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ROBOT ARM WITH SMARTPHONE CONTROL

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Abstract – *With the rise of technology and innovation at its top, construction of systems and techniques resembling to human skills are increasingly integrated into working task to cater the rapid surge of people's needs. Such revolutions are made with the aspirations of making peoples live simpler. This article focuses on the development of the electro-mechanical robotic arm which's practical try to do a pick and place and guided or controlled by using a cell-phone application via Android smartphone. Designed to figure pre-decided commands, the electro-mechanical robot arm has potential to maneuver especially in four directional axis; left, upward, downward and right control at a stated angles with six servo motors and stated by the cell-phone application specifications. Designed and realized, the robotic arm control is through the utilization of a cell-phone application via Bluetooth module, that has been programmed through Arduino UNO controller.*

1. INTRODUCTION

Robotic Arm is an Electro-Mechanical model in which electrical components, electronic components and mechanical components are used. Mechanical parts of the arm are connected by servo joints. A Robotic Arm is programmable, with similar relation to human arm. The rotation servo motors controlled with smartphone using android application.

Now a days the automation industry is rapidly growing in India. Automation may not be new, but with the integration of robotic technology with automation, it has become productive, easy and cost effective. It has also eliminated potential efforts or risk and dangerous to human lives, this making production process safer.

1.1 Projected Method

Research on possible designs and basic information about the robotic arm was initially made. Using SolidWorks - a desktop software used for planning, visual ideation and feasibility assessment, in finalizing the design. Using 6 servo motors, the robotic arm could move in different directions and could hold or release things with its gripper. For the proper control of the arm, the Arduino UNO controller is used. This microcontroller was preferably used since it is low cost and good for beginners especially in writing the program. The program code was written in Embedded C language which is one of the most popular and fundamental programming language. We also created smartphone application that will be linked to the Arduino UNO microcontroller via Bluetooth module. Controlling the robotic arm will be achievable by make a use of the smartphone application.

1.2 Recommendation

The result of tests indicates the inability of the servo to perform complex operations due to certain limiting factors. Successful benchmarks during pre-assembly show that the communication between the robotic arm and the smartphone is without issue. It is, however, failing when it comes to post assembly tests due to the underpowered servo motor. To increase the performance, a torque not less than that of a MG995 servo motor is recommended. Reducing the prototype's density may also improve overall usability. PLA (Polylactic Acid) is a material with excellent rigidity to weight ratio and can be manufactured easily with 3-D printing. Saving operations greater than five directions may also pose a problem to the Arduino board. Although the code only occupies 60%, simultaneous procedure proves to be too taxing for the processor. Continuous operating module like the HC-05 also adds to the performance losses of the CPU. As such, an Arduino MEGA is recommended since it also offers UART and a faster processor than the UNO R3.

2. LITERATURE REVIEW

Industry 4.0 is a new area where the Internet of things alongside cyber-physical systems interconnect in a way where the combination of software, sensor, processor, and communication technology plays a huge role in making "things" to have the potential to feed information into it and eventually adds value to manufacturing processes. (Mohd. Aiman et al., 2016).

Today technology is developing in the same direction in line with rapidly increasing human needs. The work done to meet these needs makes life easier every day, and these studies are concentrated on robotic arm studies. (Rajashekar K et al., 2020).

Recently, designing a robot along with a navigation-computing platform is not a problem anymore. In robotics, navigation guides to the way a robot finds its way into the environment and is a common requirement for almost any mobile robot. (G. N. Coelho, 2008).

"Today's smartphone is already equipped with multiple built-in sensors for navigation purposes like accelerometer, gyroscope, camera, GPS, and Wi-Fi transceiver plus most of them embedded with fast processors. (W.-W. Kao and B. Q. Huy, 2013).

The designers have wide options to choose any built-in sensors to create the navigation platform of their robots. It is like using the smartphone as a "brain" for the robots. (R. V Aroca et al., 2012).

In this project, by using an android application, the robots could be controlled with a Bluetooth device, interfaced to the control unit on the robot for sensing the signals transmitted by the android application in the wide range area. Normal practice for the past few years ago, robots are controlled by using RF circuits, which have several limitations like working range, frequency range, and control range. These limitations could be vanished by using smartphones for robotic control, it has more advantages like robust control, large working range coverage and the biggest advantage is long-lasting controlled. (Nik Firdaus, 2015).

