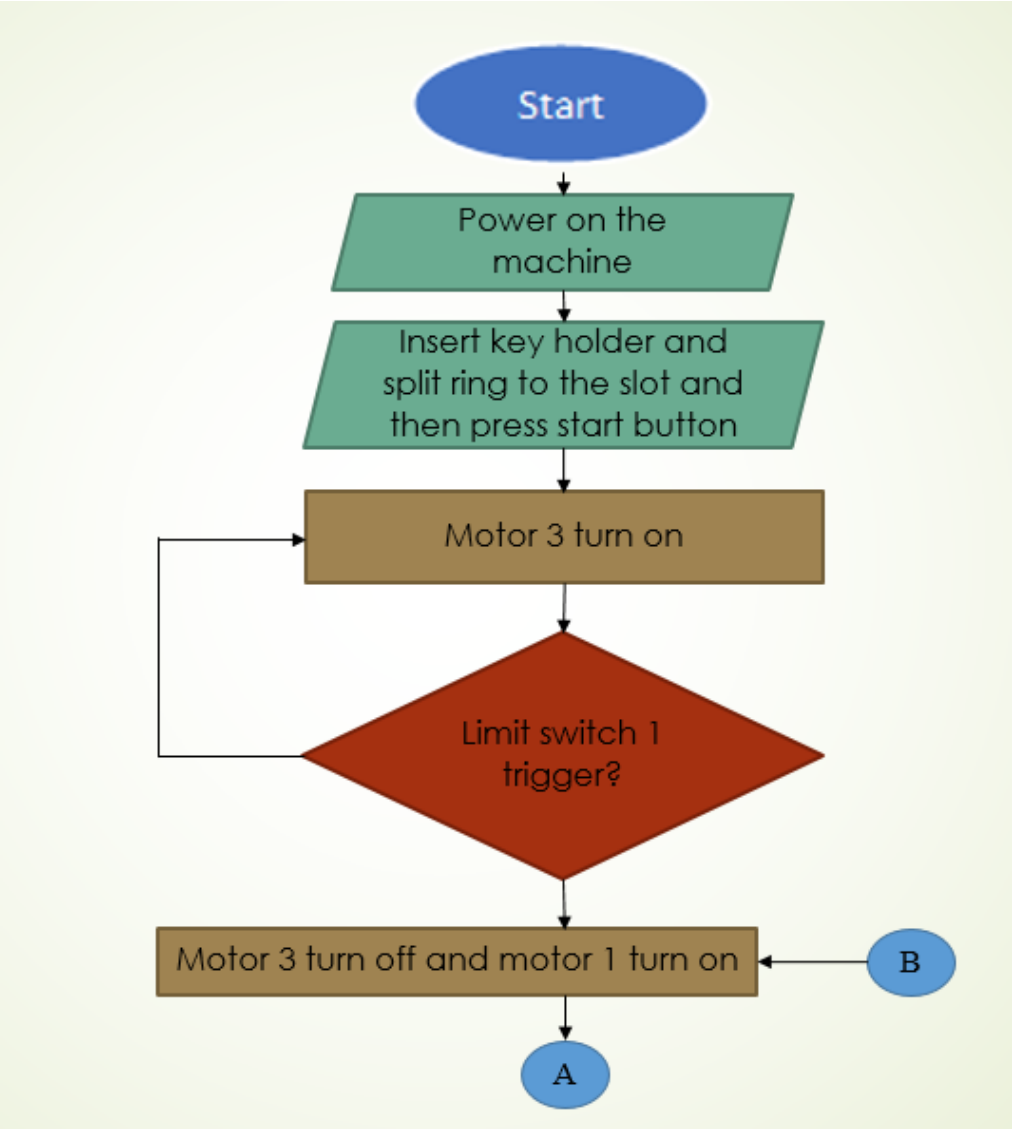

Figure 3.28: the program flowchart of the project

