

BORANG PENGESAHAN STATUS TESIS

JUDUL: DEVELOPMENT OF AUTOMATIC GATE OPENER MECHANISM

SESI PENGAJIAN: 2007/2008

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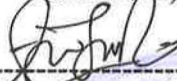
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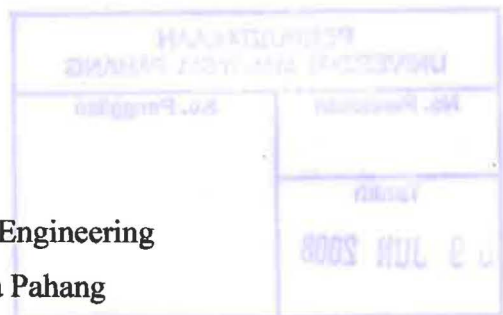
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DEVELOPMENT OF AUTOMATIC GATE OPENER MECHANISM

MOHD TARMIZI BIN ABD AZIZ

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

Faculty of Mechanical Engineering
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NOVEMBER 2007

SUPERVISOR'S DECLARATION

I hereby declare that I have read this project report and in my opinion, this project report is sufficient in terms of scope and quality for the award of the Diploma of Mechanical Engineering.

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DECLARATION

I declare that this report entitled "Development of Automatic Gate Opener". This result is my own research except as cited in the references. This thesis has not been accepted for any diploma and is not concurrently submitted in candidature of any other diploma or degree.

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DEDICATION

To my beloved parents, Abd Aziz bin Othman and Horhafidah binti Sauman, family and friends, without whom and his/her lifetime efforts, my pursuit of higher education would not have been possible and I would not have the chance to study for a mechanical course. Especially also to my supervisor, Mohd Fadzil Faisae bin Ab Rashid and Mechanical Staff, without whose wise suggestions, helpful guidance and direct assistance, it could have neither got off the ground nor even been completed. Thanks a lot to my university and my friends in their support and advice towards this project. Thanks to all for your enduring patience and continuous encouragement.

ACKNOWLEDGEMENTS

I would like to express my gratitude and appreciation to all those who gave me the possibility to complete this report. I am very grateful to my supervisor Mohd Fadzil Faisae b Ab Rashid for his patience and supporting for guide me finishes this project. I would also like to acknowledge to all staff in Mechanical Laboratory, that gave me permission to use all the necessary tools in the laboratory and shows me how to operate the machines.

Special thanks to my fellow undergraduate student that have give me help, support and ideas for my project. Finally, I thank my family for their continues support and confidence in my efforts.

ABSTRACT

This project presents mechanisms of automatic gate opener swing operator. The objectives of this project are to design automatic gate opener mechanisms, fabricate and assemble gate opener components. Mild steel and galvanizes iron were used as material in this project. The structural three-dimensional solid modeling of mechanisms automatic gate opener was developed using the solidworks drawing software. The arms that mount to the gate were fabricated using metal inert gas welding. The box for store the motor was fabricated using turret punch machine and bending machine. Result for the first test is the gate not move because the output power that need to push or pull the gate not enough. Result for the second test is the gate can move because the gate is lighter than the first one. The automatic gate opener can be added with remote control system. Therefore, the gate can be opened from more distance.

ABSTRAK

Projek ini menerangkan mekanisma pembuka pintu pagar automatik yang beroperasi secara ayunan. Objektif projek ini adalah untuk mereka mekanisma pembuka pintu pagar automatik, menghasilkan dan memasang komponen pintu pagar. Keluli lembut dan besi bergalvani telah digunakan sebagai bahan dalam projek ini. Struktur 3 dimensi mekanisma pembuka pintu pagar automatik telah dihasilkan menggunakan perisian lukisan Solidwork. Mekanisma lengan yang dipasang telah dihasilkan menggunakan kimpalan gas. Kotak untuk menyimpan motor telah dihasilkan menggunakan mesin penebuk dan mesin pembengkok. Keputusan untuk ujian pertama adalah pintu pagar tidak dapat bergerak kerana kuasa untuk menolak dan menarik pintu pagar tidak cukup. Keputusan untuk ujian kedua adalah pintu pagar boleh bergerak kerana pintu pagar ini lebih ringan daripada pintu pagar pertama. Pintu pagar automatik boleh ditambah dengan sistem kawalan jauh. Jadi, pintu pagar boleh dibuka daripada jauh.

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CHAPTER 1

INTRODUCTION

1.1 Project Background

Now days, we can see that many of people in big city use the automatic gate system at their home. This is happen when they are often to use transport like car to work. To open or close the gate they need to step out side from the car to open it. It just wastes the time. So, they prefer to the automatic gate system because it can save their time and energy. They just need to push the remote control while in the car to open the gate. We rarely to see people outside from the city using the automatic gate system at their home. Probably because the cost to install this system is high.

The function of automatic gate opener is to help user open or close the gate automatically using electrical source without manually pull or push the gate.

There are two types of operator. First, the swing operator. This type usually using at home. Second, the slide operator. This one often to use at industry or large building.

The problem that occurred for using this system are the cost and how to install this part to the gate. The cost will include cost of installment and maintenance. The costs are quite expensive. There will be a problem during how to install this system to the gate.

To solve this problem, on this project, there will be design the simple mechanism operating gate opener. It has two arms that mount each other. First arm is

mounting at the motor and the second arm is at gate. When the motor is on the arm will pull or push the gate to open or close. The motor will be store in the box and will install at the pillar of the gate.

1.2 Problem Statement

In this project, it can be concludes that have two main problems. The first problem is the cost. The costs include the cost of installment and maintenances. The second problem is the how the part will install to the gate.

To solve this problem, this project will have the simple mechanism that can save the cost. The part will install at pillar of the gate.

1.3 Project Objectives

This project is base on this two objective:

1. To design gate opener mechanism.
2. To fabricate and assemble gate opener component

1.4 Project Scopes

On this project, it will focus on mechanisms parts of automatic gate opener. It includes the movement and component part of automatic gate opener. It does not include the electronics part of this system. The project is especially for the swing type gate. It also limited for motorizes use only. For this project, there will be two different gate will be tested. The first one located at café Kolej Kediaman 1 and the second one located at entrance of Taman Teknologi dan Inovasi in Universiti Malaysia Pahang.



Figure 1.1: Gate at café Kolej Kediaman 1



Figure 1.2: Gate at entrance of Taman Teknologi dan Inovasi UMP

1.5 Thesis Organization

For chapter 2, it will discuss about the literature review. This chapter will discuss about the reviewing study about the automatic gate opener mechanism.

For chapter 3, it will discuss about the methodology of the project. This chapter will discuss more about the fabrication process of the project. It includes the analysis design, material, and method for fabrication.

