UNIVERSITI TEKNIKAL MALAYSIA MELAKA
(UTeM)

MOTORIZED WORKTABLE FOR ROBOTIC APPLICATION

Thesis submitted in accordance with the partial requirements of the
Universiti Teknikal Malaysia Melaka for the
Bachelor of Manufacturing Engineering (Robotics and Automation)

By

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DECLARATION

I hereby, declare this thesis entitled "**MOTORIZED WORKTABLE FOR ROBOTIC APPLICATION**" is the result of my own research except as cited in the references.

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ABSTRACT

The motorized work table for robotic application is not a new idea. Although, there are not many official researchers of it, this technology has potential to be developed. In this project, this motorized work table will produce a table that has multi-function for robotic applications. The main objective of this new motorized work table is, it has movement function for up and down, left and right, and front and behind. At the end of this project, the design of the motorized work table will be showed after the proper review and analyze is made. Then, there are simulations for this motorized work table in the end of this project for the main result. Thus, the appropriate literature view was finding regarding the information that related to this motorized worktable. After that, the processes of making this motorized worktable will be cover in methodology chapter which that the detailed planned was created to compete this thesis. Next, the result of the motorized worktable was shown in step by step from designing until simulation. It was consists the figures of sketching until the final design. Then, the every part of design was shown in isometrics drawing and orthographic drawing with the dimension. After that, the simulation process was shown detail in figures which the figure of first position of motion compares to end position of motion are shown. Lastly, in the discussion, the improvements of the mechanisms used in this motorized worktable are discuses in detail in order for future work.

ABSTRAK

Idea dalam penciptaan meja kerja bermotor bukan sesuatu yang baru. Walaupun begitu, penyelidikan secara rasmi juga kurang dilakukan. Oleh itu, teknologi ini berpotensi untuk dibangunkan. Dalam projek ini, meja kerja bermotor ini dapat melakukan pelbagai fungsi untuk aplikasi robot. Tujuan utama meja kerja ini di rekabentuk ialah mempunyai pergerakan naik dan turun, kiri dan kanan serta depan dan belakang. pada akhir projek ini, rekabentuk meja kerja bermotor ini akan ditunjuk secara teliti bersama dengan analisis-analisis yang berkaitan. Seterusnya, persembahan simulasi akan menjadi keputusan utama dalam merekabentuk meja kerja bermotor ini. Justeru itu, kajian-kajian literasi telah dilakuan secara terperinci dengan mencari maklumat-maklumat yang berkaitan dengan meja kerj abermotor ini. Selepas itu, perancangan-perancangan juga dilakukan dalam bab pengkaedahan yang menerangkan perancangan untuk melaksanakan tesis ini sehingga lengkap diterangkan secara terperinci. Selain itu, gambar-gambar telah ditunjukan di dalam bab keputusan secara terperinci daripada lukisan sehingga ke proses simulasi yang mengandungi gambar-gambar daripada lakaran sehingga lukisan terakhir. Setiap lukisan ditunjukkan dalam bentuk lukisan isometrik dan lukisan ortografik serta dengan demensinya. Selain itu, gambaran simulasi pula ditunjukkan dengan mengunakan gambar pada awal gerakan dan gambar pada akhir gerakan. Kemudiannya, dalam bahagian diskusi, cara peningkatan pengunaan mekanisme pergerakan diambil berat untuk keguanaan pada masa hadapan.

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CHAPTER 1
INTRODUCTION

1.1 Project Background

Nowadays, robotic applications are widely use in industry mainly on automation industry. The technologies have been evolving since its first introduction. Today the revolution of this technology spread faster and goes all around the globe. The robots itself have been evolve. However, the workplace for the robot has yet to catch up the performance of the robot. Nowadays, the work tables for the robot application are static and limited motion capabilities.

The work table used currently is not compatible in term of performance. The limitation makes continuous problems to the robot also to its designer. Therefore, a dynamic work table is required. For most criteria that is needed is multifunction. The functionality of the work table symbolic its specialty and work compatible with the robot. Thus, this can make the pushing onwards the robot capabilities to its limits.

Accumulating all possibilities, it is certain that the productivity will rise enormously. Thus, it will create a higher level pound in automation.

1.2 Problem Statement

From the research that the work table of robotic application is no involved very well. All the involver the robotic field is not gave full attention in developing the work table.

Then, there is some of the dynamics work table but there it was not for the robotics application. It was the ergonomics factor. The ergonomics factors involved the factor of the interaction between the worker and the work situation. Then, it cannot use for the robotics application.

The robotic application involved is welding, pick and place, sorting, drilling, and others as well. Thus, there needs the further research from involver in this fields and need the detailed information in order to make the dynamic work table for robotic application.

1.3 Project Objectives

First of all, the main objective of this project is to design a work table for the robot application with SOLIDWORK software and analyze it in details. Then, in order to completed this project and to shows the result, the simulating of the work table must been done.

