# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## PLC SIMULATION CONTROL FOR MOTORIZE WORKTABLE

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

By

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TAJUK: **PLC Simulation Control For Motorize Worktable**

SESI PENGAJIAN: 2008/09 Semester 2

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# ABSTRACT

The robotic and application is one of industry widely use. Although, the motorize work table for robotic is one application use in the industry. In this project, it is an improvement design on the previous project that use the Programmable Logic Controller (PLC) to control the motorize worktable motion in X, Y and Z axis. Then, the projects are also to make some improvement for existing of motorize worktable design. In order to fulfill this project, the modification were needed on the necessary part of the motorize worktable, make the analysis and working simulation programming by use the suitable programming software. The software that use for this project are SolidWorks, Automation Studio and Automation Studio as the PLC programming software. Thus, the appropriate literature review was finding regarding the information that related to this motorized worktable. After that, the processes of making this motorize worktable will be cover in methodology chapter which that the detailed planned was created to complete this project. Then, the design chapter views all the criteria that involve and needed to complete this project properly. At the end of this project, the design of this project will be showed by use the sketching drawing, three dimension drawing and the working PLC simulation programming are done on the motorize worktable to make it function smoothly.

# ABSTRAK

Robotik dan aplikasi adalah satu aplikasi penggunaan yang meluas dalam industri. Walaupun begitu, mesin kerja bermotor merupakan salah satu aplikasi yang digunakan dalam industri. Dalam projek ini, penambahbaikan akan dilakukan pada reka bentuk dari projek yang telah dilakukan dengan menggunakan program komputer yang berkaitan, iaitu *"Programmable Logic Controller (PLC)."* Program tersebut bertujuan untuk mengawal pergerakan meja kerja bermotor dalam tiga dimensi iaitu paksi X, Y dan Z. Kemudian projek ini juga bertujuan untuk melakukan sedikit penambahbaikan pada reka bentuk meja kerja bermotor yang sedia ada. Bagi menyiapkan projek ini, pengubahsuaian diperlukan pada bahagian yang diperlukan oleh meja kerja bermotor, melakukan anlisis dan persembahan program simulasi dengan menggunakan program komputer yang sesuai. Antara program komputer yang digunakan dalam melaksanakan projek ini adalah *"Automation Studio," "SolidWorks,"* dan *"Automation Studio"* atau dikenali sebagai *PLC* program komputer. Justeru itu, kajian ilmiah telah dilakukan secara terperinci dengan mencari maklumat yang berkaitan dengan meja kerja bermotor ini. Selepas itu, perancangan-perancangan juga telah dilakukan dalam bab pengkaedahan yang menerangkan tentang perancangan dalam melaksanakan projek ini sehingga selesai dengan penerangan secara terperinci. Kemudiannya, bab reka bentuk saringan menceritakan mengenai semua kriteria atau bahagian yang berkaitan dan diperlukan untuk melengkapkan projek ini dengan sebaik-baiknya. Pada penghujung projek ini, reka bentuk meja kerja bermotor yang terbaik ditunjukkan dengan menggunakan lukisan lakaran, lukisan tiga dimensi dan program *PLC* simulasi bergerak telah dilakukan pada meja kerja bermotor ini untuk membolehkan ia berfungsi dengan baik.

# DEDICATION

*For My beloved family*

# ACKNOWLEDGEMENTS

First of all, I want to thank and praise The Almighty God because of His permission that gives me strength to finish my Final Year Project (PSM) with successfully even many difficulties that had come. I also thanks and deepest gratitude from the bottom of my heart for all the support, encouragement and inspirations that me obtained through out the duration of this project. The help rendered to me priceless, be it from the smallest of its kind to the largest. They include;

My supervising lecturer, Mr. Khairol Anuar bin Rakiman of which we had a good working relationship and who offered tremendous help and encouragement,

My family, who inspired me whether through the storm and carry on,

My friends and peers who are good companions in times of need.

