

A DESIGN AND DEVELOPMENT OF RAIN-SENSING
AUTO WINDOW CLOSURE FOR HOME

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**A DESIGN AND DEVELOPMENT OF RAIN-SENSING
AUTO WINDOW CLOSURE FOR HOME**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Design) (Hons.)

by

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TAJUK: A DESIGN AND DEVELOPMENT OF RAIN-SENSING AUTO WINDOW CLOSURE FOR HOME

SESI PENGAJIAN: **2015/16 SEMESTER2**

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design) (Hons.). The member of the supervisory is as follow:

.....

(Dr. Suriati binti Akmal)

Supervisor

ABSTRAK

Penderiaan hujan untuk produk penutup tettingkap automatik merupakan inovasi untuk menutup tingkap apabila hujan dikesan menggunakan sensor hujan. Tujuan projek ini adalah untuk menyelamatkan harta di dalam rumah seperti perabot yang mudah rosak apabila terdedah kepada basah titisan hujan seterusnya boleh mengelakkan pembaziran wang untuk menggantikan item yang baru. Ini disebabkan oleh kerana kebanyakan negara adalah di lingkungan kawasan hujan tropika terutamanya negara Asia yang mendapat purata hujan yang optimum. Perkara yang khusus mengenai ergonomik, pelanggan, alam sekitar, kos, keselamatan dan standard, estetika, operasi, jangka hayat perkhidmatan, jangka hayat produk, pasaran, bahan, paten, prestasi, kualiti dan kebolehpercayaan, ujian dan berat adalah diambil dikira. Selepas memberi sumbang saran, projek ini diteruskan dengan pengurusan projek, kajian analisis pasaran, spesifikasi produk, melakar generasi konsep, membuat pemilihan konsep, dan membuat ujian konsep. Kemudian, bahan baru dipilih dengan menggunakan perisian CES. Analisis reka bentuk telah dijalankan melalui Analisis Elemen Terhad (FEA) dan analisis kelesuan dengan menggunakan perisian Solidowork. Setelah kajian yang dilakukan berhasi sepenuhnya, prototaip produk dibina selama tempoh lima minggu. Akhir sekali, laporan bertulis bagi Projek Sarjana Muda 1 (PSM 1) dan Projek Sarjana Muda 2 (PSM 2) dilengkapkan.

ABSTRACT

The rain sensing for automatic window closure product is an innovation to close the window once the rain is detected using a rain sensor. This is because many country is under the area of a tropical rain forest climate that got an optimum average of rainfall. The aim of this project is to safe the property in the house such as the furniture that are easily damages when exposed to the wet of rain drops, thus can avoid waste of money to replace the item for a new one. The specific thing about ergonomics, customer, environment, cost, safety and standards, aesthetics, operation, life in service, product life span, market, material, patents, performance, quality and reliability, testing and weight are calculated. After brainstorming, the project is continued by project management, survey the market analysis, product specifications, a concept generation, a concept selection and a concept testing. Then, a new material is selected by using CES software. An analysis on the design is done through conducting FEA and fatigue analysis by using Solidwork software. After a research is fully done, the prototype of the product is made for five week duration. Finally, a written report for the Bachelor Project 1 (PSM 1) and Bachelor Project 2 (PSM 2) are completed. Secara keputusannya, nilai faktor keselamatan yang diperoleh dari analisa statik bagi gabungan bahagian pengehad penggerak dan bahagian penggerak tidak akan gagal pada faktor keselamatan 2.50 Mpa apabila tenaga putaran 1 N.m digunakan. Selain itu, bahagian silinder akan gagal apabila faktor bebanan dibawah nilai 1.0 apabila daya 50N dan 100N dikenakan bagi 1000 kitaran. Manakala, bahagian-bahagian yang lain tidak akan gagal terhadap daya 100N.

DEDICATION

Specially dedicated to my beloved mother, father, family, friends, lecturers and staffs who provide a loving, caring, encouraging and supportive atmosphere. These are characteristics that contribute to the environment that is always needed to achieve the goals ahead.