1.4 Scope of the Project

The scopes of this study are;

a) Designing the appropriate work table for multifunction in robotic application

b) Analyzing the design in order to get the best design to make further step

c) Simulating the product to get the overall the view of this idea

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Robotics is the science and technology of robots, their design, manufacture, and application. Robotics requires a working knowledge of electronics, mechanics, and software. The word robotics was first used in print by Isaac Asimov, in his science fiction short story "Runaround" (1941)

Although the appearance and capabilities of robots vary vastly, all robots share the features of a mechanical, movable structure under some form of autonomous control. The structure of a robot is usually mostly mechanical and can be called a kinematics chain which is its functionality being akin to the skeleton of the human body. The chain is formed of links which is its bones, actuators which is its muscles and joints which can allow one or more degrees of freedom. Most contemporary robots use open serial chains in which each link connects the one before to the one after it. These robots are called serial robots and often resemble the human arm. Some robots, such as the Stewart platform, use closed parallel kinematics chains. Then, there are have other structures, such as that mimic the mechanical structure of humans, various animals and insects, are comparatively rare. However, the development and use of such structures in robots is an active area of research. Robots used as manipulators have an end effectors mounted on the last link. These end effectors can be anything from a welding device to a mechanical hand used to manipulate the environment.

The mechanical structure of a robot must be controlled to perform tasks. The control of a robot involves three distinct phases - perception, processing and action which is robotic paradigms. Sensors give information about the environment or the robot itself such as the position of its joints or its end effectors. Using strategies from the field of control theory, this information is processed to calculate the appropriate signals to the actuators or motors which move the mechanical structure. The control of a robot involves various aspects such as path planning, pattern recognition, obstacle avoidance, etc. More complex and adaptable control strategies can be referred to as artificial intelligence

The study of motion can be divided into kinematics and dynamics. Direct kinematics refers to the calculation of end effectors position, orientation, velocity and acceleration when the corresponding joint values are known. Inverse kinematics refers to the opposite case in which required joint values are calculated for given end effectors values, as done in path planning. Some special aspects of kinematics include handling of redundancy those different possibilities of performing the same movement, collision avoidance and singularity avoidance. Once all relevant positions, velocities and accelerations have been calculated using kinematics, methods from the field of dynamics are used to study the effect of forces upon these movements. Direct dynamics refers to the calculation of accelerations in the robot once the applied forces are known. Direct dynamics is used in computer simulations of the robot. Inverse dynamics refers to the calculation of the actuator forces necessary to create prescribed end effectors acceleration. This information can be used to improve the control algorithms of a robot

2.2 Robot Application

Robots are built with own intents or agencies and different from other robots. Thus, different robots will have different applications ability. Most common industrial robots applications are pick-and-place, machine loading and unloading, welding, die casting, spraying, machining, palletizing, packaging, ironing, and assembly. In the other hand, as for mobile robots, the applications in human daily life even wider than the industrial

robots as the use of them are not just applicable for industrialists but also for home user, normal workers or in other section such as military. Other than for entertainments, mobile robots are also use in most industries to carry heavy loadings such as use of an AGV or remotely operated vehicles. Certain kinds of mobile robots are use to do the housework such lawn mowing, washing dishes, vacuuming, and mopping. Moreover, as for manual control robot, mostly is build for own collection, interest or personal use. A simple example of a manual control robot is the remote control (RC) toys.

2.3 Relation between Existing Products with Motorized Work Table

First of all, the workplace is a place of work. Meanwhile, the table is piece of furniture. Thus, the work table is the piece of furniture that placed of several of work. However, there are many type of the work table which is for computer table, adjusted table, level table, hash table and others as well. Thus, the work table is also having the purpose which is for the ergonomics purpose or the adjusted purpose. Then, there several type of the work table in the FILA Table or Fact, Idea, Learning and Action Table.

Table 2.1: The Fila Table To Shows the Related Finding with the Motorized Work Table

No.	Fact and Findings	Idea Generating	Learning Outcomes	Action can be taken
1	Welding turn table	There are having turntable and rotary table.	Is have specific motorized for the robotic application?	Make research about the motorized work table.
2	Interaction adjustable table	Only several application of robotic involved	Are cost to make motorized table is high?	Make some simulation with software.
3	Product table from Elite Teams	Can't fully automated	Where are always using motorized	Make the prototype of the new motorized

			table?	work table.
4	Rotary tables at Direct Industry	Many from ergonomics purposed	Why is not many research done in motorized table?	Design useful motorized work table.
5	Motorized rotary table	Have table to computer workstation	Is robotic table is powerful and capable?	Design the part by part of the motorized work table.
6	Fabric cutting work table from GLOBALSPEC	There is having the art table also.	When the motorized table will expand?	Try to present the design to the board at industry.
7	Ergonomics Workstation Adjustable table	Certain table for the several process	Who are responsible to make the motorized table?	Give the suggestion of this technology to the Engineer Society to expand it.
8	Adjustable table ERGOWORKS	Not many have motorized table	How to expand the application of the motorized table?	Build the motorized table and exposed it to media.
9	Flexible Workstation	There are many industries that involved in making table.	What are purposes of the motorized work table?	Separate the information about this technology to engineers.
10	Robotic Turntable	The upgrading table is always happen.	Is the cost of this work table is effective for production?	