For chapter 4, it will discuss about the result and discussion. For this chapter, it will show the details of the result from testing the mechanism of automatic gate opener.

For chapter 5, it will conclude the project, about the conclusion from the project. It also includes the summary from the project and recommendation for future project.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The automatic gate opener mechanism is the system that combined mechanical system and electrical system. The function of mechanical part is to move the gate according the directions that have been set. While, electrical system is to give source energy to move the mechanical part.

The function of automatic gate opener mechanism is to help user open or close the gate without using human energy to pull or push the gate. It functionally automatic to move the gate by switch on the switch.

There are various kind types of automatic gate opener. For example, the swing operator and slide operator. Many of users at home usually use the swing type operation. While, at big industry they using the slide type operation.

2.2 Types of drive system operator

There are two different type of drive system operator for automatic gate opener. First, is using the torque motor. This type is commonly used in market. There can be operated by using electrical source and battery supply 12 V.

Second, is using the belt system. This is the latest technology for safest and more efficient operator. There can be operated by using electrical supply.

2.3 Design of Swing Type Operator

The swing type operator is suitable use at home. It is because it easy to install and time to open or close the gate is faster than slide operator. The cost to install and maintenance are low than slide type operator.

2.3.1 Bottom Mounted Swing Arm

These units have the arm mounted on the bottom. The main advantage to this design is that you do not see an unsightly arm in the middle of your gate. The arm is usually positioned to match up with the bottom of the gate.

Of all the gate operators available, this is the fastest opening unit. It can open a gate in as little as six seconds. Another major advantage to this design is the cover opens without having to remove the arm first. This makes it one of the most accessible and easy to service operators. Manual release of this unit is by removing a lock and pin that is located on the arm.



Figure 2.1: Picture of bottom mounted swing arm

2.3.2 Top Mounted Swing Arm

These units are favored as the work horses of the industry. These units on a majority of high use applications. This type of operator usually features two oil bathed gearboxes and a very heavy chassis. The circuit board can be accessed through the front panel, but you have to remove the arm to gain access to the mechanics.

To manually release the unit, the bonnet on the arm is removed by unfastening a bolt and a lever is lifted to release the gate. Some security is lost due to the units not having a locking mechanism. Need to use wrench handy open units during a power outage.



Figure 2.2: Picture of top mounted swing arm

2.3.3 Mechanical Ram Arm

Ram arms are small and make a very clean looking installation. The mechanical ram arms use a jackscrew design. This long threaded shaft rotates and moves a piston. Most ram arms have a separate control box for the electronics and power supply.

Soft stop is a desirable feature when purchasing this type of unit. Many of the units now on the market are 12-24 Volts DC. Mechanical ram arms are well suited to lighter gates and lower duty cycle such as residential use.



Figure 2.3: Picture of mechanical ram arm

2.3.4 Hydraulic Ram Arm

These compact and attractive units are operated by a hydraulic piston that has a self-contained pump. The hydraulic ram arms are usually more durable than mechanical ram arms and some units are suitable for commercial application. Hydraulic ram arms have a separate control box for the electronics and accessories.

Precision control over the force these units exert makes them extremely safe. All hydraulic units need a positive stop added either to the gate or internally. These stops allow precision positioning of the gates.



Figure 2.4: Picture of hydraulic ram arm

2.3.5 Underground Operator

Underground operators are the most elegant of operators. The operators are mostly invisible and they can handle massive sized gates.

Electronics are located in a separate cabinet. When these units are installed with columns, the control unit can be flush mounted into the column for an even cleaner look. Underground operators are available in hydraulic and mechanical. Most units have a key located near the bottom of the gate to release the unit incase of power failure.

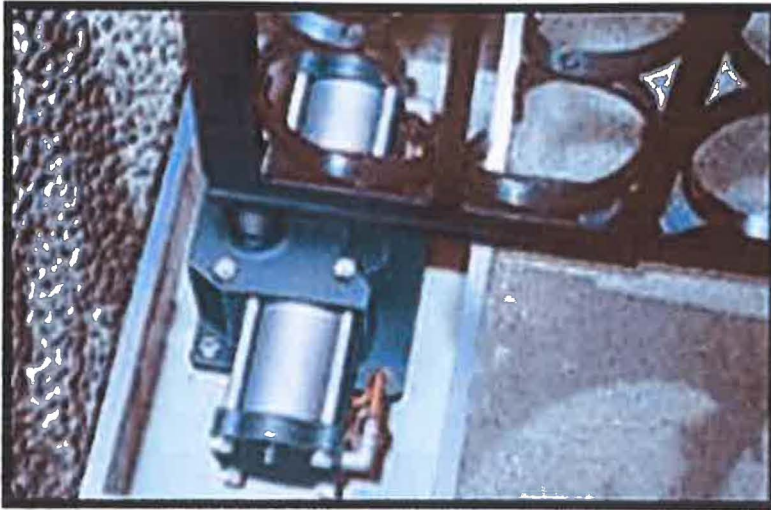


Figure 2.5: Picture of underground operator

2.4 Comparison between the designs

For bottom mounted swing arm design, the arm is mounting at the bottom of the gate. It can open the gate with the faster time than the others can. It also easy to install and service maintenance.

For top mounted swing arm design, the arm is mounting at the middle of the gate. It suitable for heavy weight gate. The power supply to generate the operator is high.

For mechanical ram arm design, the arm is small and mounts the body at bottom of the gate. It suitable for light weight gate and small gate.

For hydraulic ram arm design, the system operated by a hydraulic piston that has a self-contained pump. The hydraulic ram arms are more durable than mechanical ram arms and more precision positioning stop.

For underground operator design, the units are installing at the underground of the gate. It suitable for heavy and light weight gate. It is the most secure from the other because the mechanism located at below ground.

CHAPTER 3

METHODOLOGY

3.1 Project Flow Chart

In fabrication of Automatic Gate Opener, there is a planning of the overall progress to assure the project can be finish on schedule

From the flow chart below, this project started with the literature review and research about the title. The main important of the project is to achieve the objective of the project. The study and make a lot of investigation about automatic gate opener mechanism. These tasks have been done through research on the internet, books and others.

After the information has been collect and gather, the project will be continuing with the design process. In this stage, the knowledge and lessons that have studied will be applied in sketching. There will be three different sketches for this project. Then, only one sketches will selected after collect the data analysis.

Next, the project continuing with the evaluate design process. The three sketches will be analyzed and make a comparison between the sketches. The data from the analysis will collect and the best sketches will selected. After the sketch has select, the design will transfer to engineering drawing by using Solidworks software.

After all the engineering drawing finished, the drawing was used as a reference for the next process, which it is fabrication stage. This process is consists fabricate all the parts that have design before by following the exact dimension.