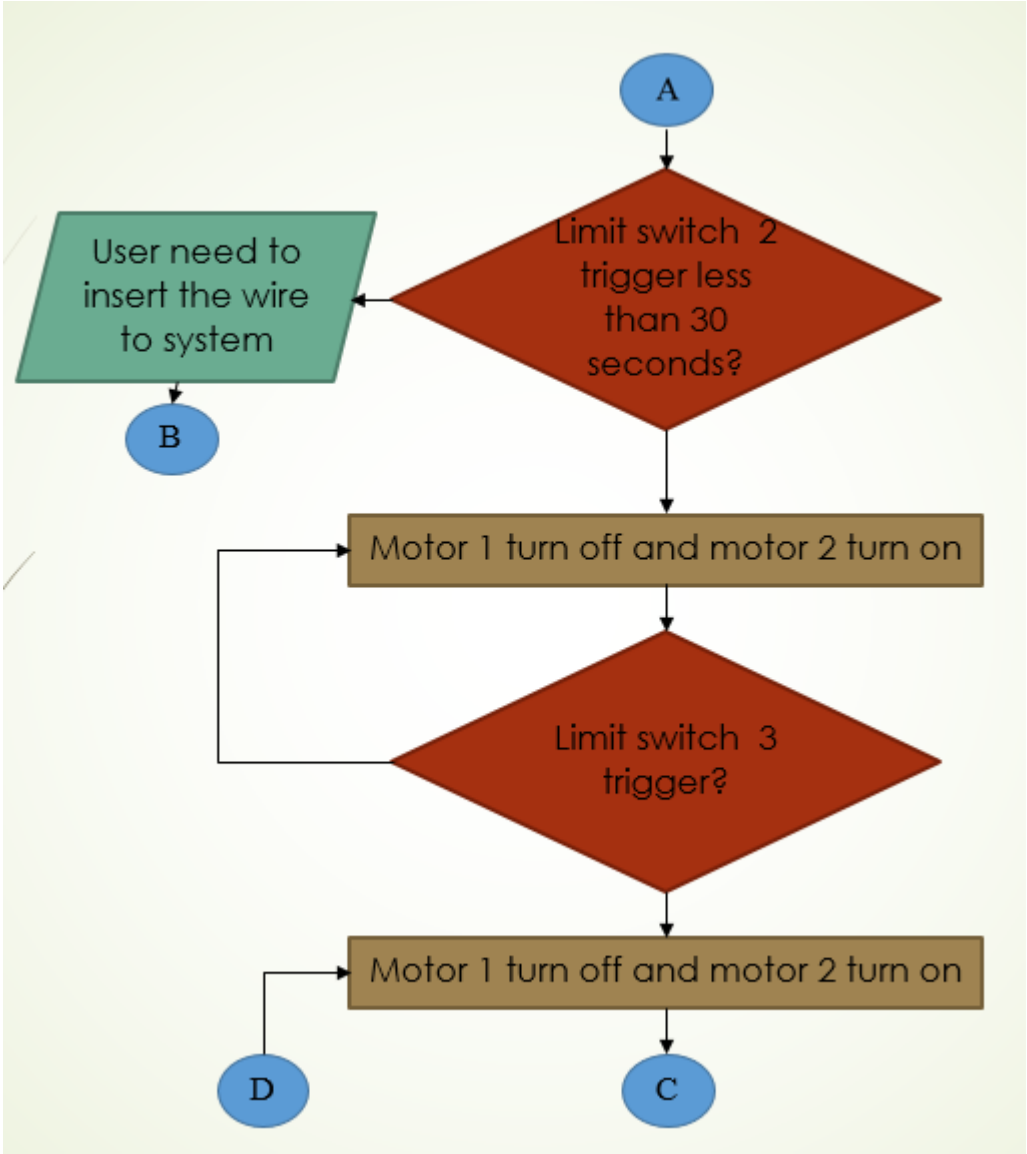

Figure 3.29: The program flowchart of the program (continuation)

