



# **UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

## **MECHANISM DEVELOPMENT OF FLEXIBLE WORKTABLE**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotics and automation) with Honours

by

**MOHD MUAMMAR GADDAFI B. AB. AZIZ**

**B050810045**

FACULTY OF MANUFACTURING ENGINEERING

2011

MECHANISM DEVELOPMENT OF FLEXIBLE  
WORKTABLE

MOHD MUAMMAR GADDAFI B. AB. AZIZ  
B050810045

UNIVERSITI TEKNIKAL MALAYSIA MELAKA  
2011

B050810045 BACHELOR OF MANUFACTURING ENGINEERING (ROBOTICS & AUTOMATION)

2011 UTaM



## UNIVERSITI TEKNIKAL MALAYSIA MELAKA

### BORANG PENGESAHAN STATUS LAPORAN PSM

TAJUK: **Mechanism Development of Flexible Worktable**

SESI PENGAJIAN: 2010/11 Semester 2

Saya **MOHD MUAMMAR GADDAFI B. AB. AZIZ**

mengaku membenarkan tesis (PSM/Sarjana/Doktor Falsafah) ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. \*Sila tandakan (✓)

SULIT

(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia yang termaktub di dalam AKTA RAHSIA RASMI 1972)

TERHAD

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

TIDAK TERHAD

Disahkan oleh:

\_\_\_\_\_

\_\_\_\_\_

Alamat Tetap:  
LOT 345, KAMPUNG JOH,  
LABOK,  
18500 MACHANG,  
KELANTAN DARUL NAIM.

Cop Rasmi:

Tarikh: \_\_\_\_\_

Tarikh: \_\_\_\_\_

\* Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.

## **DECLARATION**

I hereby, declared this report entitled “Mechanism Development of Flexible Worktable.”  
is the results of my own research except as cited in the reference.

Signature : .....

Author's Name : MOHD MUAMMAR GADDAFI BIN AB. AZIZ

Date : 01 NOVEMBER 2010

## **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 (Robotics and Automation) with Honours. The member of the supervisory committee is as follow:

.....

Supervisor

## **ABSTRAK**

Projek development flexible worktable yang akan digunakan di dalam pelbagai bidang termasuk industri. meja kerja yang fleksibel mempunyai x, y, dan z paksi memerlukan bentuk yang sistematik, sangat menitik berat seperti kos bahan, proses pemilihan bahan, pemilihan proses, alat alat yang di gunakan untuk membangunkan projek ini dan fungsi bentuk dengan pergerakan paksi x, y dan z tanpa halangan pergerakannya. Semua idea dan perkiraan asal di tulis dengan membuat lakaran, seterusnya dipindahkan ke lukisan yang lebih terperinci. Kesemua bahagian lukisan dimasukkan pada proses pergerakan menggunakan solidwork. Walau bagaimana pun, untuk menggunakan meja kerja ini mestilah melibatkan kerja kerja yang ringan sahaja kerana meja kerja ini terdapat spesifikasi yang telah di kaji dalam projek ini.

## **ABSTRACT**

The project development of flexible table which is can be used in various field includes industrial field. This flexible table are built in 3 axis. Axis X, Y and Z needs systematic design to make sure it is stable and suitable to the situation of uses. During the process in making the flexible table it is important to choose the quality and suitable materials, and tools to make sure the movement of every axis doesn't have any distraction. The flow of making also important to support the stability of the product. All the original idea are sketch and then transform to the details drawing. Then the details drawing are bring to the movement and motion process using SolidWork software. Although the chooses of the material for this flexible table is very specific, it only can be uses for minor work only. It is depends on specification that had been examine.



## **DEDICATION**

Allhamdullillah thank God, finally I can complete these reports on time. Thank you also to my beloved parents who gave me full support as I able to complete my PSM report.

To my beloved Lecturer Mr. Khairol Anuar Bin Rakiman thank you for your assists and your understanding. Your guidance and advice is very helpful for me in completing the PSM report.

