DESIGN OF AN EASY TO CLEAN CEILING FAN FOR DOMESTIC USERS

By:

ZAINAL BIN MUSA

(Matrix number: 120824)

Supervisor:

Associate Professor Dr. Jamaluddin Bin Abdullah

June 2017

This dissertation is submitted to

Universiti Sains Malaysia

As partial fulfillment of the requirement to graduate with honors degrees in

BACHELOR OF ENGINEERING (MANUFACTURING ENGINEERING WITH MANAGEMENT)

School of Mechanical Engineering

Engineering Campus

Universiti Sains Malaysia

DECLARATION

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

Signed …… (ZAINAL BIN MUSA)

Date ……..

STATEMENT 1

This thesis is the result of my own investigations, except where otherwise stated.
Other sources are acknowledged by giving explicit references.
Bibliography/references are appended.

Signed …… (ZAINAL BIN MUSA)

Date ……..

STATEMENT 2

I hereby give consent for my thesis, if accepted, to be available for photocopying and for interlibrary loan, and for the title and summary to be made available outside organizations.

Signed …… (ZAINAL BIN MUSA)

Date ……..

ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious and the Most Merciful, the utmost thanks to Allah with His Greatest power, I have successfully completed this final report *Alhamdulillah.* A special acknowledgement and appreciation goes to my supervisor, Dr Jamaluddin Bin Abdullah for his supervision, commitment, professionalism, advice and guidance in assuring my project succeed. Secondly, I would like to express warm gratitude to the School of Mechanical Engineering staffs for full co-operation and commitment given to assist me a lot while performing this project.

I also want wish the most gratitude to mom, father and family in helping me financially, advice, guidance and in spirit so that I successfully completed this final year project. Without support and inducement from them, I may not be able to finish my final year project successfully. Thank you I say also to my friends that also directly involved or indirect in giving advice, inducement and skills that they shared with me.

I hope with knowledge that I gained from completing my final year project, can I used in my job later. May Allah repay their good merit that either directly or indirectly in helping me to complete this final year projects. Thank you for everything.

ZAINAL BIN MUSA

7th JUNE 2017 (2016/2017)

TABLE OF CONTENTS

Page

ABSTRAK (BAHASA MELAYU)

Tesis ini adalah berdasarkan kepada projek tentang reka bentuk dan fabrikasi kipas siling yang mudah dibersikan, untuk pengguna domestik. Projek ini membantu pengguna domestik bagi memudahkan mereka melakukan pembersihan kipas siling. Pembuatan produk ini bermula dengan selidik dalam pasaran tentang produk, analisis spesifikasi, reka bentuk konsep dan fabrikasi produk. Produk yang dipilih daripada pasaran telah di analisis dan selidik. Satu jenis produk yang sesuai dan patut semua spesifikasi yang telah dipilih untuk direka. Siasatan telah dibuat dalam skop kekangan yang mungkin berlaku bagi pembangunan produk dan perkaitan proses pembuatan produk. Produk ini telah fabrikasi mengikut kaedah kejuruteraan melalui banyak proses fabrikasi seperti memotong, penggerudian dan pemasangannya. Hasil daripada kajian ini membuktikan bahawa rekabentuk baru kipas siling ini lebih senang dan pantas untuk mencucinya. Untuk pembangunan projek ini dan kerja-kerja masa depan, beberapa cadangan telah dibuat untuk menaik taraf produk. Cadangan ini adalah untuk memastikan produk ini akan bersaing dengan produk sedia ada dalam pemasaran.

ABSTRACT

This thesis is based on the project about design and fabrication of an easy cleaning ceiling fan for domestic user. This project helps domestic consumers to enable them to perform cleaning ceiling fans. The fabrication of this product started with surveying in market about the product, specification analysis, concept designing and fabrication of the product. The selected product from the market were analysis and investigation. One types of the product that suitable and fit all the specification was chosen to fabricate. The investigation was made in scope of the constraint that may occur for the development of the product and relevance of the product manufacturing processes. This product have been fabricate according to engineering method through many fabrication process such as cutting, drilling and assembling. The results of this study prove that the new design of the ceiling fan easier and faster to wash. For development of this project and future works, some suggestion was made for upgrading the product. The suggestion are to make sure this product will competitive with the existing products in the marketing.

CHAPTER 1
INTRODUCTION

1.1 Overview

This chapters introduces ceiling fan, its components and their mechanisms, as basis to further understand the issues associated with current ceiling fan design. Furthermore, problem statement, objectives and scope of the project will be included in this chapter to give more exposure about this research.

1.2 Background

A ceiling fan is defined as a hard-wired, non-oscillating fan that is suspended from the ceiling for circulating air via the rotation of horizontal fan blades to cool the room temperature. Electric motor powered ceiling fans have been used for cooling building occupants since the 1880's with little change in the basic configuration of the fan. They consist of three to five flat blades attached to an electric motor, which is usually suspended from the ceiling by a down rod.