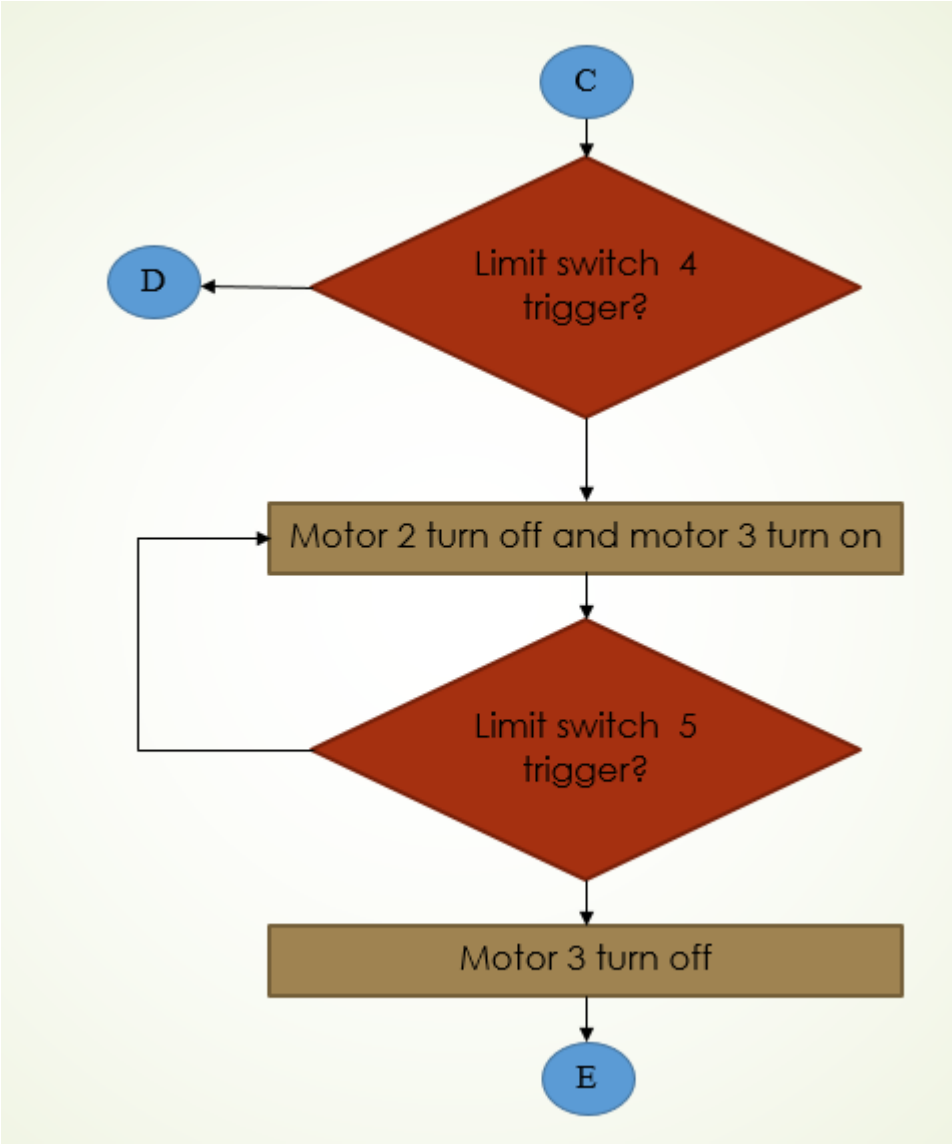

Figure 3.29: The program flowchart of the project (continuation)

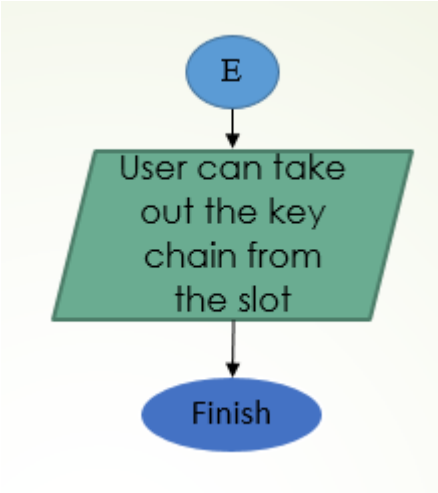

Figure 3.30: The program flowchart of the project (continuation)

3.8 GANTT CHART

The gantt chart of the project is used to show the progress of the project. This gantt chart will be shown in the table 3.1