For comparison, from the definition; "Wi-Fi is a cheap solution aimed to cover short distances such as airport, hotels, and conference areas". From this, Wi-Fi has some limitations in providing a wide coverage solution, while the Infrared, WLAN, and Bluetooth technology only able to remote some equipment in the coverage less than Wi-Fi. (S. Tang, 2011).

3. Electronic Circuit Design and Hardware Selection

3.1 Arduino UNO R3

Although microcontroller is usually used in programming and software fields, it is an open-source controller, ATmega328P based microcontroller.

Arduino UNO is single board controller which means the board equipped with analog and digital Input or Output pins that may be connected with various circuits and expansion boards. Processing is written for non-programming users. Figure 1 shows the Arduino Uno R3 is used in this project.

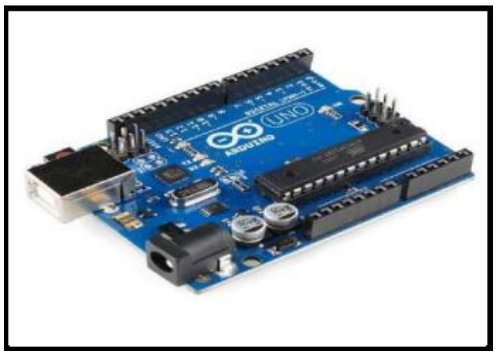

Fig.1- Arduino UNO R3

3.2 Servo Motor

Servo motor can rotate an object at guided angles. It is a simple motor which runs on a servo mechanism. A servo motor usually comes with shaft and gear arrangement that allow us high torque by lightweight and small servo motor. According to these features servo motors are used in various applications like Toys, Robotics, Printers, etc.

Figure 2 – SG90 ang MG995R servo motor

Table -1: Specifications of Servo Motors

Specifications	MG995	SG90
Operating Voltage	4.8 – 6.0 V	4.8 – 6.0 V
Torque	9.0 kg/cm	2.0 kg/cm
No Load Speed	0.17 sec/60°	0.09 sec/60°
Rotational Range	Approximately 180°	Approximately 180°

3.3 HC-05 Bluetooth Module

This module is used to communicate between two microcontrollers like Arduino or communicate with any device via Bluetooth. This module communicates with the help of USART at 9600 baud rates. The HC-05 that show in Figure 7 has two operating modes, 1 is the data mode in which it can send and receive data from other Bluetooth devices and the other is AT command mode where the default device setting can be changed.

4. Robot Arm Design

Robot Arm design classified into two parts, the mechanical design parts and installation. In this project, the hardware and software function are combined to make the system productive and reliable.

4.1 Mechanical Design

Stuffs required for the mechanical body of the arm were supplied, and were designed on SolidWorks desktop software in IPS unit form. The Robot Arm will have 5 outputs which consist of grip, wrist, base, elbow and shoulder. The robot has a round and rectangular foundation capable of

mounting Arduino UNO controller and the body of mechanical arm. Chipboard 2.0 was referred as the main stuff for the manufacturing of the arm due to it is vulnerable to be manufacture, low cost and can easily handle the motor weight and adjustable positions. The robot DOF technique is powered by two various categories of servo. The gripper is made of plastic object.

4.2 Mechanical Mounting

The robot arm changes its position in 4-axis with 6 servo motors at a specified position to match the mobile application specifications. The robot is projected to have a static base and adjustable arm body with the help of servo motors fixed to adjust the arm position. Each servo motor is set apart as mechanical connections of arm which then compatible with it, on the smartphone app namely for the; waist, shoulder, elbow, wrist toll, wrist pitch and grip. Installation of servo is given on Figure 2.

Figure-2: Installation of Servo Motors
(Some were enclosed inside the body)

4.3 Android Programming

The Android application used in the project was done with App Invertor. App Invertor is a free web application unified development environment developed by Google and later developed by the MIT. The mobile application was developed and created by dropping and dragging components into a construction view and using a visual blocks language to behavior of program application. In this section, the design criterion where many variables such as the Wrist Pitch, Wrist Roll, Elbow, Shoulder, Grip, Waist and the Speed of the arm.