Most ceiling fans have at least three speeds or five speeds. Other than that ceiling fans also were attached with lighting fixtures or can be retrofitted with lighting kits. Before the advance of mechanical air conditioning, ceiling fans were always there in residential, commercial, and industrial buildings, but they lost popularity with the increased of central air conditioning market. Recently, the residential ceiling fans have experienced resurgence with many new homes often being equipped with multiple fans.

This project involves designing and fabricating ceiling fan blades that can easily clean and maintain. This ceiling fan would be entirely different from existing ceiling fan. This project could be divided into 3 stages, which are concept review and development, designing and fabrication. The process of development is initiated from designing the shape of the ceiling fan by considering the function as well. In order to produce user friendly product that is suitable to the consumer, consideration to the others factor is taken into account.

Ceiling fans are very difficult to clean and the top surface of the blades may be impossible to reach. Standing on a step ladder was not only difficult, but also a dangerous step for human body posture. Basically, the main purpose of this project is to design a ceiling fan that would allow easy cleaning of the blades. Many manufacturers have produced ceiling fans filter to trap the dust. Placing these dust filters on ceiling fans is quick and easy. As the fan spins, the filters will act as a dust collection tool. Each of the blades has one of the filters positioned on. The air filter is constructed from porous material capable of having air pass there through while trapping airborne particles from the air.

But, on this redesign model of ceiling fan modification help the domestic user to clean up the dust from the fan blades easily with a good posture and reduce the time for the cleaning process. The user also does not need to climb up the ladder to clean up the blades with a dangerous posture human body. This design very suitable for the domestic user and friendly.

1.3 Problem Statement

All of the residential houses normally equip with the ceiling fan. This ceiling fan was installed at the top of the house or at the ceiling to cool the room temperature. However, the user having a hard time to clean and maintenance the ceiling fan at the same time because of the high of this ceiling fan from the floor without using the additional equipment like steel stairs. This new designs of the ceiling fan develop to help domestic user to solve this problem where it will help user to make sure they can clean all the dirt at the fan and well maintain when they want. Because cleaning a ceiling fan is not comfortable and easy task for a person to reach fan blades and perform the cleaning in uncomfortable posture with head facing upwards. This become very tiring and dangerous posture for prolong period of time when doing cleaning process.

1.4 Objectives

The main objective of this project is to design a ceiling fan prototype so that the process of cleaning fan blades can be much easier. To achieve this project goal, research about the ceiling fan, design, operating and mechanism method need to be done to choose which part is more suitable for this project. The objectives of this project are:

1.4.1 Design and fabricate the new ceiling fan that can be easily clean and maintain
1.4.2 Create a ceiling fan that can be easily reach the blades at certain height and perform
1.4.3 Reduce the amount of time to clean ceiling fan

1.5 Scope of the Project

The scope of this project is divided into two phases. The first phase is planning, research and material selection. In planning process, the design will be randomly draws with any design. Then, the best design will be selected and drawing using Solidwork software. The research about ceiling fan, mechanism, electrical part and ergonomic need to be collected. The material were selected based on the research.

The second phase is fabrication and testing design. The fabrication process involved the rapid prototyping machine. It can be quickly fabricate a scale model of physical part using three-dimensional computer aided design (Solidwork) data. When the design had been done, the test and experimental procedure on the design started.

1.6 Thesis Outline

This thesis is divided into five main chapters. The first chapter discusses on overview of ceiling fan. Problem statement regarding the experimental problem is also reviewed in this chapter. This chapter also contains the project scopes, project objectives and outline of the report.

Next, in chapter two, some literature reviews are made based on journals, books and webpages as references. Detail explanations about this research are described in this chapter. In Chapter 3, the methodologies in term of fabrication of the ceiling fan, test and experimental procedure will be presented. This chapter will describe about the materials and equipment used in this experimenting procedure. In Chapter 4, results obtained from the experiments will be discussed and verified here.

Finally, the conclusion of the project will be made in chapter 5. Some suggestions and recommendations are given for improvement in future research.

CHAPTER 2
LITERATURE REVIEW

2.1 Overview

Throughout the years, there are many researchers that interested in the designing of fan. They are many laboratory experiments that had been done on the performance, design and working principle of fans over the years. This chapter will be reviewing their method, findings, and suggestions on the topic. Thus, it gives ideas on how to conduct a new project in designing the prototype of fan.

2.2 Pre Review

Nowadays, all the residential houses equip with the blade fan. Because of the design and the way they reduce the hot temperature, this fan blade installed at the top of the house or at the ceiling. Because the high of this fan blade from the floor make it difficult to clean without using the additional equipment like steel stairs.

From this design, we can reduce the amount of time to clean a ceiling fan. Ergonomics course are included in this project to support the life style for user to clean ceiling fan in safe body posture. The user does not need to climb high to reach the blade's ceiling fan. The user can reach the blade without look up the ceiling fan to clean it. In other word, the user safe energy to clean it.

2.3 Types of ceiling fan

There are many types of ceiling fan that commonly domestics user. Firstly, the standard ceiling fans. The standard fans amount on flat or sloped ceiling with downrod, a metal pipe that connects the motor housing to the mounting bracket, which allows the ceiling fan blades to hang at least 7 feet above the floor as required by National Electric Code. These types of fans are intended for rooms with a ceiling height of 8 feet or greater.