To all my friends thank you very much for your help and support in completing the project and everything in this semester. The spirits of your words as well as to prepare reports affect my PSM.

May God bless you all.

Thank you.

## ACKNOWLEDGEMENT

*In The Name of Allah Almighty and The Most Merciful and Blessing  
Be Upon His Messenger Prophet Muhammad S.A.W<sup>o</sup> and His Companions*

I am thankful to God for His guidance of divine inspiration, which has helped me in solving this PSM. I am indebted to the following colleagues for their suggestions, assists and support: Mr. Khairol Anuar Bin Rakiman (my supervisor), Dr Zamberi Bin Jamaludin (Robotics and Automation Head of Department). Thank you also for the lecturers FKP for advice and support on the PSM. I am grateful to my dear BMFA colleagues for their support and encouragement. I want to thank my father and my mother, for warmth and a strong support. Thanks go to my housemate's for their support and understanding. I also want to thank my family for the courage and their nonstop support. I must thank all the friends who knew me for advice, supporting and understanding.

Last but not least, I do not know how to thank my lecturers PSM appraiser, who have take the time to evaluate my PSM. Kindness and sincerity, I hope to receive a blessing from God and I truly appreciate your sincerity.

**Thanks & Best Regards**

MOHD MUAMMAR QADDAFI BIN AB AZIZ

# TABLE OF CONTENTS

	<b>Page</b>
Abstrak	i
Abstract	ii
Dedication	iii
Acknowledgement	iv
Table of Content	v
List of Tables	ix
List of Figure	x
List of Abbreviations, Symbols, Specialized Nomenclature	xii
<b>1. INTRODUCTION</b>	<b>1</b>
1.1 Project background	1
1.2 Problem statement	2
1.3 Objectives	3
1.4 Scope of the project	3
1.5 Project planning	3
<b>2. LITERATURE REVIEW</b>	<b>5</b>
2.1 Introduction	5
2.2 Material Selection	5
2.2.1 Intuitive methods in material	5
2.2.2 Basic of systematic material selection	7
2.2.3 First part: The base	9
2.2.4 Second part: The stand	9
2.2.5 Third part: The top of the table	10
2.3 Selection Process	10
2.3.1 Conclusion	12
2.3.2 Fishbone diagram	13

2.4	Equipment and tools	14
2.4.1	Electrical part	14
2.4.1.1	Motors	14
2.4.2	Software component	19
2.4.2.1	Software SolidWord	19
<b>3.</b>	<b>METHODOLOGY</b>	<b>20</b>
3.1	Introduction	20
3.2	Process of flow chart	20
3.3	Conceptual design	22
3.3.1	Sketch of conceptual design	22
3.4	Mechanical properties	24
3.5	Component fabrication	25
3.5.1	Feature base	25
3.5.2	Feature stand	26
3.5.3	Feature top	26
3.5.4	Entire dimension	27
3.5.5	Theory of calculation	29
3.5.6	Motor selection	32
3.5.7	Specification motor	34
3.5.8	Assembly process	34
3.8	Prototyping test	35
3.8.1	Discussion	35
3.8.1.1	Manufacturing costing	35
<b>4.</b>	<b>DESIGN AND DEVELOPMENT</b>	<b>37</b>
4.1	Mechanical structures	37
4.1.1	Rendered	37
4.1.2	Unrender	38
4.1.3	Ortographic	39
4.1.4	Movement on axis	40

