DESIGN OF WIRELESS INDUSTRIAL ROBOTIC ARM AND CONTROL USING ANDROID PLATFORM

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ABSTRACT

Nowadays, robot such as line robot car, robotic arm, robotic finger and others product were being using for several purpose. Robot bring a lot of benefit to the society, so it is very popular used in industry, house and work place. In this project, the design of wireless industrial robotic arm should be able to handle and lift up an object and also can be controlled using Android Platform. Apps created is used as interface between the robotic arm and the microcontroller (Arduino UNO), if the signal is transferred from android, then Arduino UNO will received signal and start to control robotic arm. For the wireless part, Bluetooth was chosen as the connection between android and Arduino UNO. Any signal transferred to the Arduino UNO should pass through Bluetooth in order to run the industrial robotic arm.

ABSTRAK

Pada masa kini, robot seperti kereta talian robot, lengan robot, jari robot dan produk yang lain digunakan untuk beberapa tujuan. Robot membawa banyak manfaat kepada masyarakat, jadi ia adalah sangat popular digunakan dalam industri, rumah dan tempat kerja. Dalam projek ini, reka bentuk lengan robot industri tanpa wayar akan dapat mengambil dan mengangkat objek dan juga boleh dikawal menggunakan "Android Platform". Aplikasi dicipta digunakan sebagai antara muka antara lengan robotik dan pengawal mikro (Arduino UNO), jika isyarat dikeluarkan dari android, isyarat akan didapati oleh Arduino UNO dan mula mengawal lengan robot. Bagi bahagian tanpa wayar, Bluetooth dipilih sebagai hubungan antara android dan Arduino UNO. Apa-apa isyarat dipindahkan ke Arduino UNO harus melalui Bluetooth untuk menjalankan lengan robot perindustrian.

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CHAPTER 1

INTRODUCTION

1.1 Background and Project Overview

Robotic arm is a human technology device in order to help user or human to handle, lift, stir and others kinematic motion some object. A lot of industry are now using robotic arm to do some part or step which is hard for human arm such as soldering, putting and recovering certain device with a very perfect specification and step. For civil engineer, it is used to handle and lifting some heavy object from one place to another place. Others than that, in molding and casting part, the robotic arm is using for cutting and pressing purpose. Furthermore, robotic arm also use for packing process in the food industry, so robotic arm has bring a lot of benefits to the world. The industrial robotic arm nowadays is all controlled by human or the machine, so this project was going to create a different industrial robotic arm and controlled it with the different device from the industry.

This project is created by using hardware (Body of Robot) and Software (Program to control robotic arm with wireless). The shape of robotic arm has similar function as human arm, the links of the manipulator can be considered to form a kinematic chain. In this project I want to be able to utilize a robotic arm that will be able to pick up various object with different shape by gripper. C++ program as an interface between robot and computer and Arduino UNO as a microcontroller of the robot that consist of 4 degree of freedom. For wireless part, an Android platform of application is created to control the robotic arm with computer, hand phone or others device. In generally, the android app will generate a signal and then the signal is received by the microcontroller (Arduino

UNO), so the industrial robotic arm is able to move or work according to the predefined program wrote in the microcontroller.

A signal is generated from the android app which will be received by the controller device and the robotic arm works according to the predefined program[23]. The android application is acted as the command center of the robotic arm that means the whole movement of the robotic arm is based on android. The program is written in the high level programming language in the microcontroller and the requirement to control the arm position is depended to the data and programming language in the android and microcontroller.

1.2 Problem Statement

Robot is very popular be used in industry nowadays. In case of control the robot with wireless device, there have some problem occurred in control section, even the way to construct a new robot also will face some general problem. The problem faced by the developer when constructing a robotic arm is the labor cannot move around the robot freely because of disrupting with cable[2]. The wire will disturb the motion and movement of the robotic arm if without any wire dressing process is apply to it. Second problem is the robotic arm is difficult to be controlled and time consuming to control[3]. In order to pick up some object, the position of the robotic arm should be exactly correct, if there is any misdirection or over motion of the robotic arm then that object may not be lifted up properly or failed to be handled. Android can be used to control the robotic arm, but it is hard to make android device interoperate with the remaining parts of the robot[4]. This is because the original position of the servo motor do not be set properly and the android cannot control 2 or more servo motor in the same time.

1.3 Objectives

In order to solve the problem face by developer, some objectives were needed. The objectives of this project are to design and construct a robotic arm capable of handling and lifting and to design and develop a wireless robotic arm using Android Platform.

1.4 Scope of Project

The motion of this industrial robotic arm is limited to a circular path that means the robotic arm can move in an autonomy of degree. For example, the volume and the area of sphere is $\frac{4}{3}\pi r^3$ and $4\pi r^2$respectively, so the movement and motion of the industrial robotic arm was restricted according to the formulae. Any duty which can be done by the movement along the circular shape of sphere can be performed by this robotic arm if the coding written is matched. Arduino UNO is used as controller device (Using C++ programing), generally the reset circuitry and power setup will be ready especially the circuitry of programming and communication between microcontroller and Universal Series Bus (USB). The body and some special part of the robotic arms can be done with aluminum board, hard and soft metal, board, PVC board and jumper wire. There are 3 arthrosis should be considered in robotic arm, so the materials used for the gripper and the motion part are flexible. For the wireless control device, Android Platform of application is used by connect it with Bluetooth.