Figure2. 1 Standard Ceiling Fans

Secondly, low profile ceiling fans. It is also known as hunger ceiling fans or mount ceiling fans. It install directly on the mounting bracket, which secures the fans against the ceiling. Use these types of fans in rooms where the ceiling height is less than 8 feet. This application allows the blades to rest 7 feet above the floor.

Figure2. 2 Low Profile Ceiling Fans

Thirdly, ceiling fans with integrated lighting merge two valuable household fixtures, your ceiling fan and your overhead light fixture into one. Integrated light kits are compatible with incandescent, halogen and compact fluorescent light bulbs. It can directly lighting up or down depending on the glass shade's design. The glass shades come in a range of styles and colours to complement the ceiling fan's overall style.

Figure2. 3 Ceiling Fans with Lights

Next, the outdoor ceiling fans include moisture-resistant motor housing and all-weather blades that battle warping. Outdoor ceiling fans are classified into two categories,

UL-rated damp ceiling fans and UL-rated wet ceiling fans. These types of fans often include natural design elements such as bamboo or palm leaf blades.

Damp ceiling fans withstand humidity and moisture, and are suitable for covered patios, porches, and sunrooms with no direct exposure to precipitation.

Wet ceiling fans hold up to rain, snow, and oceans, and are suitable for exposed spaces such as gazebos, patios, and porches. A wet-rated ceiling fan is appropriate for damp and dry locations; however, a damp-rated fan is not appropriate for wet locations, and an indoor fan is only appropriate for dry locations.

Figure2. 4 Outdoor Ceiling Fans

After that, Energy Star-rated ceiling fans feature energy-efficient motors and aerodynamic blades, which allow the ceiling fan to operate on less energy. These types of fans are at least 20 percent more efficient than standard ceiling fans. Energy Star fans with integrated lights are 50 percent more efficient than standard ceiling fans with lights.

Figure2. 5 Energy Star Ceiling Fans

Dual motor fans deliver extraordinary style and performance to indoor and outdoor spaces. These ceiling fans feature two adjustable fan heads supported by horizontal rods that extend from the compact motor housing. Two high-performance motors power the unique ceiling fans. Dual motor ceiling fans make a strong decorative statement in a living room, dining room, or patio.

Figure2. 6 Dual Motor Ceiling Fans

Remote control ceiling fans offers the modern convenience of adjusting multiple fan speeds and lighting with the press of a button. A remote control transmits a unique frequency to the receiver located in the canopy, prompting changes in speed, direction, or lighting. Some ceiling fan remotes can transmit frequency within a 40-foot to 50-foot range. A ceiling fan with remote control is ideal for individuals who cannot reach the fan to make adjustments.

Figure2. 7 Remote Controlled Ceiling Fans

Desk fans, also known as tabletop fans, are a portable cooling solution for small spaces. Use these fans in rooms ranging in size from 75 square feet to 120 square feet, such as a cubicle or a home office. A rotary switch adjusts the airflow while a toggle switch allows the fan head to pivot from side to side. Some desk fans include a knob that adjusts the fan head's angle.

Figure2. 8 Desk Fans

Lastly, Wall fans are the ultimate space saving fan. These fans mount directly to your wall, freeing up room on your floors and desks. Many wall mounted fans have head tilts and on/off oscillation controls. These fans create low-pressure airflow with a low volume. This means they can be used as both a ventilation and cooling system.

Figure2. 9 Wall Fans

2.4 Fans System

Fans can be divided into two categories: centrifugal and axial. Centrifugal fans generate their air flow by radially accelerating the airstream and then convert the kinetic energy into pressure. Axial fans are just like propellers where it can generate airflow along the direction of the fan's axis. Axial and centrifugal fans both have similarity capabilities in terms of pressure, airflow, and efficiency but usually they are not interchangeable.

2.4.1 Centrifugal Fans

Centrifugal fans are the most commonly used type of industrial fan. Centrifugal fans are capable of generating high pressures with high efficiencies, and they can be constructed to accommodate harsh operating conditions.

2.4.2 Axial Fans

Axial fans are frequently used in exhaust applications where airborne particulate size is small, such as dust streams, smoke, and steam. Axial fans are useful in ventilation because of its ability of generating reverse airflow. Although the fans are mainly designed to generate flow in one direction, they can also operate in the reverse direction. This characteristic is useful when a space may require contaminated air to be exhausted or fresh air to be supplied.

2.5 Ceiling Fan

A ceiling fan is defined as a hard-wired, non-oscillating fan that is suspended from the ceiling for circulating air via the rotation of horizontal fan blades. Electric motor powered ceiling fans have been used for cooling building occupants since the 1880's with little change in the basic configuration of the fan. They consist of three to five flat blades attached to an electric motor, which is usually suspended from the ceiling by a downrod. Most ceiling fans have at least three speeds and also may have a reversing switch for operation in the winter. Often ceiling fans ship with attached lighting fixtures or can be retrofitted with lighting kits. Before the advent of mechanical air conditioning, ceiling fans were ubiquitous in residential, commercial, and industrial buildings, but they lost popularity with the increased penetration of central air conditioning. Recently residential ceiling fans have experienced a resurgence, with many new homes often being equipped with multiple fans.

