UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF ALGORITHM TO INTEGRATE WITH ROBOTIC ARM USING NERVE SENSOR

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours.

by

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DECLARATION

I hereby, declared this report entitled "Development Of Controller Algorithm For Robotic Arm Using Nerve Sensor" is the results of my own research except as cited in references.

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Date	:	09 DECEMBER 2016

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours. The member of the supervisory is as follow:

………………………………

(Mr. Muhammad Salihin Bin Saealal)

ABSTRAK

Struktur lengan robot dan algoritma kawalan yang direka untuk tujuan, untuk memilih dan meletakkan satu tugas iaitu objek. Ia dikawal oleh sistem kawalan isyarat inovasi, Gelang Myo Gerak Isyarat Kawalan pengawal. Struktur lengan pilih dan letak dikawal oleh Arduino sebagai pengawal mikro untuk mengawal sudut dan anjakan motor servo dengan tepat. Pengesanan pose dan orientasi tangan diproses oleh membangunkan algoritma kawalan dalam pemprosesan dan dihantar ke Arduino. Persamaan bagi persamaan kinematik dan kinematik songsang dan pengiraan diprogramkan ke dalam Microsoft Visual C# untuk algoritma kawalan. Akhir sekali, perkakasan dan perisian yang digabungkan bersama-sama. Dengan algoritma kawalan maju, lengan robot dikawal oleh pergerakan yang ditimbulkan dan tangan yang lebih pengguna antara muka mesra terutama apabila melakukan memetik dan meletakkan objek. Oleh kerana ia direka untuk pilih dan letak kegunaan, ketepatan dan ketepatan adalah penting untuk senjata robotik, ia menjalani beberapa percubaan dan ujian untuk menyiasat prestasi kebolehpercayaan lengan robot maju.

ABSTRACT

The robotic arm structure and control algorithm are designed for a purpose, to pick and place an object task. It is controlled by an innovated gesture control system, Myo Gesture Control Armband controller. The arm structure of pick and place is controlled by Arduino as microcontroller to control the angles and displacements of the servo motor precisely. The detection of pose and orientation of the hands processed by develop control algorithm in Processing and sent to the Arduino. The equation for kinematic and inverse kinematic equations and calculations are programed into Microsoft Visual C# for the control algorithm. Lastly, the hardware and software combined all together. With developed control algorithm, the robotic arm were controlled by posed and hand movements which more user friendly interface especially when doing the picking and placing of an object. Since it designed for a pick and place uses, the accuracy and precision are crucial for robotic arms, it undergo several experiments and tests for investigate reliability performance of developed robotic arm.

DEDICATION

To my beloved parents, I acknowledge my sincere indebtedness and gratitude to them for their love, dream and sacrifice throughout my life. Their sacrifice had inspired me from the day I learned how to read and write until what I have become now. I cannot find the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to achieve my dreams

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First and foremost, all praise to Allah the Almighty for giving me the strength, health, knowledge and patience to successfully complete this Finale Year Project report in the given time. I would like to address my deepest appreciation to the supervisor, Mr. Muhammad Salihin Bin Saealal for his encouragement, comments, guidance and enthusiasm through the time developing the report. This project report might be impossible to complete without all of your help. Last but not least, thank you to everyone that directly and indirectly involved in helping me finishing this Finale Year Project report. Thank you.

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API	-	Application Pprogram Interface
CMOS	-	Complementary Metal-Oxide Semiconductor
CPU	-	Central Processing Unit
IDE	-	Integrated Development Environment
IK	-	Inverse Kinematics
IR	-	Infra-Red
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
PC	-	Personal Computer
PLC	-	Programmable Logic Control
SDK	-	Software Development Kit
RISC	-	Reduced Instruction Set Computing

CHAPTER 1

INTRODUCTION

1.0 Introduction

In chapter 1, it provides an introduction about this project. Basically, it starts with describing the background of the project, project overview, problem statement of this project, description of prototype, objective, scope and thesis outline of development of the controller algorithm for robotic arm using motion and muscle sensor.

1.1 Background

For a pick and place task in a factory, the robotic arm structure and control algorithm are designed for a purpose. Furthermore, the robotic arm is controlled by an innovated gesture control system, nerve sensor. By using Arduino as a microcontroller which can control the arm structure of pick and place as it controls the angles and displacements of the servo motor precisely. The detection of pose and orientation of the hands processed by develop control algorithm in Microsoft Visual Studio and then, sent to the Arduino. For the forward kinematic equations and inverse kinematic equations and the calculations are programmed by using Microsoft Visual Studio programming language for the control algorithm.