After finish fabricates all the part that has been design, then the project will be continuing with assembly process. This process will follow the drawing assemble. These processes include the welding process, wiring, and combine the parts with bolt and nuts.

Then, the project will continue to testing process. The objective for testing process is know the result success or not. In this stage, the testing process will continue until it gets the success result.

Finally, after finish all the process, the project will be present in the final presentation project. This stage, all the result and problems will shows.

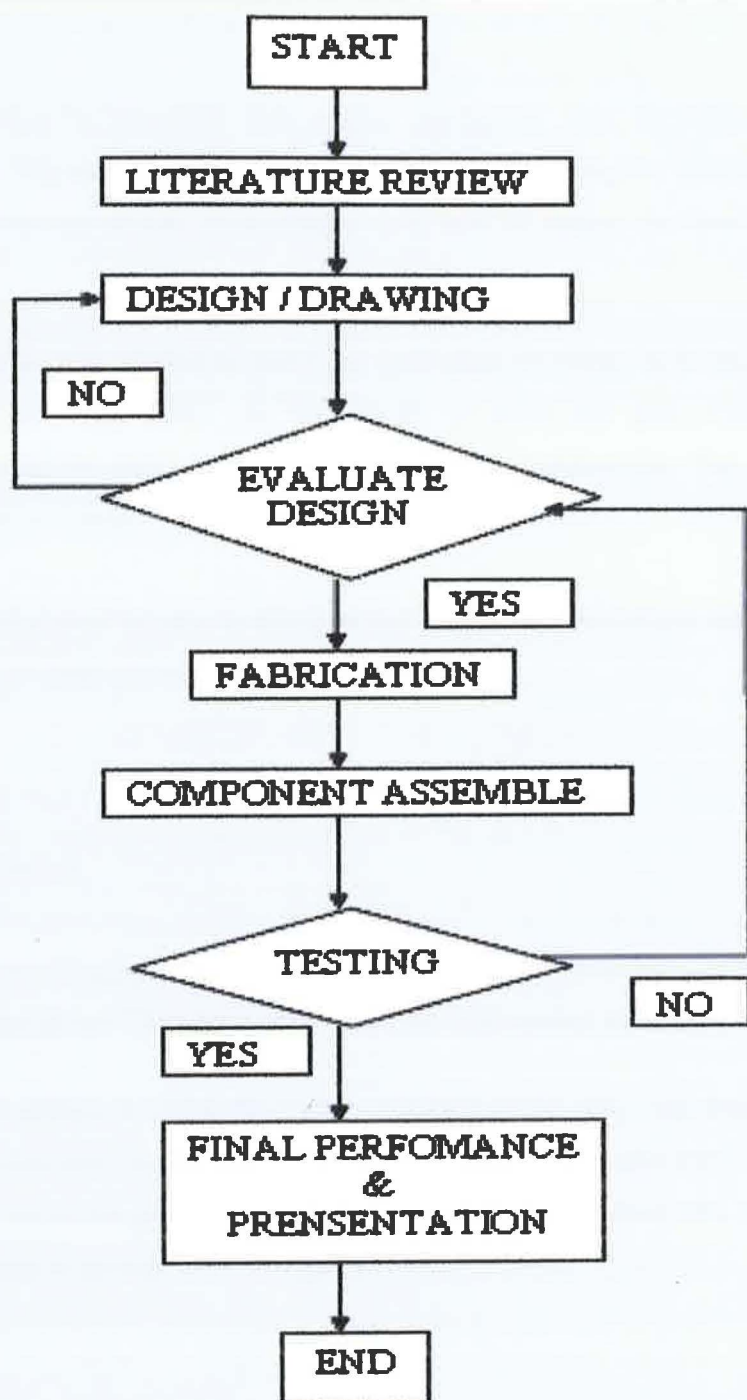


Figure 3.1: Project flow chart

3.2 Design

The design for automatic gate opener mechanism must be compliance to several aspects. The aspects that must be considered in designing the automatic gate opener mechanism are torque, maintenance, cost, ease of design, and time to open/close.

The torque that needed to move the gate must be lower. It is because the output power from the motor can be enough to move the gate. The system maintenance must be easy, so it save the cost for maintenance. The cost for installment must be lower.

The design must be easy to fabricate and assemble. The designs also need to make sure time to open or close gate lower or fast.

3.2.1 Propose Design

From many design of the automatic gate opener, only three designs have been chosen to be considered. The sketched of automatic gate opener are shown below;

For first design, it called the bottom mounted swing arm. This design is the simple design and easy to fabricate. The cost for maintenance and install are low. The torque for move the gate is also low because of the design that used two arms. The time that take to open or close, the gate is fast.

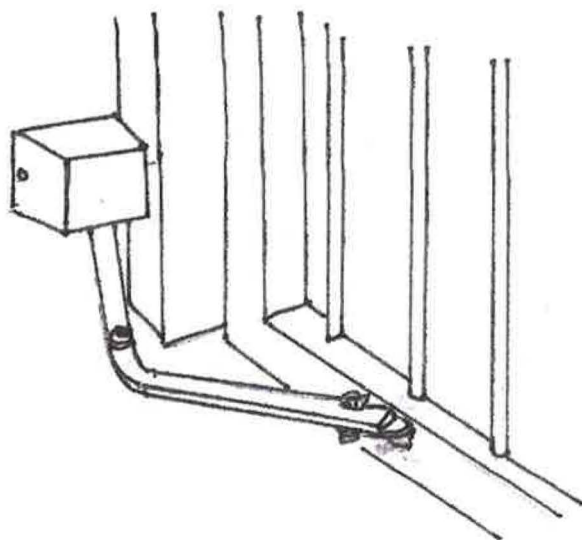


Figure 3.2: First design

For second design, it called the mechanical ram arm. This design needs a high torque. Is suitable for small gate. The design is simple and easy to fabricate. The cost for maintenance and install are low. The time that take to open or close, the gate is slow.

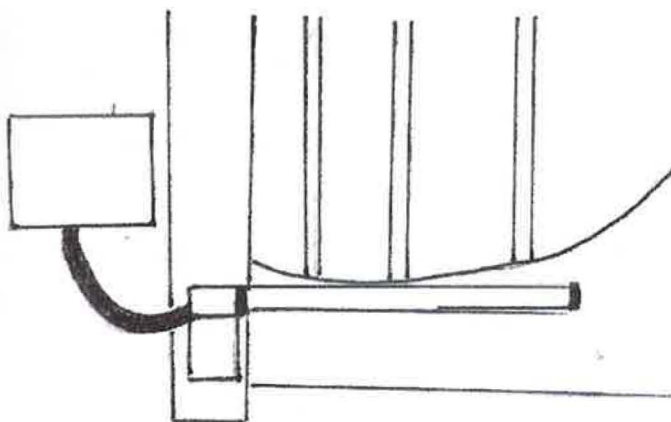


Figure 3.3: Second design

For third design, it called hydraulic ram arm. It used hydraulic system for move the gate. This design is hard to design and fabricate. The cost for maintenance and install are high. The torque for move the gate is low because it used the fluid to extend and retract. The time that take to open or close, the gate is fast.