All of them will be remain in my heart always and may god bless everybody.

Wassalam.

***Normaizatulakma Bt Amir***

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PLC - Programmable Logic Controller

# CHAPTER 1
# INTRODUCTION

Automation and robotics are two closely related technologies. In an industrial context, the automation defines as that is concerned with the use of mechanical, electronic and computer-based systems in the operation and control of production. Nowadays, project research in the few of science and technology is widening through out the world. Its aim is to produce product that are able to reduce human energy in doing work. All researches in this field also aim to investigate phenomena that occur on us using technology in engineering field. Malaysia is among the countries that is actively involved in the field of research concerned which the hope that this country can contribute to the use of sophisticated technology. One of the continuous researches that are being undertaken in the engineering field is as the PLC simulation control for motorizing worktable.

## 1.1 Background

The word robot is commonly defined as a mechanical device capable of performing human tasks, or behaving in a human-like manner. A robot is a special brew of motors, solenoids, wires and assorted electronic odds and ends, a marriage of mechanical and electronic gizmos. Robotics like rocketry, television and countless other technology-based endeavors started smaller. But progress in the field of robots has been painfully slow. Robotics is still a cottage industry, even considering the special purpose automatons now in wide use in automotive manufacturing (Craig, J. J., 1989).

A programmable logic controller is a solid-state system designed to perform the logic function previously accomplished by components such as electromechanical relays, drum switches or mechanical timers/counters for the control and operation of manufacturing process equipment and machinery. Even though the electromechanical relay such as control relays and pneumatic timer relays has served well for many generations, often under adverse conditions, the ever-increasing sophistication and complexity of modern processing equipment requires faster acting, more reliable control functions than electromechanical relays and/or timing devices can offer. Relays have to be hardwired to perform a specific function and when the system requirements change, the relay wiring has to be changed or modified. In extreme cases, such as in the auto industry, complete control panels had to be replaced since it was not economically feasible to rewire the old panels with each model changeover.

According to Cox, R. A. et al., (2007), PLCs are designed to be operated by plant engineers and maintenance personnel with limited knowledge of computers. Like the computer, which has an internal memory for its operation and storage of a program, the PLC also has a memory for storing the user program, or logic as well as a memory for controlling the operation of a process machine or driven equipment. But unlike the computer, the PLC is programmed in relay logic diagram, not one of the computer languages. It should be state, however that some PLCs will use a form of Boolean Algebra or digital gates to program the relay ladder logic. As long as the programmable logic controllers (PLCs) have made it possible to precisely control large process machines and driven equipment with less physical wiring and lower installation costs than is required with standard electromechanical relays, pneumatic timers, drum switches and so on. The programmability allows for fast and easy changes in the relay ladder logic to meet the changing needs of the process or driven equipment without the need of expensive and time-consuming rewiring.

The worktable performance that used currently is not compatible. In order to ensure favorable ergonomic conditions in the region of a workplace at a worktable for example, it is known to provide worktables with a frame which is adjustable especially with respect to its height. In order to simplify said height adjustment of worktables, electric motors are used which can be actuated via a control device. An

electric drive leads to the likelihood however that on the occurrence of an obstruction in the region of the adjusting path of the worktable, an item placed on the worktable or drive parts, said obstruction will not be recognized and will be loaded with a force which is relatively considerable as a result of the electromotive drive, leading to an endangerment of the obstruction, as well as the work table or it situated on the worktable. This applies in particular when body parts represent such obstructions.

## 1.2 Problem Statement

The problem from this project is to improve the application of the worktable that uses by the motor and control by the programmable logic controller (PLC) programming. The existing of motorize worktable not involve very well and need some improvement. The principle reasons for its popularity are its motor specifications, structure specifications, control specifications, analysis, designing and the simulation programming.