Finally, the hardware and software combined all together. By developing a control algorithm, the robotic arm was controlled by posing and hand movements which more user friendly interface, especially when doing the picking and placing of an object. Since it is designed for a factory uses, it undergoes several experiments and tests for investigating reliability performance of developed robotic arm because the accuracy and precision are crucial for robotic arms.

1.2 Problem Statement

For a few decades, remotely operated robotic arm has been used for mass application in the industry. Robotic arm plays a very vital role in pick and place, painting and welding. However, most of robotic arms are conventional controller in the market which are controlled by joysticks or buttons. Furthermore, the conventional robotic arm is usually controlled by a complicated control panel, which need time and manuals to fully operate because of the numbers of buttons, touch screen panel or joysticks. The most likely issue that the operator of the controller found out difficulties in using those control panels and complex interface. There are other alternative control mechanisms are developed to perform the same task. To enhance the target identification rate and reduce the complexity of robotic systems, the advantages in human perception and recognition skills with consistent and accuracy of the robots are combined as well as a human-robot collaboration system can enhance target.

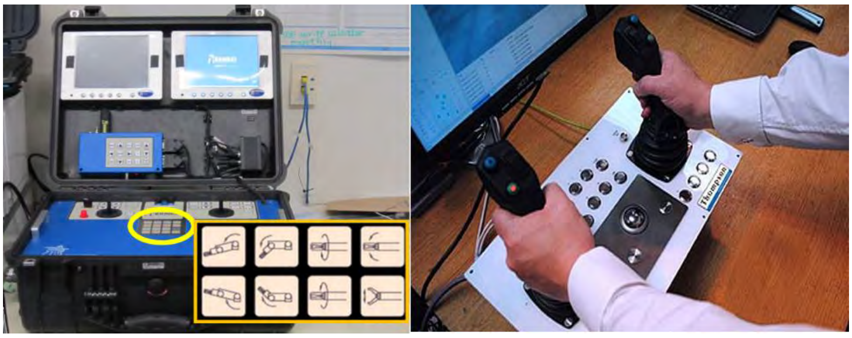

Figure 1.1 The example of input devices

1.3 Description of prototype

a) User friendly interface
   i. Controlling servo motors with hand gesture. The usual controller of the robotic arm usually requires certain amount of time to learn the button function and the process is complex with certain rules to be followed.

b) Safety
   i. Off-site servo motors control. Prevent on-site accident.

1.4 Objectives of Research

Robotic arm control using nerve sensor is actually a new breakthrough in the industrial point of view. As the way of robotic arm control are by using PLC and other conventional controller, MYO Armband Gesture serves as a better approach as it could help in easing task with user friendly interface while preventing on site accident. In this project, there are two objectives that need to be achieved. The objective of this project is:

a) To design algorithm that can control robotic arm via nerve sensor.

b) To analyse the robotic arm movement.

1.5 Scope of Research

A few guidelines are proposed to ensure that the project will achieve the objectives by narrowing the needs for this project. These are the scopes covered in this project: Using Microsoft Visual Studio to communicate MYO Armband controller to the robotic arm.

a) Controlling the robotic arm by 5 different type of pose such as wave in, wave out, fist, finger spread and double tap.

b) Controlling the robotic arm by orientation of roll, pitch, yaw which get from x, y, and z.

c) Using robotic arm model "Lynx Motion" build in with 6 degree of freedom of servo motor.

d) Using Arduino Uno board for interfacing between robotic arm and Microsoft Visual Studio.

e) Comparing between Microsoft Visual Studio, Processing and Node.js Environment for programming software.

1.6 Thesis Outline

The structure and layout of the thesis are as follow:

Chapter 1 – Introduction: This chapter briefly explains about the introduction which cover the objectives, scopes of the project and the problem statements.

Chapter 2 – Literature Review: This chapter describe what is Remotely Controlled Robotic Arm by using MYO Armband Controller and the existing project with Remotely Controlled Robotic Arm which have been developed by the previous researchers. It also consists of the information which will be the parameter for the developing this project.

Chapter 3 – Methodology: This chapter explains about the methodology of this project, which describe details about the method used for developing this project and also approach taken in order to complete the project.

Chapter 4 – Project Development: For this chapter explaining about the Remotely Controlled Robotic Arm which the hardware parts and software will be highlighted.

Chapter 5 – Expectation Result: This chapter will consider about the expectation result of the movement of the robotic arm.

