UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Design Validation and Development of 6 Axis Robot Components

Thesis submitted in accordance with the partial requirements of the
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By

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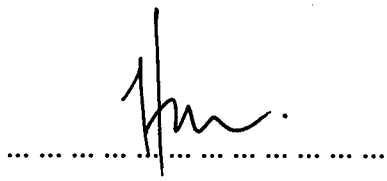
This PSM submitted to the senate of UTeM and has been as partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Process). The members of the supervisory committee are as follow:



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ABSTRACT

In this report, the design validation and development of 6 axis components is elucidated in an in-depth manner. Initially, this robot is designed primarily for the industrial field. Now, it is also widely used in the education field and has been much help in research labs. The processes that involves in completing this robot development project is described in this report as well as the several types of machining process mainly lathe, milling, and welding set. Consecutively, the CAD software is also being used to validate the drawing such as re-checking the dimension and to generate the G-code for machining process.

ABSTRAK

Dalam laporan ini, pengesahan reka bentuk dan pembangunan 6 paksi robot komponen-adalah diterangkan dalam satu cara yang dengan mendalam. Pada mulanya, robot ini adalah direka terutamanya untuk bidang industri. Sekarang, ia adalah juga luas digunakan dalam bidang pendidikan dan telah banyak membantu dalam kajian penyelidikan di makmal. Proses-proses yang terlibat dalam menyelesaikan projek pembangunan robot ini digambarkan dalam laporan ini serta bermacam proses pemesinan terutamanya melarik, mengilang, dan kumpulan kimpalan. Perisian CAD juga dipergunakan untuk mengesahkan lukisan dalam semakan dimensi dan untuk menjana G-code untuk proses pemesinan.

DEDICATION

Special thanks I dedicate to my beloved family especially for Parents and Elis. Thanks for all your love and support. I also would like to say thanks to all my friends for contributing to the success of my project. The successful of this project, cannot be achieved without all of you. Once again, thank you for everything.

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TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURE

CHAPTER 1

INTRODUCTION

1.1 Introduction

As we know today engineering and technology moved together. Both of this is very important to human beings. Without engineering and technology, people will still be as before, every work is so hard. And now with engineering and technology every parts of our life become easier.

History of the word “Robot” comes from Checzh word “Robota” which mean here forced labor. For the word “Robotic” its comes out from science fiction first appear in the short story “Runaround” 1942 by Isaac Asimov.

"A reprogrammable, multifunctional manipulator designed to move materials, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks."

The first industrial robots were Unimates developed by George Devol and Joe Engelberger in the late 50’s and early 60’s. The first patents we by Devol but Engelberger formed Unimation which was the first market robots. So Engelberger has been called the “father of robotics”. For a while the economic viability of these robots proved disastrous and thing

slowed down for robotics. But the industry recovered and by the mid-80's robotics was back on track. (Dowling, Kevin. 1996)

By using robots, the benefits that we can get for the manufacturing processes are numerous and include: increased productivity, improved and consistent output quality (which can also minimize the need for subsequent operations) reduced demand for skilled operators who are hard to find, greater reliability and ease of use , ideal for working in difficult environments or on unpleasant tasks, and the ability to work tirelessly on long shifts.

1.2 Problem Statement

In order to be competitive in the business, the use of latest technology are highly needed to give the best to the customers, which at the same time will create loyal customers because as we know, the cost of retaining loyal customers is cheaper than creating new customers.

The reverse engineering or innovation of a 6 axis robot chassis is chosen because we want to develop a new robot that can function more than its original. The purpose of this reverse engineering is done to develop a robot that can reduce cost of manufacture compare to previous project.

1.3 Objectives

The objectives of the design validation and development of 6 axis robot are:

i. To create or construct the 6 axis robot components

ii. Precision of the components critical dimension.

1.4 Scope of the Research

The scope of the research “Design Validation and Development of 6 axis Robot” are:

i. Undertsand the MTAB ARISTO Robot.

ii. Validation of MTAB aristo Robot.

iii. Apply suitable software such as Autodest Inventor, Catia during this project.

iv. Material selection.

v. Machining process.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Nowadays demand in robot technology is very high , every parts of industry need robots for example automotive industry used robots to increase volume and reduce man power. ideal for working in difficult environments or on unpleasant tasks, and the ability to work tirelessly on long shifts. By using robot technology todays, many benefits can we reap from it.

A robot is a multipurpose machine that acts like a human. It can perform a variety of different task under its conditions. Robot invention also pictured achievement of a country in the use of technology and helps to create consumers especially when the country is well known in quality and advancement in their robots. Robot has its own pros and cons. Even though the use of robot in daily work give a lot of benefits but unfortunately robot is expensive in price and the maintenance cost is high. Problems will arise when a robot is not functioning correctly.

2.2 Definition of Robot

MSN Learning & Research (2000) defined robot as computer-controlled machine that is programmed to move, manipulates objects, and accomplishes work while interacting with its environment. Robots are able to perform repetitive tasks more quickly, cheaply, and accurately than humans.(MSN & Research (2000)). The term robot originates from the Czech word robota, meaning “compulsory labour.” It was first used in the 1921 play R.U.R. (Rossum's Universal Robots) by the Czech novelist and playwright Karel Capek. The word robot has been used since to refer to a machine that performs work to assist people or work that humans find difficult or undesirable. According to the Robot Institute of America (1979) a robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks. (Robot Institute of America (1979).

2.3 Uses of Robots

There are several usage of robots, there are:

i. For industry.
ii. For exploration.
iii. For medicine.
iv. For the military and police.
v. For entertainment.
vi. For toys.