2.5.1 Ceiling Fan's Components

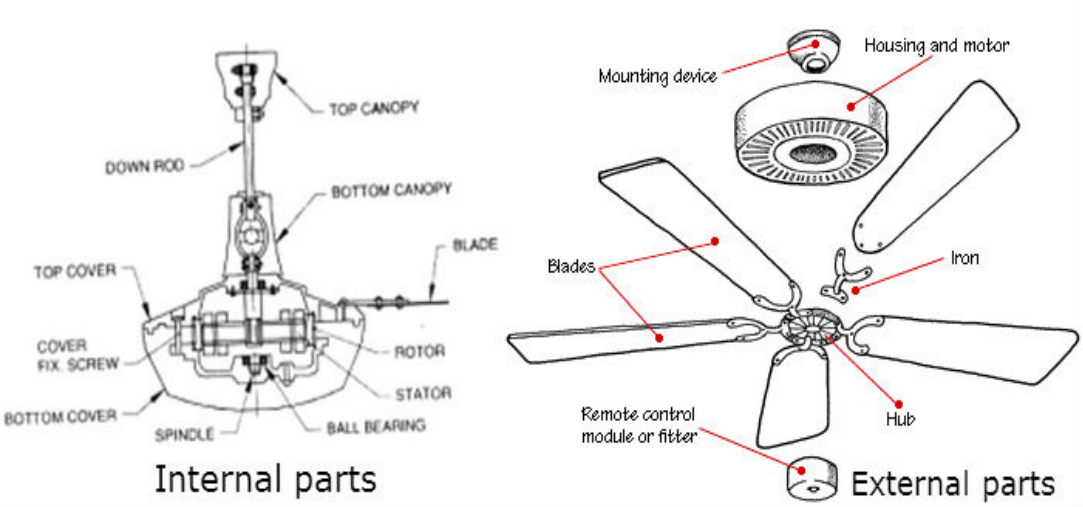

Figure2. 10 Ceiling Fan's Components

A ceiling fan consists of a few basic parts, namely an electric motor with a housing, blades and the "irons" that hold most types in place, and a downrod or other mounting device. In addition, many fans are designed to receive decorative fitters beneath the blades that hold lamps and glass or crystal shades.

2.5.1.1 Blades

2.5.1.1.1 Blades Pitch

Blade pitch refers to the angle of the blades as they move through the air. Fan blades with a relatively flat pitch between 10 and 12 degrees do not require a very large motor to reach a high speed. A steeper blade pitch, such as 14 to 15 degrees, will require a more powerful motor to achieve the same speed. Even at a high speed, the fan with the flatter pitch will move less air and may wobble or make noise due to being overworked. On the other hand, the fan with the steeper blade pitch may wear out much faster if the motor isn't powerful enough to move larger amounts of air for longer periods of time. [1]

2.5.1.1.2 Blade Shape and Size

Fan blade size and the number of fan blades do matter. The bigger (wider or longer) the fan blade, the more airflow the blade is able to generate. Having more blades moving through the air would generate more airflow too. However, this ignores the effect of drag or air resistance. Whenever an object moves through air, it experiences an opposing force to motion called as drag. It is this drag that slows down motion, reduces airflow, and increases energy consumption of a ceiling fan. [1]

2.5.1.1.3 Blade Tilt

Blade angle is the angle between the chord of a propeller or rotor blade and a plane normal to the axis of rotation, its value varying along the span and decreasing from root to tip because of blade twist. Most blades till between 12-14 degrees off horizontal. Decorative blades such as textured palm fronds can tilt up to 20 degrees. [2]

2.5.1.2 Fans Motor

Ceiling fan has a single phase induction motor assembled in it. A single phase induction motor has similar speed-torque characteristics, as that of a 3-phase, only difference is in starting torque. The ceiling fan capacitor torques up the electric motor, allowing it to start and run. An electrical current reaches the motor and then enters coils of wire that are wrapped around a metal base. As this current passes through the wire, a magnetic field is caused that expends force in a clockwise motion that actually changes the electric energy into mechanical energy. This action causes the motor coils to spin. As the coils are spinning, the fan captures this spinning motion, transferring it to the fan blades. [3]

2.5.1.2.1 Motor Efficiency

There are three factors that led to an efficient ceiling fan. Firstly, the motor size. Motor efficiency generally increases with increasing motor load relative to motor size. If the motor is oversized, the fan operates less efficiently. Secondly, motor quality. An efficient motor will accomplish more work per unit of electricity consumed. Next, the blade design. [3]

2.5.2 Operating Ceiling Fan

First is pull-chain/pull-cord control. This fan have cord that when being pulled will moves the fan through the rotational speed. Usually equipped with three speeds. Second, using variable-speed control. This was a dial mounted on the fan which, when turned in either direction, continuously varied the speed at which the blades rotated. Next, fan also can be operated using wall-mounted control. The control are mounted to the wall, not the fans. Usually the switches are combined along with the light fixtures. Besides, many home nowadays use digital control to operate ceiling fan. Controlled by a computerized wall control. All the functions such as speed, direction of rotation, turning on/off the light are in one place. Uses normal house wiring that send electrical pulses to the fan which then decode and act accordingly. [4]