Chapter 6 – Conclusion and Recommendations: This chapter will conclude about the entire project and future expectations that can be done for the future project.

CHAPTER2

LITERATURE REVIEW

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2.0 Robotic Arm

A robotic arm is a kind of mechanical arm, typically programmable, with comparable capacities to a human arm; the arm might be the whole of the system or might be a piece of a more complex robot. The connections of such a controller are associated by joints permitting either rotational movement, (for example, in an articulated robot) or translational (direct) removal. The connections of the controller can be considered to shape a kinematic chain. The end of the kinematic chain of the controller is known as the end effector and it is closely resembling the human hand. The end effector, or robotic arm, can be intended to perform any craved undertaking, for example, welding, grasping, turning and so on., contingent upon the application. For instance, robot arms in car mechanical production systems perform an assortment of assignments, for example, welding and parts turn and position amid gathering. In a few circumstances, close copying of the human hand is sought, as in robots intended to direct bomb demilitarization and transfer.

2.0.1 Bomb Defusing Robotic Arm using Gesture Control

In the paper by (Narayanan, 2015), the developing part of Remotely Operated Vehicles in bomb defusing situations supporting specialists to find, handle and decimate risky items, new natural signal construct frameworks can be demonstrated with respect to human hand developments to make the control of a complex gripper arm intuitive.

The gripper of robotic arm was customized to tail all grip and discharge operations performed by the client. The hand's rakish attributes, for example, move, pitch, and yaw edges were likewise considered to empower more reasonable impersonation of the client's arm. A two finger motion was utilized to control the basic gripper setup of the OWI automated arm. A comparable line of thought can be utilized to actualize more mind boggling frameworks with higher degrees of opportunity and better gripper designs. Association with the Arduino Uno small scale controller permits the execution of extra sensors, catches or show frameworks.

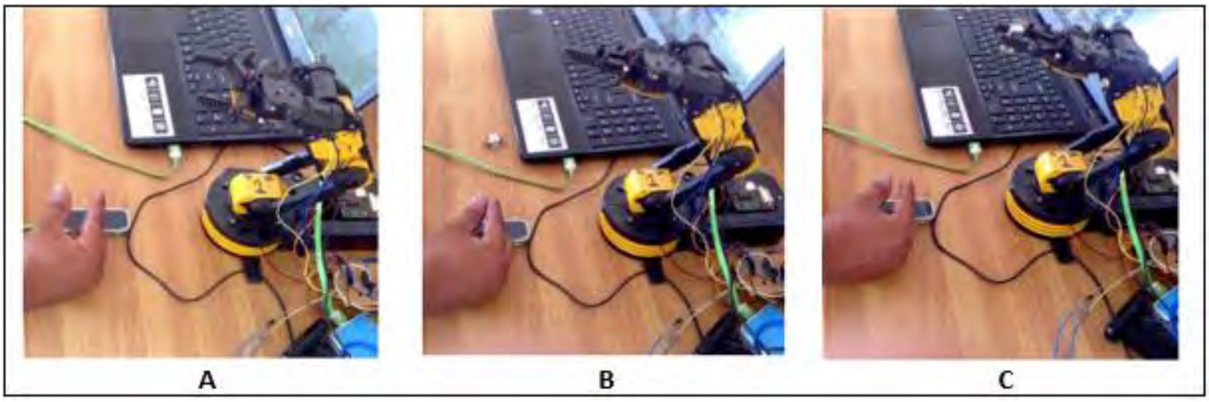

Figure 2.1 Condition of Gripper

Figure 2.1 The motion based plan was additionally effectively tried to get and snatch an article utilizing its gripper arm. The number of degrees of flexibility gives us a reasonable thought of the measure of capacities of a mechanical arm, and basically alludes to the quantity of independently controlled joints in the gripper arm. Grippers most regularly have two parts that move autonomously taking into consideration it is possible that maybe a couple degrees of flexibility. The human hand involves 27 degrees of flexibility (Smagt, 2009). More degrees of opportunity permit a gripper to get and effortlessly conduct objects in a more prominent number of ways. At the point when there are just a couple of degrees of opportunity, the operator should initially position the gripper arm precisely. The gripper thus should be prepared to place extensive force on the target to have a solid hold (Massa, Roccella, Carrozza, & Dario, 2002). In this way the stability and sensitivity of both the arm and hazard are critical elements to consider. More noteworthy degrees of freedom permit a more significant number of purposes of contact which make the grip sturdier while likewise lessening the power connected on the target.