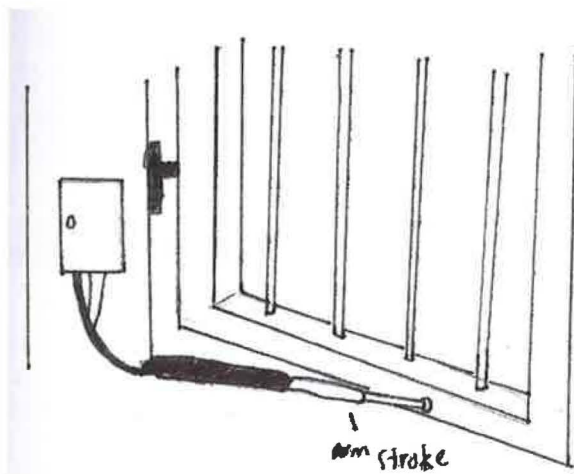


Figure 3.4: Third design

3.2.2 Data Analysis

The data analysis for the three designs is shown below;

Table 3.1: Data analysis for three designs

Features	First design	Second design	Third design
Torque	Low	High	Low
Maintenance	Easy	Easy	High
Cost	Low	Low	High
East of design	Easy	Easy	Hard
Time to open/close	Fast	Slow	Fast

From the data, for the first design, the torque is low. The cost for installment is low. Easy to maintenance and easy to fabricate. The time that take to open or close the gate is fast.

For the second design, the torque is high. The cost for installment is low. Easy to maintenance and easy to fabricate. The time that take to open or close the gate is slow.

For the third design, the torque is low. The cost for installment is high. Hard to maintenance and hard to fabricate. The time that take to open or close the gate is fast.

3.2.3 Selected Design

The design that has been selected is First design. The selection of this design is because the factors of low of torque is low, easy to maintenance, low cost for installment, easy to fabricate and time to open or close the is fast.

After design has been selected, the design will transfer to 3D drawing using Solidworks software. It includes the complete assembly of the part and the detail dimension of the drawing.

3.3 Drawing Design

The drawing design includes the drawing parts, details of the parts, and assembly drawing.

3.3.1 Drawing Parts

For this project, it has six parts that have been design. The drawings are shown below;