2.3.1 For exploration.

People are interested in places that are sometimes full of danger, like outer space, or the deep ocean. But when they cannot go there themselves, they make robots that can go there. The robots are able to carry cameras and other instruments so that they can collect information and send it back to their human operators.[1]

2.3.2 For industries

When doing a job, robots can do many things faster than humans. Robots do not need to be paid, eat, drink, or go to the bathroom like people. They can do repetitive work that is absolutely boring to people and they will not stop, slow down, or fall to sleep like a human. [1]

2.3.3 For Medicine

Sometimes when operating, doctors have to use a robot instead. A human would not be able to make a hole exactly one 100th of a inch wide and long. When making medicines, robots can do the job much faster and more accurately than a human can. Also, a robot can be more delicate than a human. Some doctors and engineers are also developing prosthetic (bionic) limbs that use robotic mechanisms. Dr. David Gow, of the Prosthetics Research and Development Team at Princess Margaret Rose Orthopaedic Hospital, made the first bionic arm called the Edinburgh Modular Arm System (EMAS) in 1998. [1]

2.3.4 For Military

Some doctors and engineers are also developing prosthetic (bionic) limbs that use robotic mechanisms. Dr. David Gow, of the Prosthetics Research and Development Team at Princess Margaret Rose Orthopaedic Hospital, made the first bionic arm called the Edinburgh Modular Arm System (EMAS) in 1998. [1]

2.3.5 For Entertainment

At first, robots where just for entertainment, but as better technology became available, real robots were created. Many robots are still seen on T.V. (Star Trek - The Next Generation) and in the movies (The Day the Earth Stood Still, Forbidden Planet, Lost in Space, Blade Runner, Star Wars). These imaginary robots do a lot of things that the real ones can not do. Some robots in movies are made to attack people, but in real life they cannot really hurt people at all because they are not in control of themselves. Robots also attack humans in video and computer games. So do not think all robots do is kill, because they can't.[1]

2.3.6 For Toys.

The new robot technology is making interesting types of toys that children will like to play with. One new robotic toy is the "FURBY", which became available in stores for Christmas 1998 - and continues to be very popular. Another is the "LEGO MINDSTORMS" robot construction kit. These kits, which were developed by the LEGO company with M.I.T. scientists, let kids create and program their own robots. A third is "Aibo" - Sony Corporation's robotic dog. Sony is selling limited numbers of Aibo in the U.S.[1]

2.4 Background Industrial Robot.

Industrial robots are mechanical devices which, to a certain degree, replicate human motions. They are used whenever there is a need to reduce the danger to a human, provide more strength or accuracy than a human, or when continuous operation is required. Most robots are stationary, but some move throughout the workplace delivering materials and supplies.[2]

Many people think of robots as the humanoid type monsters that are seen in science fiction and fantasy movies. While we may someday have the technical ability to produce such a machine, today's robots are actually quite simple devices. Motions that we take for granted picking up a coin from the table, for instance are considerably more difficult for a robot. Our brain processes thousands of variable bits of data from our eyes to instruct our arm, wrist, hand, and fingers to reach, grasp, and pick up the coin**.** Even the tactile feel of the coin constantly updates our brain to provide just enough finger pressure to grip the coin securely. Any variations in position are effortlessly compensated for in our brain. To easily and economically program an industrial robot to perform the same task, many of these variables must be restricted or eliminated. Position, reach, weight, and grasp should remain as consistent as possible so that variations do not result in missing or dropping the object. The computer that controls the robot must be programmed by a technician, to "teach" the machine to complete the motion. The areas where robots perform better than humans are in accuracy and repeatability. While some people could pick up the coin with similar motions each time, the robot can perform the operation with exactly the same motions without tiring. Many robots can repeat motions with an accuracy of a few thousandths of an inch and operate 24 hours a day. Because of this tireless, accurate work, robots are a growing segment of industrial equipment purchases. Most are used for repetitive painting and welding operations, while others, known as pick-and-place robots, are used to lift and place products into machines and packages.[2]

2.5 MTAB-ARISTO Robot

This robot is what I am going to develop. This is a 6 axis robot because it has 6 joint and it can move at that joint. ARISTO is a 6-axis vertically articulated robot, suitable for various levels of education, training and research. It is capable lifting up to 3 kg payload. It has a specially developed Robot Programming Language (RPL) and can be linked to FMS/CIM and assembly automation system.

Figure 2.1: Robot 6 axis MTAB-ARISTO

2.5.1 Standard Specification of MTAB-ARISTO Robot

2.5.1.1 Performance Features:

Payload : 3 Kg including gripper

Tip Speed : 0.2 meter/sec

2.5.1.2 Mechanical specification:

Configuration : 3 Kg including gripper

Gripper : Pneumatic / Electrical

Link 1 : 300 mm

Link 2 : 300 mm

Joint Actuators : DC Servo geared motors

Vertical Height : 400 mm

Transmission : Joint 1 : Gear Train

Joint 2 & 3 : Ball screw

Joint 4, 5 & 6 : Timing belt drive

Position Feedback : Optical Encoder (HP 2 phase 500 PPR)

Gravity Compensation: 100% (Non-back drivable ball screw)

No. of Axes : 6 (3axes waist-shoulder-elbow manipulator with 3 axes Roll- Pitch- Roll spherical wrist)

2.5.1.3 Joint Motion:

Joint 1 : 300 degree

Joint 2 : 60 degree

Joint 3 : 60 degree

Joint 4 : 300 degree

Joint 5 : 180 degree

Joint 6 : 300 degree