4.1.4.1	On X axis	40
4.1.4.2	On Y axis	41
4.1.4.3	On Z axis	43
4.2	Electrical circuit assembly	44
4.3	Motor gear ratio	45
4.3.1	Simple rpm calculation	46
4.4	Generate idea for last design	47
4.3.1	Use one jack	47
4.3.2	Use double jack	48
4.3.3	Use combine jack	48
4.5	Design prototype	50
 <b>5. RESULT AND DISCUSSION</b>		 <b>51</b>
5.1	Testing data X axis	51
5.1.1	Force for X axis	52
5.1.2	Torque for X axis	52
5.1.3	Power for X axis	52
5.1.4	Time for X axis	53
5.1.5	Discussion on the X axis	54
5.2	Testing data Y axis	56
5.2.1	Force for Y axis	57
5.2.2	Torque for Y axis	57
5.2.3	Power for Y axis	57
5.2.4	Time for Y axis	58
5.2.5	Discussion on the Y axis	59
5.3	Testing data Z axis	62
5.3.1	Force for Z axis	62
5.3.2	Torque for Z axis	62
5.3.3	Power for Z axis	63
5.3.4	Time for Z axis	63
5.3.5	Discussion on the Z axis	64

<b>6. CONCLUSION AND RECOMMENDATION</b>	<b>67</b>
6.1 Conclusion	67
6.2 Recommendation	69
<b>REFERENCES</b>	<b>70</b>

## LIST OF TABLES

2.1	The selection of material for the base part	9
2.2	The selection of material for the stand part	9
2.3	The selection of material for the top part	10
3.1	Specification of development flexible worktable	29
3.2	Motor selection	33
3.3	Estimate cost	36
4.1	Generate idea for the last design	47
5.1	Load, force, torque, power, calculated time for X axis	54
5.2	Calculated time and recorded time for X axis	55
5.3	Load, force, torque, power, calculated time for Y axis	59
5.4	Calculated time and recorded time for Y axis	60
5.5	Load, force, torque, power, calculated time for Z axis	64
5.6	Calculated time and recorded time for Z axis	65
6.1	overall result of project	68

## LIST OF FIGURES

2.1	Intuitive method in material selection	6
2.2	Basic of systematic material selection	7
2.3	Fishbone diagram	13
2.4	Block diagram of a stepper motor system	15
2.5	FANUC servo motor	15
2.6	Brush DC motors	16
2.7	A split ring commutator	17
2.8	4 pole AC motor	18
2.9	Wound field motor	18
3.1	Project flow chart	21
3.2	Sketch for design A	22
3.3	Sketch for design B	23
3.4	Sketch for design C	23
3.5	Sketch for dimension axis X	27
3.6	Sketch for dimension axis Y	27
3.7	Sketch for dimension minimum axis Z	28
3.8	Sketch for dimension maximum axis Z	28
3.9	Models and drawings of the motor	32
3.10	Table shows gear ratio selection	33
3.11	Table shows the motor according to the gear ratio selection	33
4.1	Rendered	37
4.2	Unrender	38
4.3	Ortographic	39
4.4	Normal view on X axis	40
4.5	Positive X axis	40
4.6	Negative X axis	41



4.7	Normal view Y axis	41
4.8	Positive Y axis	42
4.9	Negative Y axis	42
4.10	Negative Z axis	43
4.11	Positive Z axis	43
4.12	Electrical circuit assembly	44
4.13	Power window motor on separated	45
4.14	Two gears in the power window motor	45
4.15	Use one jack	47
4.16	Use double jack	48
4.17	Use combine jack	49
4.18	The combine jack was placed on the body worktable	49
4.19	Design prototype	50
5.1	Graph of time versus load for X axis	56
5.2	Graph of time versus load for Y axis	61
5.3	Graph of time versus load for Z axis	66

# **LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE**

CAD	-	Computer Aided Design
3D	-	3 Dimension
2D	-	2 Dimension
VDC	-	Virtual Design and Construction
PLC	-	Programmable Logic Controller
FANUC	-	Factory Automatic Numerical Control
AC	-	Alternating Current
DC	-	Direct Current
PSM	-	Projek Sarjana Muda
UTeM	-	Universiti Teknikal Malaysia Melaka