2.6 Moving Parts

2.6.1 The Features of Air Flow Induced by a Ceiling Fan

As the fan rotates, the air layers attached to the blades randomly rotate. Due to air viscosity and molecules attraction forces, the rotation effect transfers to the air in the fan plane and progress downward. The results showed that increasing the fan rotational speed results in increasing the local downward velocity distribution inside the space. Hence,

operating a ceiling-fan at an improper rotational-speed may cause disturbance for occupants. [2]

2.6.2 Thermal Comfort Enhancement by Using a Ceiling Fan

The results from the numerical simulations provide an insightful understanding of the fluid flow and heat transfer in a room with air conditioner and ceiling fan. For the base case where the fan is not in use, strong air circulations in the inlet side of the room keeps this side cooler due to convective heat transfer, while rather still air in the outlet side have the temperature distribution pattern of diffusive heat transfer. When the fan is used, strong circulations forced by the fan induces convective heat transfer that creates more uniform temperature distribution in both sides of the room. However, these circulations also reduce the total heat removal performance of the system by circulating the heat around the room instead of moving it to the outlet resulting in a slight rise of overall temperature. [5]

2.7 Dirt

The edge of blade that cuts the air experiences maximum friction, and thus collects the maximum amount of dirt. Also, the fan picks up the oil from the environment and the dust settles on to it, leading to grime formation. This type of dirt need wiping, dusting is not of much use.