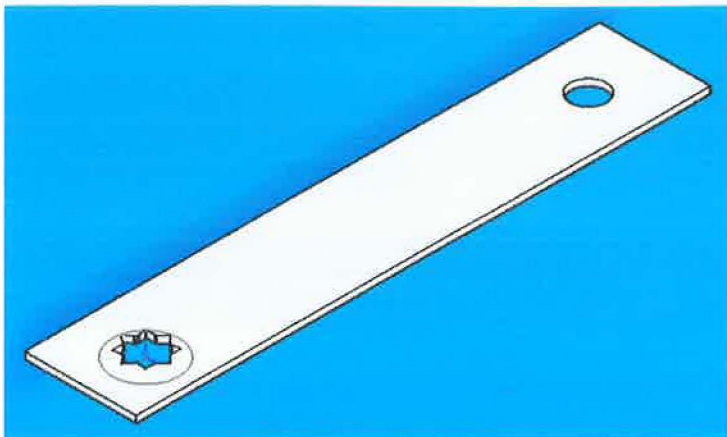


Figure 3.5: Arm 1

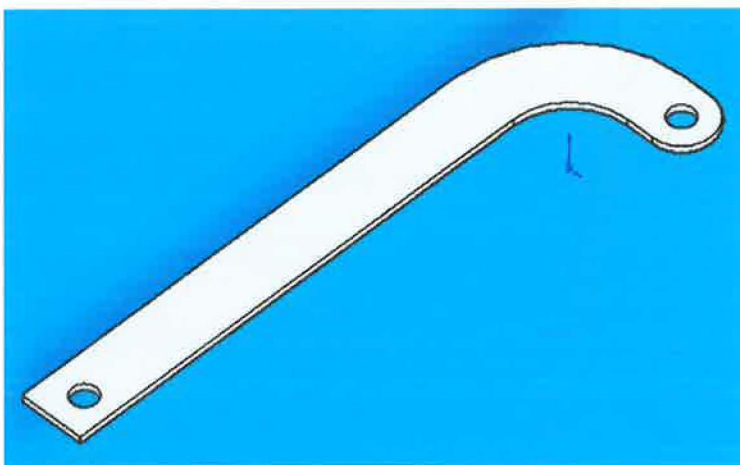


Figure 3.6: Arm 2

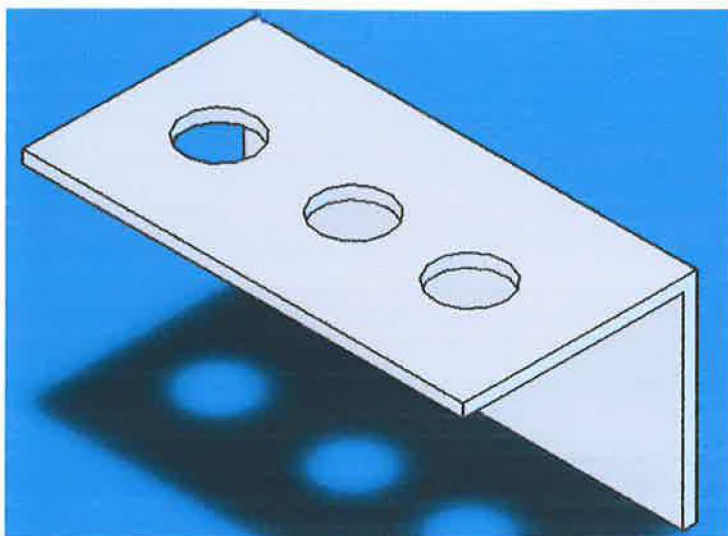


Figure 3.7: Bracket 1

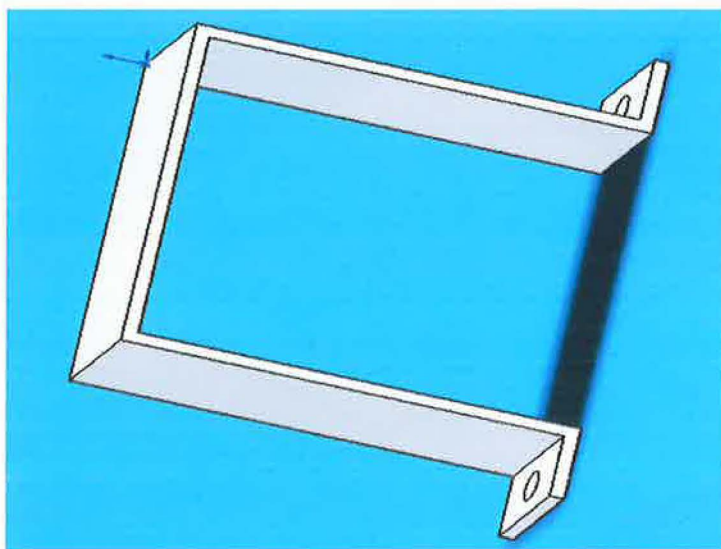


Figure 3.8: Bracket 2

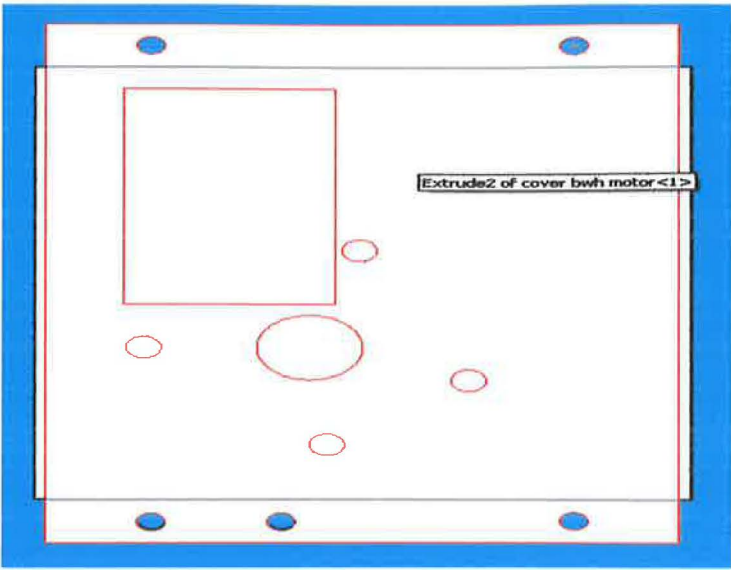


Figure 3.9: Box base

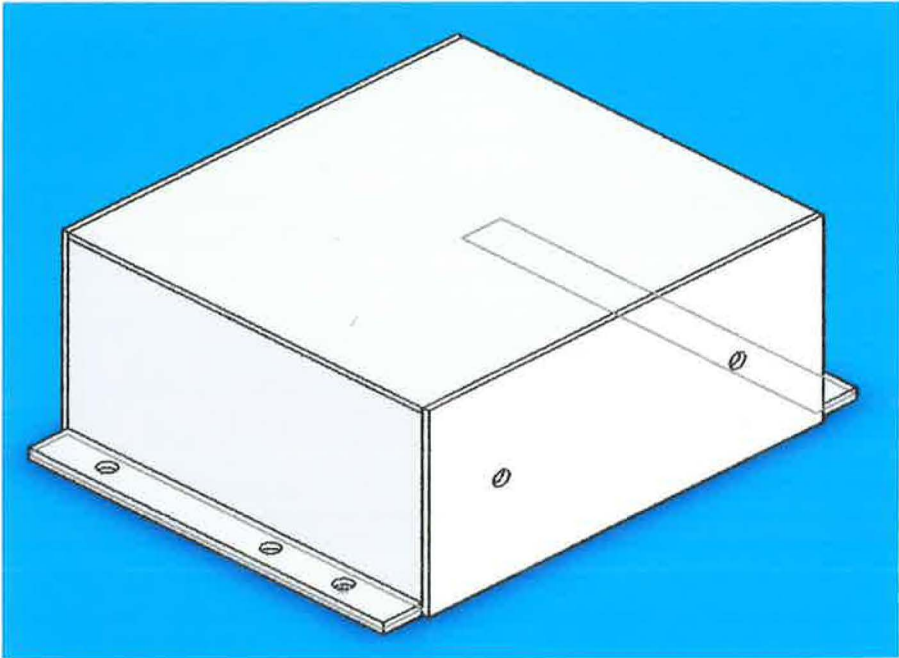


Figure 3.10: Box

3.3.2 Details Drawing

The details drawing will show the dimension of the parts. There are;