11	Multi Position Part holder for robotic application	Much industry used the motorized work table	There are many industrials need this?	
12	Rotary table	The motorized work table is complicated.		

The table is show the related the fact that the existing products. It was searched and generates the fact to become the idea. Then, come out with the question in the result of learning that can be taken. Lastly, come out with the few solution of the problem. In this section, the detail about the existing product will explain.

2.4 Example of Motorized Work Table

2.4.1 Panasonic 3 Axis Model ISP Cartesian Robotic Tig Welding Cell

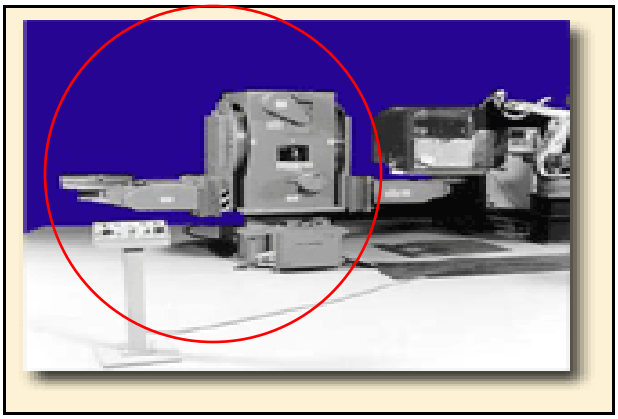

Figure 2.1 RC505001 "2003" Panasonic 3 Axis Model ISP Cartesian Robotic Tig Welding Cell

There are many examples for the welding table. One of it is RC505001 "2003" Panasonic 3 Axis Model ISP Cartesian Robotic TIG Welding Cell. Initially powered up in November 2003 this cell was used off and on for approximately 8 months before the application was discontinued. This Panasonic Model ISP Cartesian Robot has approx. 43" (x) horizontal movement, 15" (y) vertical movement and 21" (z) horizontal movement. There is also a 2 axis clamping fixture or tooling table. The complete welding package on this cell includes Two (2) Water Cooled TIG Torches with manual adjustable separation of the torch holders on one axis, Two (2) Panasonic YC-500WX4 Power Supplies completely integrated with all regulators, hoses, cables etc. Water supply required. The welding cell is 75" wide x 103" high x 145" deep and has a complete safety package including, Powered Safety Screen, Light Package, Front Operating Control and Palm Buttons. This cell could be changed to the MIG welding process.

Then, there are also have RC505002 "2003" Panasonic 4 Axis Model ISP Cartesian Robotic TIG Welding Cell. Initially powered up in November 2003 this cell was used off and on for approximately 8 months before the application was discontinued. This

Panasonic Model ISP Cartesian Robot has approx. 17 1/2" (x) horizontal movement, 10" (y) vertical movement and 15" (z) horizontal movement. The Fourth Axis is a Rotating Wrist movement for the Torch Holding Device. This Cell also includes a Horizontal Moving Fixture/Tooling Table Integrated with the Robot from the Load/Unload position to the Robotic Welding Position. The Complete Welding Package on this cell includes one (1) Panasonic YC-300WX4 Power Supply and One (1) Water Cooled TIG Torch completely integrated with all cables, hoses, etc. Water supply required. The welding cell is 75" wide x 103" high x 126" deep and has a complete safety package including, Powered Safety Screen, Light Package, Front Operating Control and Palm Buttons. This cell also could be changed to the MIG welding process.

2.4.2 Interaction Adjustable Tables by Knoll

Figure 2.3: Interaction Adjustable Tables

Interaction worktables are available with manually adjustable, crank adjustable and counterforce bases, making Interaction an ideal solution for individual and shared work areas. Most top configurations are available with a fixed height base option as well

2.4.2.1 Manually Adjustable Base

- 26 ½" to 29 ½" height range, on ½" increments
- Legs include integral vertical wire manager
- Crossbeam is designed for cable storage, and includes removable black PVC cable flap
- Locking casters can be retrofitted, and increase table height range 1 ½.

2.4.2.2 Crank Adjustable Table

- 23 ½" to 35" height adjustment range
- 300 lb load capacity(not including worksurface)
- Five turns of the handle adjust worksurface one inch
- Handle folds beneath worksurface when not in use
- Legs include integral wire manager
- Locking casters can be retrofitted, and increase table height range 1 ½"

2.4.2.3 Counterforce Table

- Counterforce provides rapid sit-to-stand adjustment, in 26" to 41" range
- Hand paddle actuates the vertical adjustment mechanism
- Safety interlock presented inadvertent height change
- Legs include integral vertical wire manager
- Locking casters can be retrofitted, and increase table height range 1 ½"

2.4.2.4 Top Crank and Electric Height Adjustable Table

- 26" to 42" height adjustment range
- 200 lb. capacity (not including work surface)