Figure2. 11 Dirt on the Edge Fan's Blade

2.8 Ergonomics Course

2.8.1 Cleaning Activity Process

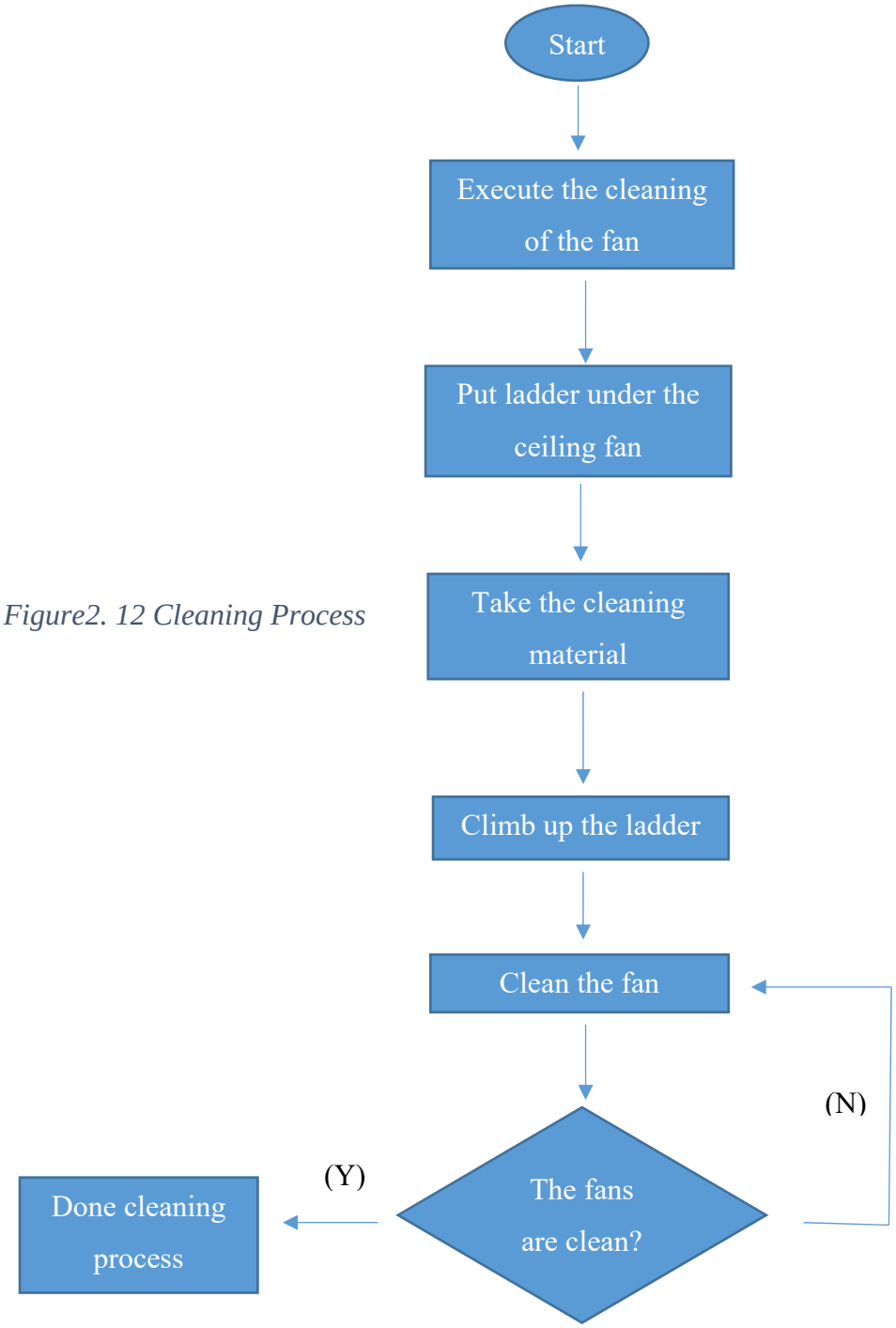

Figure2. 12 Cleaning Process

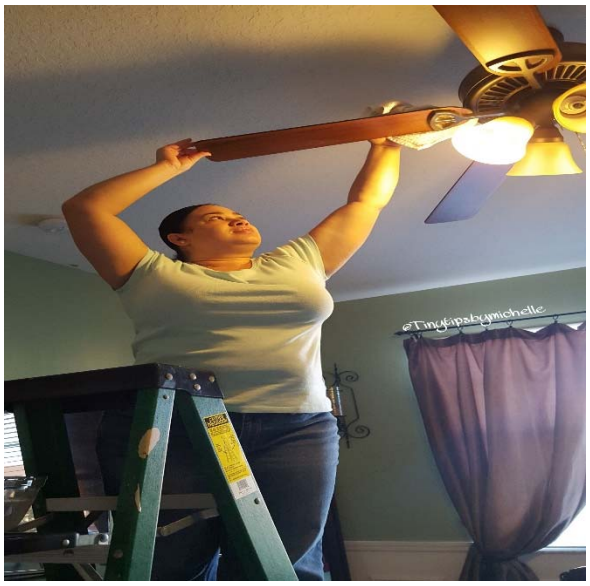

Figure2. 13 Example for Cleaning Process

During cleaning, note the odd angle of the neck and back. There is tension due to: [6]

- The height of the fan
- The direction in which one has to point
- The fact that there is not enough ample foot space to stand in a stable position.

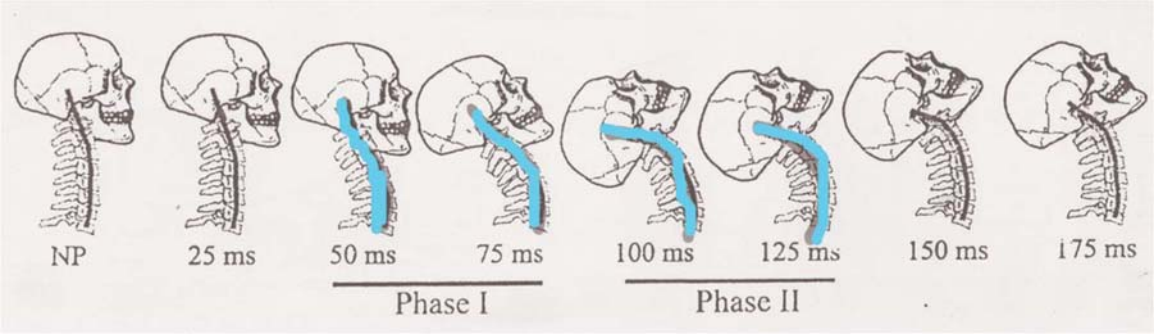

Figure2. 14 Angle of the Human Neck

2.8.2 Functional Arm Reach

Standing in erect posture, vertical comfortable arm reach height from floor. [7]

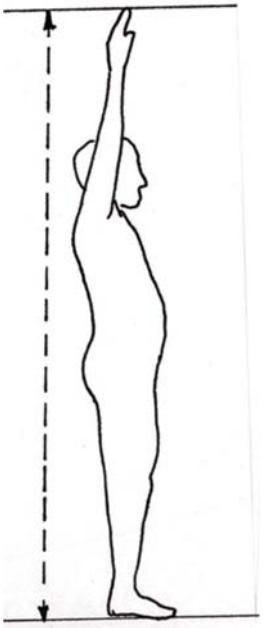

Figure2. 15 Arm Reach Height from Floor

Parameter	Gender	Min	Max	Average
Vertical upward arm reach from floor	Male	1830	2410	2101
	Female	1665	2180	1914
	Combined	1665	2410	2050

Table 2. 1 Parameter of Arm Reach Height from Floor

Difference between the centers of comfortable grip to the tip of expanded palm ranges from 30 mm to 190 mm. This is the representation of optimum reachable locations in 3D space for various reaches. [8]

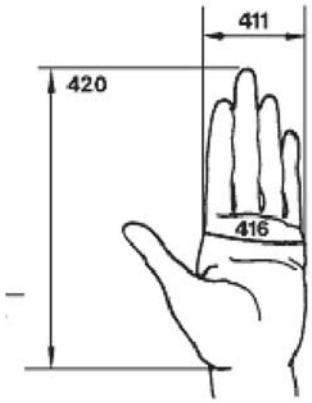

Figure2. 16 Range of Comfortable Grip to the Tip of Expanded Palm

2.9 Safety issues relating to manufacturing and installation

A residential ceiling fan should be installable by residents with only rudimentary skills. Whether installed by experts or non-experts, it is of course important when installing a ceiling fan to follow the manufacturer's instructions, which usually require that:

• the fan be positioned so that the blades are at least 2.1m (7ft.) above the floor, 0.6m (2ft.) from the wall and 0.3m (1ft.) below the ceiling

• Electrical connections be carried out using an approved electrical outlet box, which is labeled for use with ceiling fans.