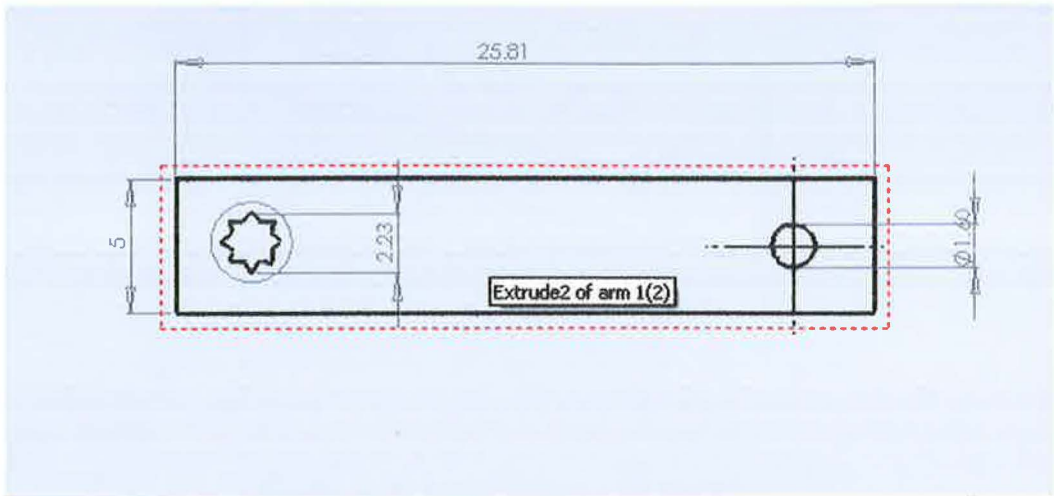


Figure 3.11: Detail drawing for arm 1

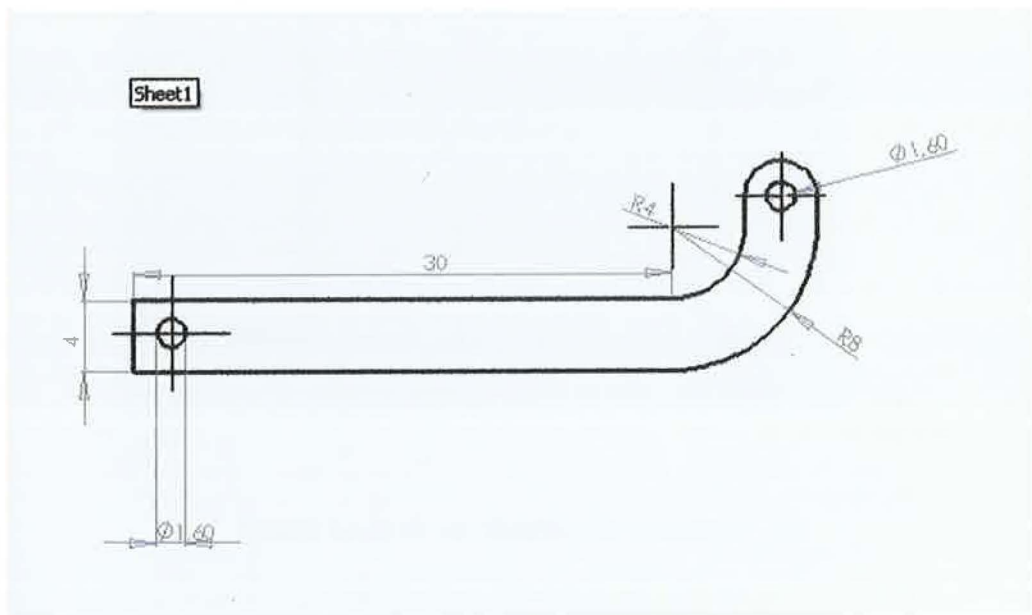


Figure 3.12: Detail drawing for arm 2

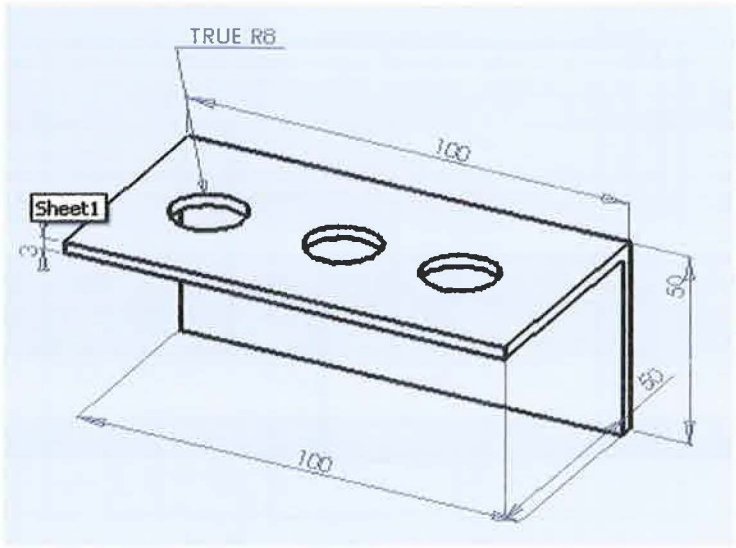


Figure 3.13: Detail drawing for bracket 1

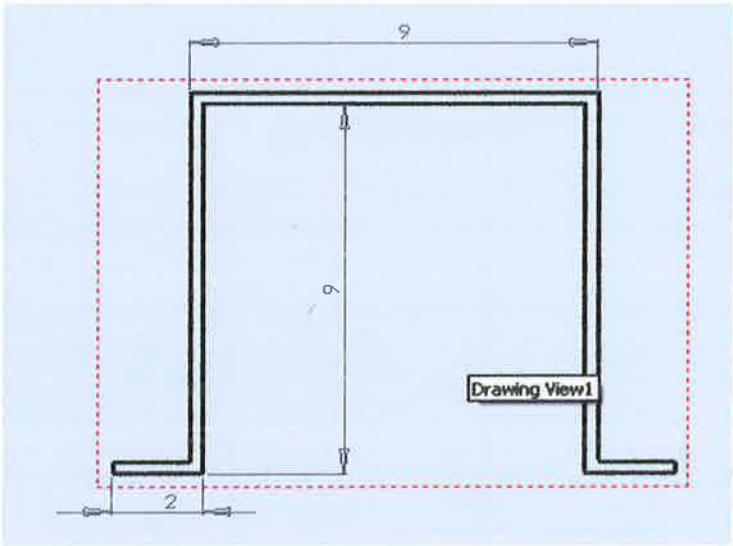


Figure 3.14: Detail drawing for bracket 2

3.3.3 Assembly drawing

The assembly drawing will show the full part of the project and the assembly at the gate.

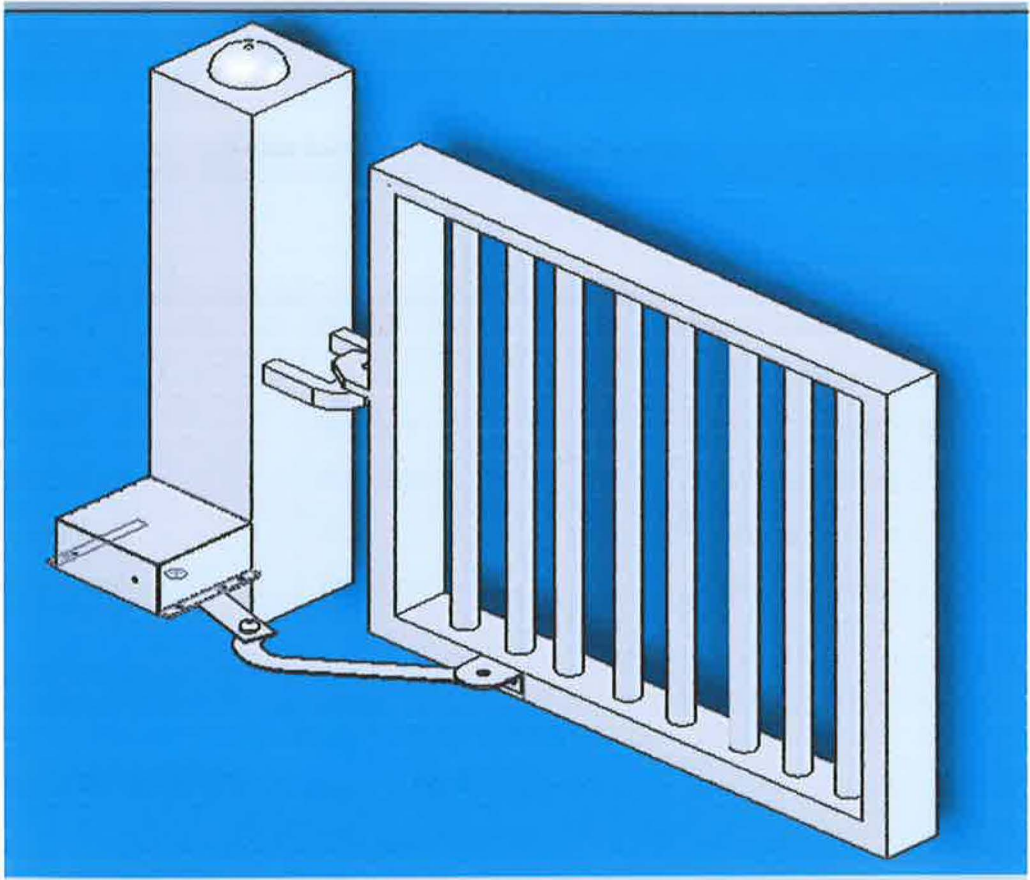


Figure 3.17: Assembly drawing

3.4 Selected Material

For this project, there are two kind of material that used to fabricate this project. To make the arm, mild steel have been used as a material. It is because the