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for Automatic window closure tool”

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LIST OF ABBREVIATIONS,SYMBOLS AND NOMENCLATURE

CAD	-	Computer Aided Design
PSM	-	Projek Sarjana Muda
Vs.	-	Versus
US	-	United States
EU	-	European Union
Ltd	-	Limited
K	-	Kelvin
AC	-	air-conditioning
HVAC	-	Heating, ventilating, and air conditioning
NV	-	natural ventilation
GM	-	General Motors
DC	-	direct current
TRMM	-	Tropical Rainfall Measuring Mission
mmh	-	Milimeter hour
%	-	Percent
mm	-	milimeter
in	-	inches
σ	-	standard deviation
x	-	each value in population
\bar{x}	-	mean of values
N	-	number of values
CV	-	Coefficient of variation
et al	-	et alii (and others)
IP	-	Ingress Protection
m	-	meter
SHEVS	-	smoke and heat exhaust systems
UTeM	-	Universiti Teknikal Malaysia Melaka

IEEE	-	Electrical and Electronics Engineers
W	-	Weight
m	-	product of the mass
g	-	magnitude of the local gravitational acceleration
SI	-	System of Units
N	-	Newton
3D	-	3-dimensional
+	-	pluses
-	-	minuses
0	-	zeroes
QFD	-	Quality function deployment
CES	-	Cambridge EduPack software
AM	-	Additive manufacturing
FDM	-	Fused deposition modelling
STL	-	stereolithography
FEA	-	Finite Element Analysis
3D	-	3-Dimensional
QFD	-	Quality Function Deployment
FOS	-	Factor of safety
Sm	-	Allowable working unit stress
sw	-	Working stress (Allowable stress)
UTeM	-	Universiti Teknikal Malaysia Melaka
Fe	-	Iron
kg/m ³	-	Kilogram per meter cubic
°C	-	Degree celcius
MPa.m	-	Mega Pascal meter
UV	-	Ultraviolet
DC	-	Direct current
LED	-	Light emitting diode
DoF	-	Degree of freedom
Kg	-	Kilogram
RM	-	Ringgit Malaysia
pcs	-	pieces

,

mm	-	milimeter
F	-	Force
S	-	Stroke
H	-	Height
W	-	Weight
N/mm ²	-	Newton per milimeter square

CHAPTER 1

INTRODUCTION

1.1 Introduction / Background

A window is an opening in a wall , entryway, rooftop or vehicle that allows the passage of light and, if not closed or sealed, air and sound. There is a variety of window design in the current era to facilitate the flow of air inside the house. However, there is a lack of facilities to prevent the entry of rain into the house when the windows should be closed manually. It is a little inconvenient that users are always busy and have a job outside the home. There are various methods used to solve the problem, such as using hands as the manual method to open the window and pulled the panel in addition to automated methods. However, this method is limited by the condition itself. The result is very different compared with the automated methods in a variety of things. Window automation is used predominately for the purpose of natural ventilation. It is very useful when emergencies in order to save their property in addition facilitate the movement of the user and is a primarily a security feature. The product that is invented called as "Rain-Sensing for Automatic Window Closure for Home" is an items that help the users to feel more easily in their work without worried on the house's condition when the rain falls. This product function when the window panel is moved closer to the wall as the system implemented on the rain sensor gave a signal to the tool that is acted as a robot arm to drag the window panel.

1.2 Problem of Statement

The motivation behind this venture is to plan a window that will close automatically during a raining season in order to avoid any hassle caused in continuously raining areas by closing the window automatically. In addition, this project assists the practice in Computer Aided Design (CAD) program for a purpose of designing the machines. "Rain-Sensing for Automatic Window Closure for Home" is one of needed product in a daily life especially for Asian country. The product invented help to against the damages of house's property when the rain drops reach an inner area of the house, thus gave the worst impact towards the users quality and economy in daily life.

1.3 Objective

The objectives of the PSM 1 and PSM 2 are:

- a) To investigate the problem regarding the existed automatic window closure in market.
- b) To design a better product of automatic window closure.
- c) To make an analysis on the design of automatic window closure product.
- d) To fabricate a prototype part of the suitable design selected.

1.4 Scope

In this project, the scope is focused on the problem investigation, product design specification, conceptual designs, details design, create a prototype and testify the function. To make a comparison from the existing product in the market, the scope of study includes the focused on the product history, literature survey, market survey and the study of capabilities of the existing product that relates with the material selection and a design comparison before the suitable new design of automatic window closure is proposed. Then, the fabrication of the prototype according to the detail design is produced.

CHAPTER 2

LITERATURE REVIEW

2.1 Window design in global used

2.1.1 History of window

A people is connected with the external world by a window which is an element of a flat and a depiction of a house. An image of the facades is created and the building's interior is decorated to protect users against rain, cold, wind and noise. By referred to a dictionary, a windows literally started out as a holes in the walls as shown in Figure 2.1.1. A light and air is certainly allowed in but also the elements and pests. The holes would be covered with animal hide, cloth or wood in the coming years. Then, a shutters that could open and close came next that offered more control over the elements as well as privacy. A windows evolved that allowed the transmission of light throughout the coming years as well as to protect the interior of the home from the elements.



Figure 2.1.1: Holes in the walls (Chatfield 2005)