# CHAPTER 1

## INTRODUCTION

### 1.1 Project Background

Development of flexible worktable is to increase knowledge in the fields of engineering and manufacturing technology of today. Additionally, many voiced the demand that attempted to comfort and convenience to consumers in various fields. To know that the problem now, which is flexible worktable existing system, is very weak in terms of movement, control, design is about function and in terms of cost is too high. Various kinds of ideas that comes to mind to provide convenience to the users to control and provide enjoyment to all levels of society to have it. With the idea of systematic design, could be adopted in all the jobs that require advanced worktable at home or in the industry. Worktable flexible is very important, for example, be used by project managers, engineers, architects, mechanics, artists, designers and others who need to make more than one task at a time. Use flexible work table is normally applied in the aircraft repair industry as a tool for increasing and decreasing the Z axis, left and right on the X axis, and forward and backward on the Y axis is the motion and correcting the position of engine and chassis during the installation of ship engines fly. With the findings and how to work this situation, flexible worktable is created with a size suitable for use in various types of professionals do the job.

As a proven flexible tool worktable is easy with the situation where the quality and space-saving and eco-environment, the electrical system is chosen as a function of the power to move it without using a system of pneumatic and hydraulic systems. X, Y and Z axis movement is a testament to save space in a variety of work situations that are very narrow and does not complicate the situation. To implement the best product, material selection and motor selection is taken seriously in the development of flexible worktable. This project is also a lot of research, expertise and selection process to be controlled for realizing the excellence of products useful in the future.

## **1.2 Problem Statement**

Individuals who often have trouble working with a narrow space, should have a desk and an adjusting movement of the worktable height, usually people who use large work space, must be taken to several places, a flexible workbench is a tool for them to do the job of the day , such as mechanics, engineers, architects, artists, designers and other professionals. Typically, they use a table that does not require a connection from a source of electricity, with a desk job that requires a flexible electrical connection or battery power to activate. As a result, flexible working desk requires high maintenance costs compared to the normal worktable, In addition, by using a flexible workbench users would be easy to put in the correct position, only for the first time. Done in the right place, it will move the worktable. For use in open space, users need to make a connection to the battery, users also have difficulty feeling of when using in the room or in the workplace.

### **1.3 Objective**

The major objectives of this project are:

- a) To study the appropriate load design and size of flexible worktable.
- b) To study proper materials to suit of materials for the development of a with flexible worktable.
- c) To develop a good flexible worktable with part of mechanism.

### **1.4 Scope of Project**

For the scope of this project, many things need to be explored, such as design loads that are suitable to the working environment and to ensure that the project is leading to the right direction to achieve goals such as finding the appropriate size. This project is aimed to design a systematic and flexible simulation worktable movement such as y axis, and z without the interference of movement, with the help of solidwork software. Before using the software, a sketch of this process is needed. To enroll this project, learning the process of selection of materials is important to produce high quality and non-perishable products. Therefore, to develop flexible worktable, it is also necessary to test each axis and to take data for every test. With the data, we can make right improvement to the products.

### **1.5 Project Planning**

The project planning is needed to identify and plan to achieve the objective with the punctual time planning. The good planning can make the project is in actual track. For a good time management planning, a Gantt chart is a suitable method in applying a guide for the project proceeds.

A Gantt chart is a type of bar chart that illustrates a project schedule. Gantt charts illustrate the start and finish dates of the terminal elements and summary elements of a project. Terminal elements and summary elements comprise the work breakdown structure of the project.



## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter is about material selection, process selection, design and specifications used in building a flexible workbench. Materials play an important role to make the product strong, durable, and relevant or appropriate in the use of industry and daily life. This can lead to comfort in the work to be done. To develop quality products, the uses of appropriate equipment are also discussed in this chapter.

#### **2.2 Material selection**

Materials selection activities can be improved by tools that are used in a design brief meeting between product designers and clients. These tools, in broad outlines, can help clients to express what kind of user-interaction they want to create with the product and its materials. Furthermore, the tools support product designers to translate these desired user interactions in a material profile. This profile is then used in the information searches about candidate materials.

##### **2.2.1 Intuitive Methods in Material Selection**

Selection of materials in the industry environment was made after detailed analysis and in accordance with a systematic procedure. Some general rules are listed in Figure 2.1