material is hard and not brittle. Therefore, it can pull or push the gate and can keep longer.

Then, for the box or chasing for the motor, galvanize iron has been used as a material. It is because the material is hard, can bend, and not brittle. Therefore, the box can capable to patch the motor and bend to make a box using bending machine.

Table 3.2: Description of the material

Material	Part	Dimension
Mild Steel	Arm 1	50mm x 250mm x 3mm
Mild Steel	Arm 2	50mm x 300mm x 3mm
Mild Steel	Bracket 1	50mm x 200mm x 3mm
Galvanize Iron	Box Base	180mm x 240mm x 1.5mm
Galvanize Iron	Box	424mm x 442mm x 1.5mm
Galvanize Iron	Bracket 2	30mm x 220mm x 1.5mm

3.5 Fabrication Process

Fabrication process is the process to make or build the part of the project. This process needs to follow the exact dimension according to the drawing design. In making the design become a real product, several processes have been used to fabricate the automatic gate opener mechanism, which is;

- i. Measuring: Measure the material according the dimension.
- ii. Marking: Mark the material after measure it.
- iii. Cutting: Cutting the material into parts that has been marked.
- iv. Drilling: To make a hole.
- v. Welding: To combine or assemble the part.
- vi. Punching: To make the box using turret punch machine.

- vii. Bending: To make the box using bending machine.
- viii. Soldering: To solder the wires with the switch.

3.3.1 Apparatus Project

There are a few apparatus or machine that has been used in this project for each of the process, which is;

- i. Cutting: Jigsaw Machine.
- ii. Make holes: Drilling Machine and EDM Wire cut.
- iii. Welding: Metal Inert Gas Welding.
- iv. Punching: Turret Punch Machine.
- v. Bending: Bending Machine.

Figure for the machine can be seen in Appendix C

3.3.2 Process Step

The fabrication process is start with measuring and marking the material, mild steel into the dimension needed according to the design. The measuring and marking process is done by using steel ruler, measuring tape and steel marker.



Figure 3.18: Process measure the work piece

After measuring and marking process done, the material will be cut according to the marked by using jigsaw machine.



Figure 3.19: Process cutting the material

After finish cutting the material into the pieces that needed, then the process continue to make the holes for the arm 1, arm 2 and bracket 1. The process done by using drilling machine.

Then the process continues with the welding process. This process is for arm 2 and bracket 1. By using metal inert gas or MIG welding this process is suitable for mild steel.



Figure 3.20: Welding process

Next, to make the hole for arm 1 that can fixed to the motor, the process continue by using EDM wire cut.



Figure 3.21: EDM wire cut process

Then, for make the box, galvanizes iron have been selected as a material. This process is done by using turret punch machine. On this process, the tools for punch the material has to select first and do a simulation to make sure there is no error while running the machine.

After finish punching the material, then the process continue to bending process. This process is to bend the material to make the box shape and bracket 2 according to design.



Figure 3.22: Bending process

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

This chapter is about result and discussion the project encounter before, during and after the project finish. For this part, the result is come from after finish fabricate the project and test to the gate. The outcome from the testing will discuss in this chapter, whether it function or not.

4.2 Result

The result for this project is shown in these figures below;



Figure 4.1: Arm 2

The Figure 4.1 shows the result of arm 2. The material for this part is mild steel. The process involved to fabricate this part is cutting to exact dimension, drilling to make a hole and welding to combine the part.



Figure 4.2: Arm 1

The Figure 4.2 shows the result for arm 1. The material for this part is mild steel. The process involved to fabricate this part is cutting to exact dimension, drilling to make a hole and EDM wire cut process to make the shape of the hole.



Figure 4.3: Bracket 1

The Figure 4.3 shows the result for bracket 1. The material for this part is mild steel. The process involved to fabricate this part is cutting to exact dimension, drilling to make holes, and welding to combine the part.



Figure 4.4: Bracket 2

The Figure 4.4 shows the result for bracket 2. The material for this part is galvanizes iron. The thickness for this material is 1.5 millimeter. The process involved to fabricate for this part is punch using punching machine and bending using bending machine.



Figure 4.5: Box

The Figure 4.5 shows the result for box. The material for this part is galvanizes iron. The thickness for this material is 1.5 millimeter. The process involved to fabricate for this part is punch using punching machine and bending using bending machine.

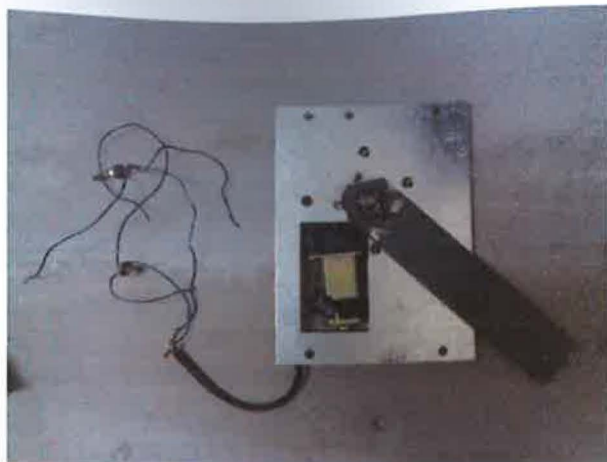


Figure 4.6: The assembly part arm 1, box base and motor

The Figure 4.6 shows the assembly part arm 1, box base and motor. The process involved to assemble the part is welding.



Figure 4.7: The fully assembly part

The Figure 4.7 shows the fully assembly part, arm 1, box, box base, motor and switch. To assemble the box and box base, four bolts and nuts has been used.