Table 3.1 are showing the gantt chart of Final Year Project 1

No	Final Year Project Progress	Week													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Meet and get title briefing from SV														
2	Literature review														
3	Prototype design sketch														
4	Methodology														
5	Prototype design using software														
	Making draft														
6	Presentation														
7	Submit draft														
	Making report														
8	Submit report														

Table 3.2 are showing the gantt chart of Final Year Project 2

No	Final Year Project Progress	Week													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Meet and get briefing from SV														
2	Secure the material														
3	Machining mechanical parts														
4	Electrical and coding parts														
5	Assembly the prototype														
6	Testing the prototype														
7	Implement improvement														
8	Presentation														
9	Submit draft														
10	Making report														
11	Submit report														

3.9 BUDGET PLAN

The budget plan of the project will determine the product cost. In this budget plan, every raw material will be shown in the table 3.3.

Table 3.3 are showing the raw material with its estimation price

No	Material	Quantity	Price per unit(RM)	Total (RM)	Source
1	40 pins PIC start-up kit combo 1	1	62.43	62.43	http://www.cytron.com.my/p-sk40-c1
2	SPDT relay SRD 5V	4	2.12	8.48	http://www.cytron.com.my/p-re-so-srd-05
3	DC Geared Motor SPG30-300K	3	53.53	160.59	http://www.cytron.com.my/p-spg30-300k
4	Steel sheet plate (380mm X 300mm X 5mm)	1	86.88	86.88	http://www.ebay.com.au/itm/STEEL-SHEET-PLATE-380mm-X-300mm-X-5mm-/121717063708
5	Artistic Wire 20-Gauge Antique Brass, 15-Yards	1	21.84	21.84	http://www.amazon.com/Artistic-20-Gauge-Antique-Brass-15-Yards
6	Cardboard Box (cover)	1	0.5	0.5	http://www.uline.com/Product/Detail/S-7358/Corrugated-Boxes-200-Test/12-1-

					2-x-3-x-17-1-2-Easy-Seal-Side-Loader-Corrugated-Boxes
7	Limit switch	5	1.06	5.30	http://www.cytron.com.my/p-sw-li-kw11-sn
				347.02	

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

This chapter will show the result and discussion which involved in the project. The actual machining parts of the project will be shown. The mechanical design of the project will be present and every component need to be design to meet the desired action in order to finish the task. The electrical circuit with coding embedded to the PIC also be shown the connection between the electrical component and mechanical part to create some mechanical movement via conversion of electrical energy to the mechanical motion. The result will be the formation of the ring will be discussed.