5. Results and Discussion

5.1 Projected Method

Using SolidWorks - a software used for visual ideation, planning and feasibility assessment, in finalizing the design. Using 6 servo motors, the robotic arm could move in different directions and could hold or release things with its gripper. For the optimal control of the robotic arm, the Arduino UNO single board controller is employed. This microcontroller was preferably used because it is low cost. The program code was written in Embedded C language which is one of the most popular and fundamental programming language. We also created a mobile application that will be connected to the Arduino UNO (master) controller via HC-05 Bluetooth (slave) module. Controlling or guiding the arm are going to be done by using the smartphone application application.

5.2 Complete Design of Robot Arm

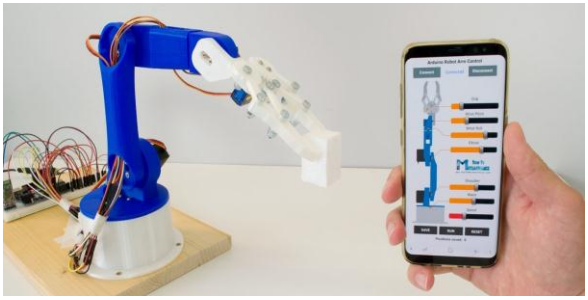

Fig-3: Completed Robot Arm

5.3 Operation of Robot Arm

The robotic arm workplace illustrated in Figure 3. For this project the robot arm has 5-DOF. Table 2 shows the angle for every servo that the robot arm can move.

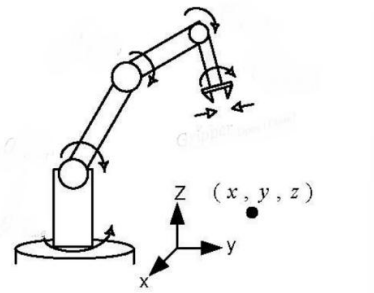

Fig-3: Robot Arm Workplace

Table -2: The different maximum angle that each servo in robot arm can move.

No.	Servo Part	Maximum Angle(°)
1	Waist	180
2	Shoulder	60
3	Elbow	85
4	Wrist Roll	180
5	Wrist Pitch	180
6	Grip	90

6. Conclusion

Overall, the objectives of this project are achieved which are developing the hardware and software for wireless mobile robotic arm, implementing the pick and place system operation and testing the robot that meets the standards of purpose project. From the analysis that has been made, it's clearly shows that its movement is accurate, simple to control and user friendly. The mobile robot has been developed successfully because the movement of the robot including mobile and arm robot can be controlled wirelessly. This robot is expected to beat the problem like placing or picking object that away from the user, pick and place hazardous object in the fastest and easiest way. The development of this system has wide area of applications like in industry.

REFERENCES

[1] G. N. Coelho (2008), Mobile Robot Navigation using Smartphones Extended Abstract.

[2] Harish K, Megha D, Shuklambari M, Amit K, and Chaitanya K Jambotkar (2017), Pick and Place Robotic Arm Using Arduino. International Journal of Science, Engineering and Technology Research (IJSETR) Volume 6, Issue 12, December 2017, ISSN: 2278 - 7798 pp 1569

[3] Industry4WRD: The National Policy on Industry 4.0. Shaping The Future of Industry, (2018). Ministry of International Trade and Industry. Retrieve from https://www.miti.gov.my/miti/resources/Media%20Release/Media_Release__Industry4WRD_The_National_Policy_on_Industry_4.0_.pdf

[4] Nik Firdaus (2015), Smartphone-Based Robot Control for Localisation. Master's thesis, Universiti Tun Hussein Onn Malaysia

[5] Rajashekar K, Hanumantha Reddy, Ruksar Begum T, Shaheena Begum, Syeda Ziya Fathima, Saba Kauser (2020), Robotic Arm Control Using Arduino. Journal of Emerging Technologies and Innovative Research (JETIR) June 2020, Volume 7, Issue 6 pp, 453- 455

[6] R. V. Aroca, A. P. B. S. de Oliveira, and L. M. G. Gonçalves (2012), Towards Smarter Robots with Smartphones in Robocontrol: Proc. 5th Workshop Appl. Robot. Autom., Bauru, Brazil, pp. 1–6

[7] S. Tang (2011), Performance analysis of an integrated wireless network using WiMAX as backhaul support for WiFi traffic," - MILCOM 2011 Mil. Commun. Conf., pp. 1833–1837, Nov. 2011.

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