There, the motor specifications include the types and function of the motor. For the structure specifications include the material, size and load that use for the worktable operation. Then, the control specifications define the programming that suitable to control the motor of worktable operation. All the specifications need the analysis to improve the motorize worktable operation that control by the programmable logic controller (PLC). Due to its importance in the field of automotive manufacturing, it has been a task of choice to be assigned for students to analyze the motorize worktable model and propose according to the PLC programming software.

## 1.3 Objective

The aim of this project is to improve, design, analyses and build a working control model that can show the motion of motorize worktable by use the programmable logic controller (PLC) programming software. Throughout this project, the following objectives will be achieved:

a. To improve the existing of motorize worktable design.
b. To design a PLC simulation programming.
c. To build a working simulation and make analysis of motorize worktable in Automation Studio software by use the PLC programming.

## 1.4 Scope of Project

The scope of this final year project is to improve and designs the PLC simulation for motorize worktable using PLC programming software. This project will be focus to:

a. Analyzing the worktable motion sequence for the motorize worktable operation.
b. Analyzing the appropriate load and motor specification.
c. Designing and modifying the motorize worktable by use the suitable of necessary parts.
d. Simulating the PLC programming to control the motor of worktable operation.

# CHAPTER 2
# LITERATURE REVIEW

This project is propose to build a working simulation of control for motorize worktable in Automation Studio software by using PLC programming. There involve the explanation about the worktable, programmable logic controller (PLC), control system, motor and programming platform. The literature review has been done for overall elements involve in control for motorize worktable.

## 2.1 Introduction of Robotic

A robotic can be defined as a programmable, self-controlled device consisting of electronic, electrical, or mechanical units. More generally, it is a machine that functions in place of a living agent. Robots are especially desirable for certain work functions because, unlike humans, they never get tired, they can endure physical conditions that are uncomfortable or even dangerous, they can operate in airless conditions, they do not get bored by repetition, and they cannot be distracted from the task at hand (Fu et al.,1987).

A robot can include any of the following components:

a. effectors - arms, legs, hands, feet

b. sensors - parts that act like senses and can detect objects or things like heat and light and convert the object information into symbols that computers understand

c. computer - the brain that contains instructions called algorithms to control the robot

d. equipment - this includes tools and mechanical fixtures

e. characteristics that make robots different from regular machinery are that robots usually function by themselves, are sensitive to their environment, adapt to variations in

the environment or to errors in prior performance, are task oriented and often have the ability to try different methods to accomplish a task.

Common industrial robots are generally heavy rigid devices limited to manufacturing. They operate in precisely structured environments and perform single highly repetitive tasks under preprogrammed control.

The inspiration for the design of a robot manipulator is the human arm, but with some differences. For example, a robot arm can extend by telescoping. That is, by sliding cylindrical sections one over another to lengthen the arm. Robot arms also can be constructed so that they bend like an elephant trunk. Grippers, or end effectors, are designed to mimic the function and structure of the human hand. Many robots are equipped with special purpose grippers to grasp particular devices such as a rack of test tubes or an arc-welder. The joints of a robotic arm are usually driven by electric motors. In most robots, the gripper is moved from one position to another, changing its orientation.

A computer calculates the joint angles needed to move the gripper to the desired position in a process known as inverse kinematics. Some multi-jointed arms are equipped with servo, or feedback, controllers that receive input from a computer. Each joint in the arm has a device to measure its angle and send that value to the controller. If the actual angle of the arm does not equal the computed angle for the desired position, the servo controller moves the joint until the arm's angle matches the computed angle. Controllers and associated computers also must process sensor information collected from cameras that locate objects to be grasped, or they must touch sensors on grippers that regulate the grasping force. Any robot designed to move in an unstructured or unknown environment will require multiple sensors and controls, such as ultrasonic or infrared sensors, to avoid obstacles. Robots, such as the National Aeronautics and Space Administration (NASA) planetary rovers, require a multitude of sensors and powerful onboard computers to process the complex information that allows them mobility. This is particularly true for robots designed to work in close proximity with human beings,