2.0.2 Modelling and Implementation of Wireless Embedded Robot Arm for Object Sorting

Robotic arm modelling was done using LabVIEW and its programming was done using embedded C language. IK program for the present work was established using the example program of robotics in LabVIEW. The output of the IK program gives three joint angles of robot arm excluding robot arm base and gripper. The joint angles are transmitted by using parallel printer port and the program for parallel communication was written and integrated into the inverse kinematics program.(C. Chandra Mouli1, 2014).

As presented in (Mouli, Jyothi, Raju, & Nagaraja, 2013), IK model and implementation of robot arm was being tabled upon. In this paper, IK model and parallel communication being developed prior to the geometric method. This modelling was used to transmit the joint angles to LPC2148. In this modelling, there are only three joint angles being calculated, i.e. shoulder (Theta1), elbow (Theta2), and wrist pitch (Theta3). The other two components which are the base (Thetab) and end effector (Thetag) are not being calculated as both are straight away given for desire position so as to control only five servo motors of the robot arm. Wrist roll (Thetaw) control are the present work that are being nurtured. Same as Thetab and Thetag, Thetaw is also straight away given as input through front panel.

Figure 2.2 shows the LabVIEW front panel of the present work. XBee port setting, Robot Arm Input and Robot Arm Joint Angles are the components that it consists. X, Y, ThetaB, ThetaW and ThetaG are the cluster of five elements. This cluster is used as robot arm inputs. To observe the robot arm transformation in simulation, 3D Picture Control VI is used for Robot Arm Movement analysis. Robot Arm Joint Angle are 64-bit numeric indicators used to display the joint angles of the robot arm.

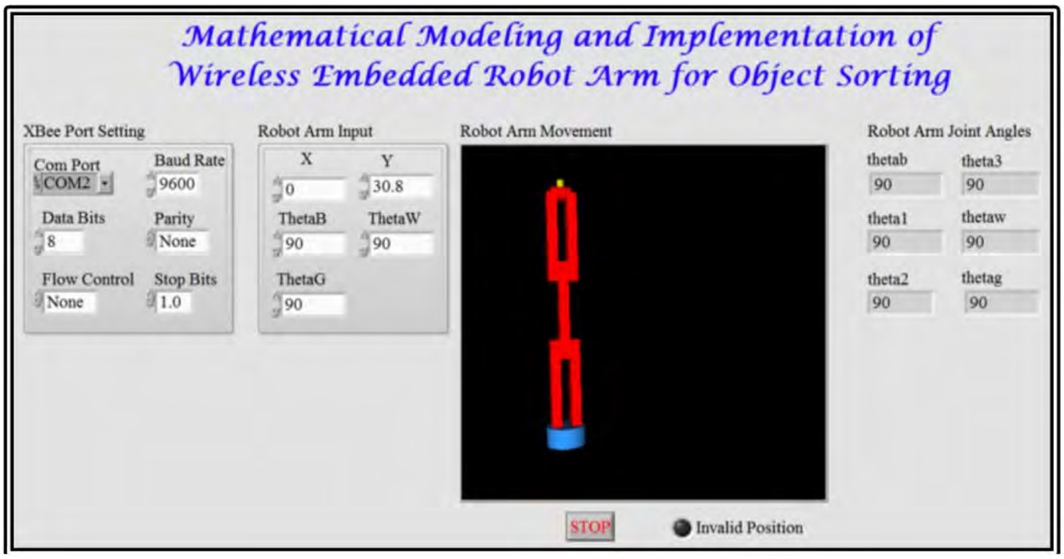

Figure 2.2 LabVIEW Front Panel of the present work of specified style in document.

2.0.3 Overview on Latest Gesture Controlled Systems for Robotic Arm

In the paper by (Ugale, 2016),The Software Development Kit (SDK) furnishes the data worried with Cartesian space of predefined protests, for example, the fingertips, pen tip, hand palm position, and so forth. Alongside, data managing the pivots of the hand, for example, Roll, Pitch, and Yaw are open also. The Entire conveyed positions are in respect to the Leap Motion Controller's middle point, which lies between the two IR cameras, just on top of the second IR emitter. It utilizes a variety of infrared sensors. It keeps running on windows, Mac and Linux environment. It underpins improvement in C#, C++, Objective C, Java, Python, and JavaScript. It contains API's for basic motion for quick prototyping. The Proposed framework depends on the "Normal" human-robot connection. Jump Motion is a PC equipment sensor gadget that backings hand and finger movements as information, similar to a