It is noted that, despite the requirement that ceiling-fan blades be no closer than 2.1m (7ft.) from the floor, safety concerns can remain. For instance a person could be injured by an operating ceiling fan when extending arms into the air, or if the person is carrying a long object like ladder which accidentally comes into contact with the ceiling-fan blades. [9]

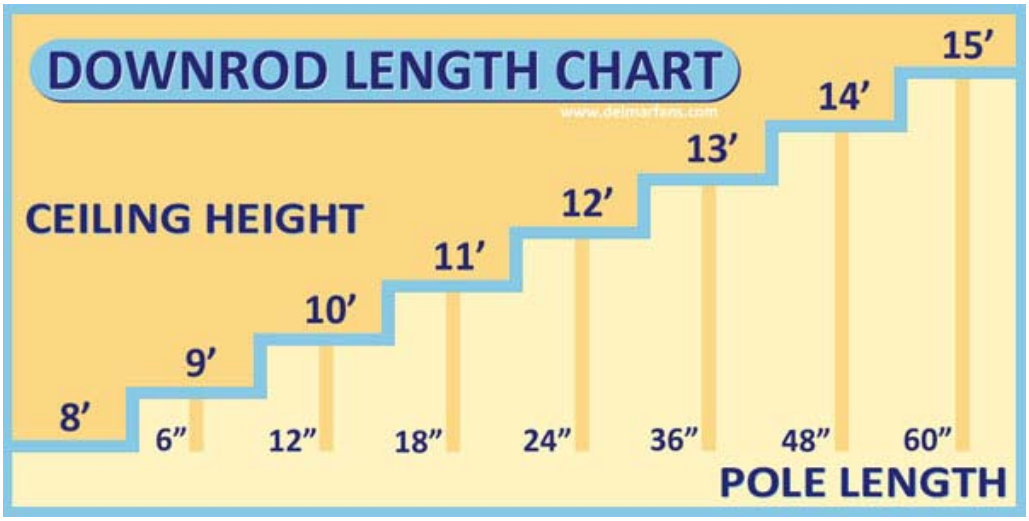

Figure2. 17 Suitable Downrod Length for Home

CHAPTER 3
METHODOLOGY

3.1 Overview

On this chapter, it will cover the details of methodology that will be used to make this project complete and perform well. The method is use to achieve based on the objective of the project that will be accomplished.

3.2 Details about the flow of the project

From the Figure 3.1 below, the project starts with literature review and research about the title. This consist a review of the concept of ceiling fan, the scope of project and also the problem statements. These tasks have been done through research on the internet, books and others sources.

After gathering all the relevant information, the project undergoes design process. In this step, from the knowledge gather from the review is use to make a sketch design that suitable for the project. After several design sketched, design consideration have been made and one design have been chosen. The selected design sketched is then transfer to solid modeling and engineering drawing using SolidWorks program. [10]

After the engineering drawing finished include detail design, the drawing was used as a reference for the next process which is fabrication process. This process is consists fabricate the parts that have design before by following the dimension using various type of manufacturing process. The manufacturing process included in the process is drilling and cutting.

After the fabrication process, come testing process. The testing is to gathered information about design that has been fabricated. The test process just to testing whether the instrument are functioning or not. If this ceiling fan is working, its will go through the next process that is final report process. And if the ceiling fan is not working properly there should begin again with the design process.

All the material for report writing is gathered. This process also included the presentation slide making for the final presentation of the project. The project ended after the submission of the report and the slide presentation has been present.

