TWO DEGREE OF FREEDOM (2DOF) MOTION CONTROL OF UPPER LIMB ROBOTIC ARM MECHANISM

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TWO DEGREE OF FREEDOM (2DOF) MOTION CONTROL OF UPPER LIMB ROBOTIC ARM MECHANISM

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A report submitted
in partial fulfillment of the requirements for the degree of
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DECLARATION

I declare that this report entitled “Two Degree of Freedom (2DOF) Motion Control of Upper Limb Robotic Arm Mechanism” is the result of my own work except for quotes as cited in the references.

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Author : …………………………………

Date : …………………………………

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APPROVAL

I hereby declare that I have read this thesis and in my opinion, this thesis is sufficient in terms of scope and quality for the award of Bachelor of Mechatronic Engineering with Honours.

Signature : …………………………………

Supervisor Name : …………………………………

Date : …………………………………

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DEDICATION

To my beloved mother and father.

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ABSTRACT

The project's main purpose is to plan a controller which can control the yield plot for an upper limb of robotic arm. A structure of mechanical arm of two degree of freedom (2-DOF) designed and optimized. Study is done to explore the controller to be connected on the mechanical arm. PID controller is picked and analysed in term of its execution, for example, rise time, settling time, steady-state error, and overshoot. The experimental setup is carried out. Open loop simulation are first done to acquire the transfer function of each of the motor. Simulation for an uncompensated framework is done to watch the closed loop system characteristics without utilizing the controllers. From that point onward, closed loop simulations are completed for compensated system by utilizing PID controller. Two kinds of trials are done, to be specific point to point direction control and tracking control tests. Investigation is made dependent on the outcomes acquired.

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ABSTRAK

Tujuan utama projek ini adalah untuk mereka bentuk pengawal yang dapat mengawal sudut keluaran untuk lengan robot. Struktur lengan robot dua darjah kebebasan (2-DOF) direka dan dioptimumkan. Kajian dijalankan untuk mengkaji jenis pengawal yang sesuai untuk digunakan pada lengan robot. Pengawal PID dipilih dan dikaji dari segi prestasinya seperti kesilapan keadaan mantap, masa penyelesaian, masa meningkat dan ‘overshoot’. Persediaan eksperimen dijalankan. Simulasi ‘open loop’ mula-mula dijalankan untuk mendapatkan fungsi pemindahan setiap motor. Simulasi untuk sistem ‘uncompensated’ dijalankan untuk memerhatikan ciri sistem ‘closed loop’ tanpa menggunakan pengawal. Selepas itu, simulasi ‘closed loop’ dijalankan untuk sistem ‘compensated’ menggunakan pengawal PID. Dua jenis eksperimen dijalankan, iaitu titik ke arah kawalan trajektori dan eksperimen kawalan penjejakan. Analisis dibuat berdasarkan hasil yang diperoleh.

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LIST OF SYMBOLS AND ABBREVIATIONS

DOF	-	Degree of Freedom
Kp	-	Proportional Gain
Ki	-	Integral Gain
Kd	-	Derivative Gain
Ku	-	Ultimate Gain
Ti	-	Integrator Time Constant
Tu	-	Ultimate Period
Td	-	Derivative Time Constant
Tr	-	Rise Time
Ts	-	Settling Time
Ess	-	Steady State Error
OS	-	Overshoot

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CHAPTER 1

INTRODUCTION

1.1 Motivation

Robots are progressively being incorporated into working undertakings to supplant people particularly to play out the monotonous assignment .These robots are right now utilized in numerous fields of uses including office, military errands, healing center tasks, hazardous condition and farming [13]. In this manner, the control of the robot ought to be planned so as to give fitting execution to a nonlinear, multivariable, nonstationary framework [14].

The motivation for this undertaking is to enhance the movement for a robotic arm utilizing position control and dissect the execution of the controllers as far settling time, rise time, and steady-state state error.

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1.2 Problem Statement

Improper motion control may result in wounds and casualty. It is critical to improve the capability of a robotic arm along these lines. For movement control of automated arm, it is required to be in is required to be in high precision, high efficiency, low in error for the output which empower it to decide the correct direction and the torque expected to accomplish a focused on result.

To achieve precise motion control, there are difficulties to obtain the desired output due to the sensitivity of the controller. For example, the parameters for PID controller are rather difficult to estimate in noisy environment while fuzzy logic does not required noise-free environment [1].

1.3 Objective

The main objectives of this project are:

1. To design and optimize the mechanism of 2DOF robotic arm
2. To derive each motor's transfer function by running the open loop test.
3. To design and develop controller to control the position for 2DOF upper limb robotic arm.
4. To analyze and compare the performance of the controller in terms of steady-state error, settling time and rise time.

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