4.2 THE MACHINED MECHANICAL PARTS

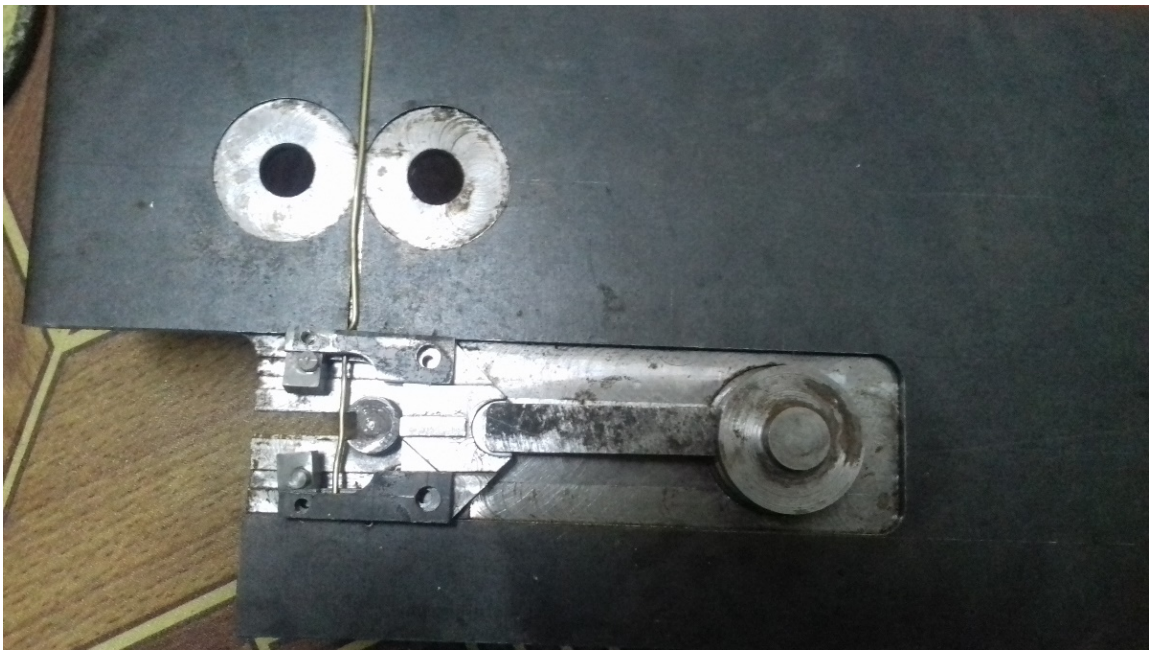

Figure 4.1: The machined mechanical parts of the project

The mechanical parts for this project are made fully manual using milling and lathe machine. There are clear machining pattern due to milling which cause the surface of the machined parts having high roughness as shown in Figure 4.1. The mild steel used are prone to rust. Hence, the use of lubricant is needed to avoid the parts from rusting and it also helps to make the part movement smoother.

4.3 THE ELECTRICAL CIRCUITS AND ITS POSITION ON THE MECHANICAL PARTS

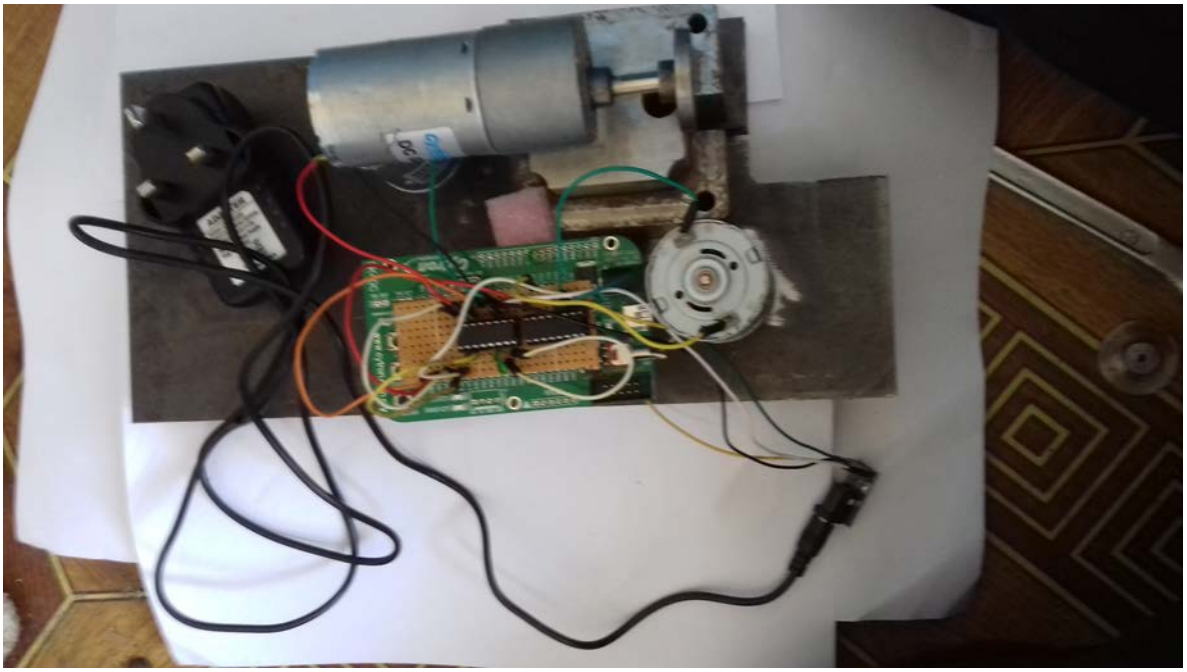

Figure 4.2: The electrical circuits and its position on the mechanical parts of the project

There are three geared motor used and assembled outside of the base part. The motor are powered by two motor driver L293D which can give the output of 12 volt to each of the DC geared motor.

