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DEVELOPING MOBILE APPLICATION TO PROGRAM AND CONTROL ROBOT

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ABSTRACT

In today's world, automation is widely used in many aspects to help humans do their job and increase the efficiency of the job. The robot is one of the kinds of an automation system that mostly used to help human to completed their job. Robots have many roles in human life, and robots are used to help humans do various kinds of jobs more easily. Robots are widely used because they can make it easier and done the work effectively and efficiently. There are many implementations of the robot to help humans do their jobs, such as welding robot, agriculture robot, drone robot, and many more. A robot arm is one type of robot that we often encounter, and a robot arm has a function similar to a human arm. In its application, the robot can be controlled through several methods, some are directly using a cable connection, and some are using a wireless method. Also, to control a robot, a controller is needed, which will be the robot's brain. This project aims to develop a controller based on Arduino, one of the most widely used microcontroller boards for education, hobby, or professional, and develop a mobile device application to control the robot arm via Bluetooth connection. The methodology used in this research is starting from the identification and data collection of the program from several sources such as a journal or discussion forum, then continue with the systems schematic design of the hardware that used in this project and will continue by the program of the Arduino and smartphone app. The testing result shows the accuracy of actual motion is quite close to the desired position as programmed, and the servo test shows that the error value average is about 3,54% for the MG996R servo and 4,44% for the SG90 servo. Thus, the robot error value is about 1,38% on the x-axis and 12,14% on the y-axis in the first test. And for the second test is about 1,96% on the x-axis and 3,15% on the y-axis.

Keywords: Robotic Arm, Arduino, Wireless, Automation

I. INTRODUCTION

Nowadays, humans live in an age where technology is very developed, and humans get many advantages that a lot of work can be done easily with the help of an automation system. Automation systems cover many human shortcomings in doing work so that work can be done efficiently in terms of time, consistency, and quality. One of the branches of automation that are often found in daily life is robots, which are widely applied in various aspects of life, from industry, agriculture, household, health, military, and even entertainment.

In the industrial world, one of the types of robot that mostly used is the robot arm. This type of robot is used in various aspect. One of which is assembly component, welding, painting process, move things and many more. The main reason for the usage of the robot is because it has high accuracy, and it can work continuously, efficiently, and stably.

The advancement in communication technologies has made people very dependence on a gadget such as personal computer, laptop, and especially the smartphone. One of the reasons for this dependence is that with the existence of gadgets, especially smartphones, almost all needs can be resolved in just the grip and touch of a finger. Starting from contacting friends, setting reminders, opening and composing electronic mail, even doing various office and school work can be done only via a smartphone.

With the development of automation systems and also the increase in the use of smartphones for learning purposes, the aim of this project is to create a 5 DOF pick and place robotic arm system based on an Arduino controller that can be controlled using a smartphone via a Bluetooth module for educational purposes.

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II. METHODOLOGY

This research focuses on developing the robot arm controller using Arduino microcontroller board. The flow of the research will start from the observation and data collection, the system schematic design including the circuitand the mechanical structure, the Arduino program, the MIT App inventor program, and the last is the system testing.

Observation And Data Collection

In this observation, it is focused on learning and gather some information about the robot arm controller using Arduino. The aim of this project is to develop the 5 DOF robot arm controller using Arduino and smartphone as the remote control. There are several Arduino based robot arm project in several Arduino forum related to the main objective of the project. Then, modify and develop the system in order to achieve the aim of the project. There is also several information about the controller and servos specification.

Table 1. Arduino program and application data

No.	Servo Name	Servo Placement	Initial Position (Degree)	Min Value (Degree)	Max Value (Degree)
1	Servo01	Base	90°	0°	180°
2	Servo02	Shoulder	90°	40°	100°
3	Servo03	Elbow	180°	90°	180°
4	Servo04	Wrist	0°	0°	180°
5	Servo05	Grip	180°	110°	180°

System Testing

After all of the program and application design also the schematic design of the system, an accuracy testing process will be conducted. The parameter that used in this accuracy test is the data from table 1, which comes from the Arduino program and a smartphone app that has a built-in previous chapter. There will be two types of accuracy test. The first one is the servo accuracy test, where the accuracy of the servo will be tested one by one using a protractor as the measuring tool in order to measure the deviation of the output. Then, the second test will be theaccuracy test for the end of the effector of the robot. The second test will conduct after the servo assembled with the robot arm body. The method that will be used in this second test is by moving the robot arm from one to another desired position and measure the displacement on the target. Then, the results will be compared with the target position data in order to get the error value. The result of the test will be shown in the next chapter.

III. RESULT AND DISCUSSION

Robot Assembly and Test Template

Here is the result of the assembled robotic arm. All of the parts that have been assembled are made using the 3D printer with PLA material. And the base of the robot arm is screwed on the top of the table and also the test template. This robot arm has 5 degrees of freedom. However, there are only four servos that will affect the positioning of the robot, which is the waist, shoulder, elbow, and wrist.

The last servo is attached to the gripper mechanism. Figure 10 shows the result of the assembled robot arm, the controller, and the test template.

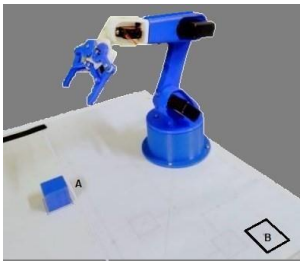

Figure 10. Robot assembly on test template

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Discussion

There is a high error percentage in the y-axis on the first test, which the movement from point A to point B. The problem is because the servo cannot reach the minimum and maximum value based on the service specification. It is believed that the problem is due to an issue with the servo specification. The robot also has problems in the shoulder, elbow, and gripper mechanism. There are many vibrations and the movement of the robot are hobbled. A small spring that placed in the shoulder is one of the best options to handle that. The gripper mechanism also needs some improvement in order to minimize and prevent the slip of the object.

IV. CONCLUSION

After creating, analyzing, and testing the program and the prototype, several conclusions can be drawn:

- The Arduino program and the simple android apps that have made using MIT App Inventor can performthe pick and place task wirelessly using a Bluetooth connection.
- The program also has the ability to perform save and repeat the position.
- The average error value of the servo motor is about 3,54% for the MG996R servo and 4,44% for the SG90 servo.
- The error of the robot for the x-axis is about 1,38% in the first test and 1,96% for the second test. However, the result for the y-axis is a little bit higher, which 12,14% for the first test and 3,15% for the second test.
- The high error value in the y-axis at the first test is caused by the servo efficiency and the movement rangeof the servo. We only get a 5° - 175° rotation range instead of 0° - 180° of rotation.
- The other factor that affects the accuracy of the robot is the vibration that happens when the servo moves. It because the servo is running in a critical situation. Thus, the servo needs several supports, such as adding a small spring in several positions, such as at the shoulder, in order to help the servo in carrying the load.

This project still lacks in many aspects. Hopefully, in the future, there will be more research to improve the robot arm performance. In the coming future, for this project, it is suggested to develop the Arduino and android application program in order to make it easier for the user to get the specific value of the input. Implementing inverse and forward kinematics into the program will improve the input and also make easier to control and calibrate the robot. The second is using a better servo motor to carry more load and create a smoother movement of the robot. The stepper motor is recommended to fulfil that task.

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