# DEVELOPMENT OF A SENSORY SYSTEM FOR A MECHANICAL LINKED ADULT FINGER

**WARHAMNI BINTI ABDUL KADIR**

**(2007271108)**

A thesis submitted in partial fulfillment of the requirement for the award of Bachelor Engineering (Hons) Mechanical

**Faculty of Mechanical Engineering**

**University Teknologi MARA (UiTM)**

**MAY 2010**

ACKNOWLEDGEMENT

Alhamdulillahi robbil A'lamin, praise to Allah the Almighty, selawat and salam to our greatest Prophet Muhammad SAW; to all his family and also to his good companions. With strength given by Allah, I finally succeed in completing this thesis.

For this golden opportunity, I would like to convey my greatest appreciation to my project supervisor Puan Roseleena bte Jaafar for her continuous support, guidance, help, patience, consideration and encouragement in the duration of the thesis preparation until its completion. I also would like to thanks Dr. Low Cheng Yee as my project co-supervisor for his generosity in sharing ideas, assistance and advice throughout this project. I am grateful for having the chance to learn from the best people within this field.

My heartiest thank goes to Saifiil Bahari bin Shaari, a postgraduate student in Mechanical Engineering UiTM who had helped me a lot in brainstorming ideas for this project. Not to be forgotten, special thanks to Kolja R8se; an exchange student from University of Applied Sciences Osnabrilck for his generosity in sharing technical knowledge for programming electronic devices and a lot more names which are not on the list. This project would not have been like this if they had not given their help and encouragement.

Finally, I would like to express my overwhelmed gratitude to my lovely family especially my mother; Puan Jamilah bte Rahmad and my father En. Abd Kadir bin Yusoff for their continuous support, encouragement, patience and most of all for having faith in me. Without them, I might not be able to be where I am today. May Allah bless to all of you.

# ABSTRACT

The aim of this thesis is to develop a sensory system to be modeled together with a mechanical linked adult finger prototype in order to sense the softness and hardness of a surface. The mechanical linked adult finger has a 3 Degrees-of-Freedom (DOF) with three links driven by an actuator through a pulley system designed using a Computer Aided Design (CAD) software; CATIA® v5. A working model using Stereolithography Rapid Prototyping (RP) technique was fabricated to demonstrate the working function of the finger. A servomotor was programmed to control both the flexion and extension movement for the mechanical linked adult finger using PIC16F877A microcontroller. A 0.2mm thin film Force Sensing Resistor (FSR) tactile sensor with a sensing area of 9.5mm has the ability of sensing force ranges up to HON, was placed at the tip of the prototype finger. In addition, the use of C-software; MPLAB® to write and compile the codes helped to ease the process of designing the applications for the controller. Both the servomotor and the tactile FSR sensor were successfully integrated into one controller board which was used to demonstrate the model's functionality. As a result, the flexion-extension movement established from the model had almost the same range of movement to a human finger while the FSR tactile sensor on the other hand was able to give load value for an object surface in contact The model however, still requires further work and upgrading on its sensory system to enhance and improve its functionality.

## TABLE OF CONTENT

**CHAPTER TITLE**

PAGE TITLE

ACKNOWLEDGEMENT

ABSTRACT

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLE

LIST OF ABBREVIATIONS

**1 INTRODUCTION**

1.1 Introduction of Project

1.2 Objective of Project

1.3 Scope of Project

1.4 Significance of the Project

1.5 Problem Statement

1.6 Project Methodology

1.6.1 Literature Review 5
1.6.2 Study on the Finger Design 5
1.6.3 Designing a Mechanical Linked Finger 6
1.6.4 Research on Sensory System in Robotic Hands 7
1.6.5 Research on Sensor Hardware and Programming 7
1.6.6 Motor and Sensor Selection and Programming 8
1.6.7 System Integration 8
1.6.8 System Functionality 9

**LITERATURE REVIEW 10**

2.1 Study of Human Fingers 10
2.2 Study of Robotic Fingers 13
2.2.1 Internal Actuator Type 13
2.2.2 External Actuator Type 15
2.3 Study of Tactile Sensor in Robotic Fingers 16

**DEVELOPMENT OF A MECHANICAL LINKED ADULT FINGER 19**

3.1 Mechanical Linked Adult Finger Design 200
3.1.1 Conceptual Design of a Mechanical Linked Adult Finger 20