3.2.1 Project Flow Chart

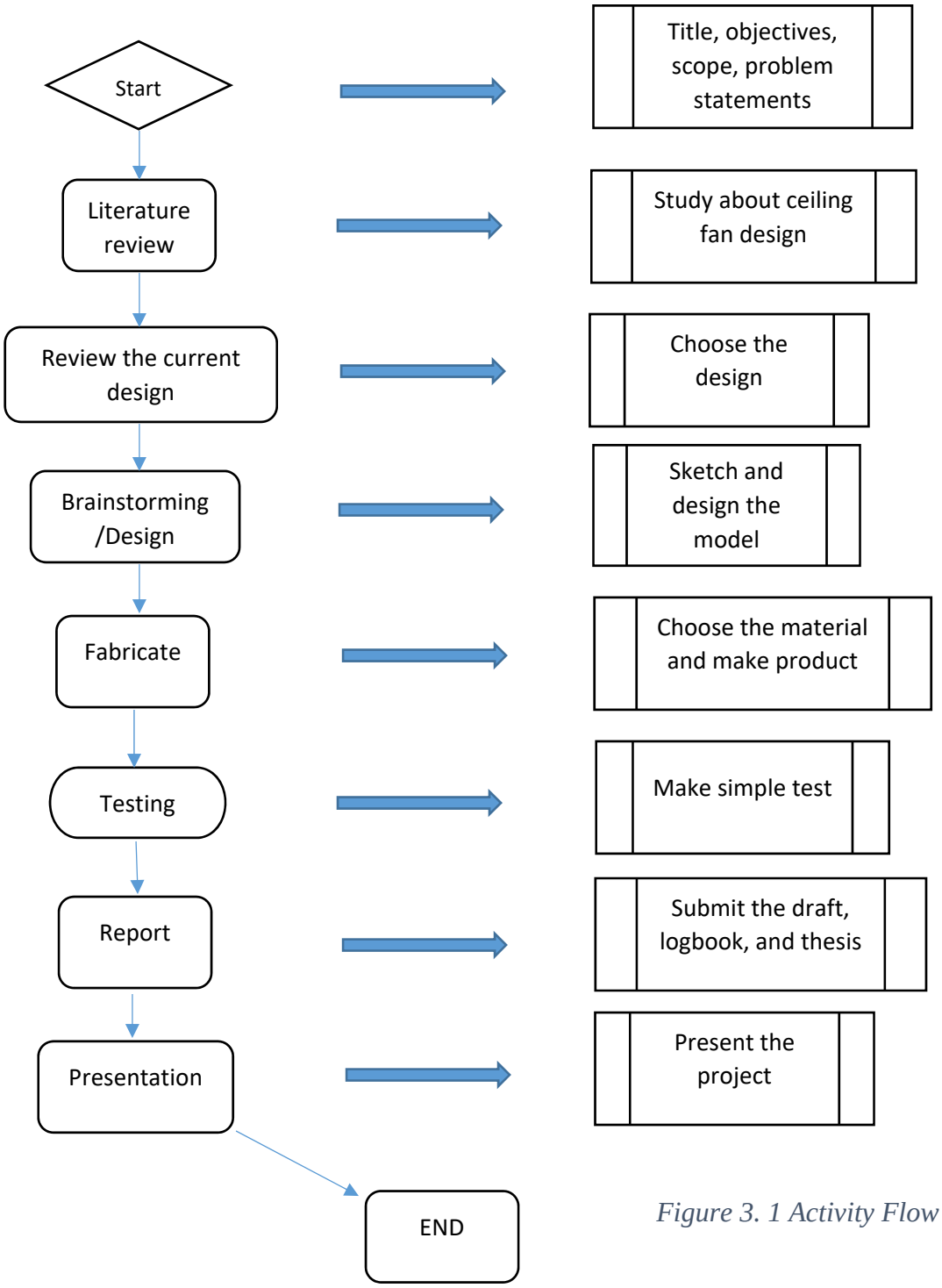

Figure 3. 1 Activity Flow Chart

3.3 Project Gantt chart

3.3.1 Semester 1 Gantt chart

This project begun with the selection of FYP title for each student on week 1. That is where students were assigned to their respective supervisors. Arrangement several meeting with supervisor were clearly about the scope of title, synopsis from previous research and tool requirement which included software (Solid Work) or hardware (machining). The following week, were about researching plan for the design for ceiling fan easily cleaning for domestic users. The research for information via internet, books, supervisor, and others relevant academic material that related to the title.

The finding of literature review is a continuous process where it will took a long time so basically it took the whole timeline of this project to finish it. The project proposal report were submitted on week 1 on November. After the proposal has been accepted, few concepts detail need to be sketched and shown to the supervisor. The information were more details on the design of ceiling fan and how it works. The sketching and concept were drawing. The selected drawing will be drawn using solidwork modelling.

The data were analyze and selected material were discussing to choose the right materials. On the following week, the interim report writing were submitted to supervisor. The Figure 3.2 below showed the Gantt chart for Semester 1 2016/17.

TASK	SEMESTER 1 2016/17											
	OCTOBER				NOVEMBER				DECEMBER			
	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 1	WEEK 2	WEEK 3	WEEK 4
FYP Briefing												
Solidwork Training												
Weekly Progress Report												
RESEARCH PLAN												
Gantt Cart												
Literature Review Writing												
Detail of scope work												
Project Background writing												
Submit Proposal												
CONCEPT DRAWING/DESIGN												
Drawing/Sketch Model Concept												
Solidwork Drawing												
EXPERIMENTAL												
Selected Materials												
Analyses Materials												
REPORT WRITING												
Interim report												
Interim Viva												

Figure 3. 2 Semester 1 Gantt chart

3.3.2 Semester 2 Gantt chart

The project were continued in semester 2 as the Figure 3.3 below. The machining and fabrication process were using as well to fabricate the main part of ceiling fan. In order to generate a brand new concept into the ceiling fan, a product concept which is a critical part that must be taken into consideration so that the prototype manufactured can reach the objectives as well as the market need.

After finishing prototype for ceiling fan, the final writing for thesis are need to be done as well. The criteria for the project were fully clear follow the objective.