Figure 4.8: Assemble to the first gate

The Figure 4.8 shows the picture of assembly component to the first gate. The first gate is located at café Kolej Kediaman 1. Bracket 1 is used to hold the arm 2 with the gate. Bracket 2 is used to hold the box with the pillar.



Figure 4.9: Assemble to the second gate

The Figure 4.9 shows the picture of assembly component to the second gate. The second gate is located at entrance of Taman Teknologi dan Inovasi UMP. Bracket 1 is used to hold the arm 2 with the gate. Bracket 2 is used to hold the box with the pillar.

4.3 Testing Procedure

The testing procedures have been doing at two different places. First is located at café Kolej Kediaman 1 and second is located at entrance of Taman Teknologi dan Inovasi UMP.

For the first gate, to assemble the component to the gate, bracket 1 is used to hold the arm 2 with the gate and bracket 2 is used to hold the box with the pillar. The arm 1 and arm 2 connected using bolt and nut. When the switch at power supply on, the positive and negative wires connected to wires at the motor. After that, the switch to open the gate is on. Then, to close the gate need to switch off the open switch and switch on the close gate.

For the second gate, to assemble the component to the gate, bracket 1 is used to hold the arm 2 with the gate and bracket 2 is used to hold the box with the pillar. The arm 1 and arm 2 connected using bolt and nut. When the switch at power supply on, the positive and negative wires connected to wires at the motor. After that, the switch to open the gate is on. Then, to close the gate need to switch off the open switch and switch on the close gate.



Figure 4.10: Testing procedure

4.4 Discussion

For this project, a few topics will be discussed in this chapter. First, is the project problem. This topic will state all the problems that occur during project progress. It includes the source supply to generate the motor and testing problem.

Second, is solution for the problems. On this topic, the entire project problem will discuss the solution that can get to solve the problem.

4.4.1 Project Problems

During the project progress, the problems that occur are the source supply to generate the motor. The first planning for this project is to use 12-volt battery to generate the motor. The problem is the battery cannot able to supply the exact source that needed.

The second problem occurs during the testing process. For this project, there are two different kind of gate that will be testing. For the first test, the gate at Café Kolej Kediaman 1 will be testing. The result for this testing is the gate not move. For

the second test, the gate in front of the entrance lab will be testing. The result for this testing is the gate.

4.4.2 Problems solution

For the first problem, the project has change to use power supply to generate the motor. This time the motor will move with 12-volt current from power supply.

For the second problem, the result from the first test is the gate not move. It is because the gate is too heavy that the motor cannot move the gate. The motor for move the gate not suitable. It has to change to other motor that suitable to move the gate. The motor is suitable for the small gate, because the torque that needed to move the gate is small.

CHAPTER 5

CONCLUSION

5.1 Summary

This chapter contains an overview of the study as well as suggestion for future research. The investigation considered in this dissertation is focus on automatic gate opener mechanism.

The significance of this study, we discussing about background of the project, project objectives and scope of the project are presented in Chapter 1. In Chapter 2, we research about literature review for this project. In Chapter 3, we discuss about methodology for the project. Chapter 4 we state the result that get from the testing process.

5.2 Conclusion

As final conclusion, the gate opener mechanism was successfully being designed. The gate opener mechanism was also successfully fabricated and assembled. The project objectives have been successfully achieved.

Fabrication process gives student experiences and skill on how to operate the machines to fabricate the project and solve problem to finish the project. In design, it gives student more knowledge and technique use by professional engineer in designing 3D drawing.

5.3 Recommendation Future Work

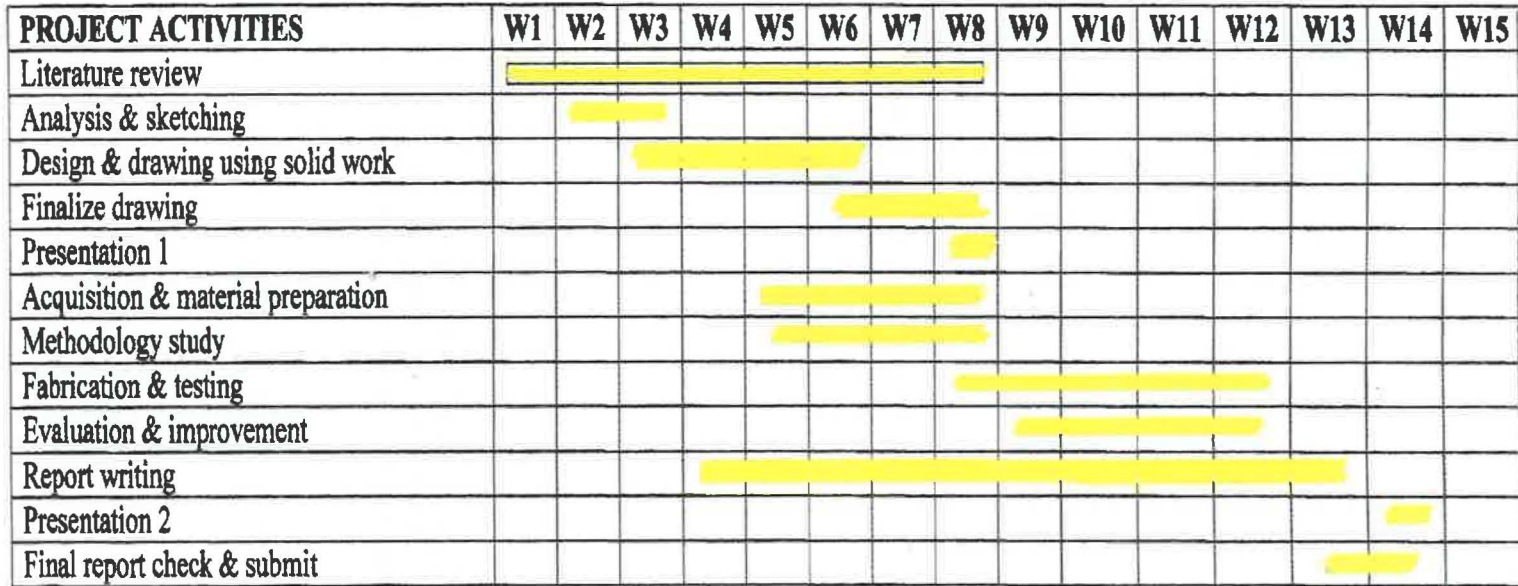
Future planning for the projects are, suggested uses other motor that can produce a big torque to move the large gate. To move the heavy gate, it needs a big torque to move the gate.

The second planning is to use a remote control button to operate the motor. The function of the remote control is, the user can open or close the gate from anywhere depends on the distance.

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Gantt chart



APPENDIX B

Figures of machine



Jigsaw machine



Drilling machine



Turret punch machine



Bending machine



EDM wire cut



Metal inert gas welding