4.4 THE RING FORMATION

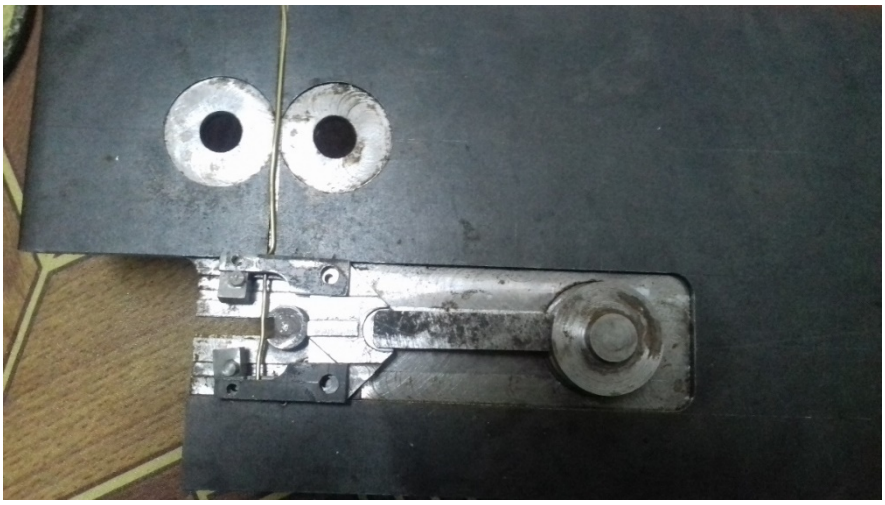

Figure 4.3: The ring formation before the bending process start

Figure 4.4: The ring forming after the bending process

Figure 4.5: The machined mechanical parts of the project

The ring formed does not closed properly since it have stored some residual stress which makes the ring to retract a bit and creates a gap to the ring as shown as Figure 4.5. The solution for the is to increase the length of the wire and apply new formula for the ring which is

$$\text{New length} = 2\pi(r+d)$$

r = radius of the bending rod

d = diameter of wire

The new length of the wire will give a full ring shape as shown in Figure 4.6

Figure 4.6: The machined mechanical parts of the project

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

This chapter will show the conclusion and recommendation for the project.

5.2 CONCLUSION

In conclusion, the project did not able to make a full circular ring due to the length of the wire does creates some gap due to the ability of the ring to store some residue energy and retract a bit which causing little opening to occur.

5.3 RECOMMENDATION

There are some recommendation can be applied for the improvement of this project which is to use some light oil or lubricant to enhance the smooth movement of the component in the machine. The lubricant also can prevent the material from wearing faster as it prevent the metal-to-metal contact which can affect the performance of the machine. The machine also can be improve by using thicker 10 millimeter plate for the base make the depth of the pocket 5 millimeter. This can improve the machine by making the smaller working parts thicker and reduce the parts failure due to over stresses which can cause bending to occur.

REFFERENCES

This thesis is prepared based on the following references;

Automatic. Oxford Dictionaries Language matters. Retrieved date = 30th November 2015.

Retrieved from = http://www.oxforddictionaries.com/definition/english/automatic

Machine. Oxford Dictionaries Language matters. Retrieved date = 30th November 2015.

Retrieved from = http://www.oxforddictionaries.com/definition/english/machine

Jordan, Nehemiah. Allocation of functions between man and machines in automated systems. Journal of Applied Psychology, Vol 47(3), Jun 1963, 161-165. http://dx.doi.org/10.1037/h0043729

The Benefit of Stainless Steel for Jewelry Design. Jewelry Making Article.

Retrieved Date = 29th November 2015. Retrieved From = http://www.firemountaingems.com/resources/jewelry-making-articles/c544

Key Ring Assembly Machine. Worth Split and Key Rings.

Retrieved Date = 15th August 2015. Retrieved From = http://webcache.googleusercontent.com/search?q=cache:sdpn8372j0wJ:rings.worthco.com/products/assembly-machines+&cd=3&hl=en&ct=clnk

LIST OF SYMBOLS

π	Pi
r	Radius
d	Diameter

LIST OF ABBREVIATIONS