The scope after the robotic arm already been constructed to a real machine will able to handle tasks that are difficult and dangerous to human beings such as the handling some chemical materials in the Lab and some other object which have the probability to make the body of human be injured. Furthermore, the industrial robotic arm is able to handle and lift a heavy object such as the weight of an object which is more than 5000N. Generally the maximum weight can be lifted or handle by human arm averagely is 600N, the human arm will be injured if the range of weight of an object is more than 600N. Thirdly, the real robotic arm after designed can move in a free circular path according to the programming and the one more importance matter is robotic arm is run by using android and electric energy, so it will not get tired, that means the industrial robotic arm can work with industry for 24-7.

1.5 Thesis Structure

This section is to talk about the overview of the thesis going to be done. In chapter 1, there are background, overview of the project and scope of project which is generally talk about the construction of hardware and software. There are also have some problem statement which are going to be solved according to the objectives given.

Chapter 2 is the literature review of the whole project. In this chapter, there are a lot of student paper, public source and Internet source were read and come out with own idea in creating the construction of industrial robotic arm.

After study all the paper and source from the internet, methodology was started which is placed in chapter 3. In chapter 3, there is the flowchart of overall progress and the flowchart of the movement of industrial robotic arm. This chapter also has mentioned the steps to construct and create the body of robotic arm and android application. Even the materials used in whole project also been clearly stated in this chapter.

Chapter 4 is the results and discussion of this project. In this chapter, all the analysis of movement such as base, lower arm, upper arm and gripper have been recorded and stated in a table and figure, so others people or student can easily to understand. Other than that, weight handling and lifting analysis also be stated and recorded. Generally chapter 4 is the way how a student analyzed the data obtain from the project, so it is importance for the student or people who are going to read.

Conclusions and recommendations were be cover in this chapter, all the sustainability, commercialization and future work will be stated in it and the achievement of the objective also will be mention to prove the progress is successful or not.

CHAPTER 2

LITERATURE REVIEW

2.1 Literature Review

From the previous project, my senior has constructed an industrial robotic arms and controlled using Visual Studio (SB). It is an integrated development environment (IDE) from Microsoft. This software can be used as a development of computer programs for the Microsoft Windows. Visual Studio is using Microsoft software development platforms such as Windows API, Windows Forms and others platform in order to control device. It can produce both native code and managed code. From the senior designation, he apply Window Forms as his controller which has the similar function as Android. Nowadays, most of the industrial robotic arm are controlled manually in the machine, anything done by engineer cannot be considered as 100% perfectly, everything is created based on safety and health of user, it is very dangerous when user control robotic arm in the machine, it will course people be injured if there is collapsing occurred.

2.2 Microcontroller

In term of desktop or laptop, microcontroller has played an importance role which is acted as a computer with most of necessary support chips on board because each of the computer contains CPU, RAM and input/output. In the other side, microcontroller is a system of self-contained with peripherals, memory and a processor that can be used as an embedded system[24]. Most of the embedded in other consumer products or machinery are using programmable microcontrollers such as peripherals, automobiles, phones and household appliances for computer systems. Since microcontroller contain “Embedded”

inside it so there is a new name was added to the microcontroller which is “embedded controller” that means microcontroller can control the functionality, action, feature and movement of the project or product. Every mission, duty or task was dedicated by microcontroller and it is able to run the specific program, since that the program be written will store in ROM and will not be change automatically, so the features of the microcontroller were always be there. Lastly, microcontroller also acted as a low-power device and it’s consume about 50 milliwatts of battery-operated.

The features or function of a microcontroller is to send a signal to specific device or component by taking an input from the controlled device. For example, microcontroller has its own program and component which is able to receive and transfer data, so the general step of microcontroller when collecting data if from the signal given from others electronic device such as computer, laptop, Apps and wireless device and then send it to the device it is going to control such as motor, data editing, button, bulb or LED and others application.

The range of an actual processor used to implement a microcontroller actually is very wide and the area to be implemented also very large. By taking one of the product nowadays such as microwave, the quantity request from the user on the CPU is in a very low value, so the price of the microwave have to be made an adjustment. But from the economic nowadays, every user of the microcontroller are wishing to get the product in low cost with high quality, so the manufactures only focus to dedicate to the microcontroller chips and make it become a low cost, low power and small in size of product. There are 2 company which can produce this kind of chips which are Motorola 68ll and Intel 8051. There might have around 1000 bytes of ROM and 20 bytes of RAM on the Chip with a typical low-end microcontroller chip and there are eight I/O pins along the chip.

2.2.1 Introduction of Arduino

Arduino is an open source platform that offers a clear and simple environment for physical computing[18]. A lot of application such as modern robotic, Internet-of-thing (IoT) nowadays are controlled or run by using Arduino. Arduino board not only give an

output to the device but also able to read input from others application. Normally Arduino UNO can read the signal given from the sensor of a light, button to an arm and some message from internet application and then convert it to the output signal to activate, control and trigger the specific device such as motor, LED and sending some message to the online source.

It is very popular because its price is not too expensive, ease to be programmed, and rapid prototyping capabilities. Normally, all of the sensor, device and components are easily be connected to the input and output of Arduino UNO doesn't matter the port is analog and digital I/O pins, which features an on-board microcontroller programmed using the Arduino IDE.

Arduino is different with some previous programmable circuit boards, from the design of the previous board, it is being separated to some specific part with a limited functions and features. From the design of Arduino UNO, it is combined with a few separated piece of hardware, so it can load a new code on to the board. Arduino just need an USB cable to connect it and computer. Additionally, the program used in Arduino IDE is C++ which is the simplified version of coding and software to allow users can learn the program easily. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package[25].

In order to make Arduino UNO to be a high quality of microcontroller, the complexity of physical computing applications is going to be increasing to make the Arduino (compatible devices) with faster processors, increased flash storage, larger memories and more complicated I/O architecture[19]. Figure 2.1 shows the several type of Arduino in the market nowadays.