

Design and Development of Pick and Place Robotic Arm with Path Record and Play

MANIVANNAN A ¹, HARI PRASATH R ², GOPI NATH K ³, RAM PRASANNA M ⁴

¹ Assistant Professor, Department of Mechanical engineering, Krishnasamy collage of engineering and technology, Cuddalore, Tamilnadu, India.

^{2,3,4} UG scholars, Department of Mechanical engineering, Krishnasamy collage of engineering and technology, Cuddalore, Tamilnadu, India.

ABSTRACT-In the past two decades the industrial works are found to be implemented through robots. The industrial robots are designed to eliminate error and intervention of human. The pick and place robot is designed to perform pick and place operation. The literature survey suggest that the pick and place robot is used in various fields such as packaging, inspection of jobs and also for military purposes for defusing bombs. The project deals with designing and analysing the structure of robotic arm with different materials. It will pick and place an object from source to destination safely. The soft catching gripper used in the arm will not apply any extra pressure on the objects. The robot is controlled using android based smart phones or PC through Bluetooth. The robotic arm has 6-DOF. It has additional features such as mechanical gripper and pneumatic gripper for versatility while using.

Index Terms - 6-DOF Robotic Arm for Pick and Place Operation

Keywords: robotic arm; path record and play; pick and place operation,

I INTRODUCTION

A robotic arm has a mechanical structure that alters its form using a group of electric motors that behave like servo motors, pneumatic, or hydraulic actuators. They are usually programmable, with similar functions to a human arm; the arm may be the sum total of the mechanism or may be part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain. The terminus of the kinematic chain of the manipulator is called the end effector and it is analogous to the human hand.

Many elements of robots are built with inspiration from the nature. Construction of the manipulator as the arm of the robot is based on human arm. The robot has the ability to manipulate objects such as pick and place operations. They attempt to reproduce movement similar to a human arm. Robots are generally used to perform operations that are risky, hazardous and troublesome tasks. They are used for different operations such as material handling, assembly, arc welding, resistance welding and machine tool load and unload functions, painting, spraying, etc.

II LITERATURE SURVEY

[1] **Design of controlling an anthropomorphic robotic arm** by Gourab Sen Gupta, S.C.Mukhopadhyay and Matthew Finnie In this paper They proposed the design of controlling an anthropomorphic robotic arm through a LAN or via the Internet. The user can control the robotic arm remotely and access its sensory feedback signals. The camera mounted on the robot arm takes images and transmits to the control station. The robot arm is controlled using a master-slave control methodology.

[2] **Design Analysis of a Remote Controlled "Pick and Place" Robotic Vehicle.** In this paper the design of a Remote-Controlled Robotic Vehicle has been completed. A prototype was built and confirmed functional. This system would make it easier for man to unrivalled the risk of handling suspicious objects which could be hazardous in its present environment and workplace. Complex and complicated duties would be achieved faster and more accurately with this design. The use of Robots is highly recommended for Industries especially for safety and productivity reasons. In their design work, they included a Robotic arm of five Degree of Freedom with its base resting directly on top of the vehicle, a body having four drive wheels coupled to the ends .In the mode of operation of robot ,they included operation such that when

the operator issues a command from the remote control to the robotic vehicle all necessary tasks will be carried out by sending signals to the microcontroller. The microcontroller then issues command to the respective channels that makes up the communication links. The electric motor will operate as per given command and the direction, speed and motion of the motor is regulated by the microcontroller.

[3]Design of a Robotic Arm with Gripper & End Effector for Spot Welding. In this paper propose of This robotic technology makes the spot welding operation more flexible and time oriented. With the help of pick and place mechanism the material handling has been easily carried out. The variation in the mechanical structure and the angle of movement can be changeable. The human hand design forms the basis of this project of developing a robotic gripper and is the source of inspiration to achieve the sufficient level of dexterity in the domain of grasping and manipulation if coupled with wrist and arm. Instrument. To achieve this goal they intend to incorporate a simple linkage actuation mechanism. An AC motor is used along with spur gears and a threaded shaft arrangement. The gripper can perform the basic function of picking, holding and grasping of objects by means of a DC motor and it forms the mechanism for the spot welding. The Project Aims to Build A Prototype of robotic arm with gripper & end effectors for spot welding, the various objectives of the prototype is as follows:- i) Having a rigid mechanical structure. ii) Ability to move each parts at define angle. iii) Optimum power consumption. iv) To pick the material in jaws and join itself by means of spot welding mechanism. From this paper ,they concluded that This robotic technology makes the spot welding operation more flexible and time oriented. With the help of pick and Gripper is an end effectors or tool to grasp any physical thing that may be a human hand or any place mechanism the material handling has been easily carried out .The variation in the mechanical structure and the angle of movement can be changeable

[4] Design Analysis of a Remote Controlled “Pick and Place” Robotic Vehicle by B.O. Omijeh In this paper, the design of a **Remote Controlled Robotic Vehicle** has been completed. A prototype was built and confirmed functional. This system would make it easier for man to unrivalled the risk of handling suspicious objects which could be hazardous in its present environment and workplace. Complex and complicated duties would be achieved faster and more accurately with this design.

III OBJECTIVE

The main objectives of this project are

- To design a robotic arm and analyse its structure with different materials (stainless steel and aluminium alloy).
- To control the displacement of the robotic arm with servo motors so that the arm can be used to pick and place the elements from any source to destination.
- To control the displacement and movement of robotic arm using Bluetooth control from smart phone or Pc.
- To implement a robotic arm with six degrees of freedom.

IV TYPES OF ROBOTIC ARM



Figure 1 A) Polar, B) Cylindrical, C) Cartesian, D) Jointed-Arm, E) SCARA

V DESIGN PROCEDURE

The robot design is the most important part in the process of constructing the robot. Here we develop new ideas for the construction of the robot and express these ideas in the form of plans and drawings. The robot arm design procedure involves:

- Material selection
- Design of mechanism
- Preliminary design
- Revision of design
- Final drawings

A) Requirements

- The robot must be Tough, Rigid and Precise.
- The arm must be rigid enough to withstand forces generated due to Own body weight Weight of the object to be lifted Inertia forces due to changes in velocity Centrifugal forces due to changes in velocity
- The mechanism must be simple such that the manufacturing process is simplified.
- The cost of the producing the robot must be reduced.

B) Robotic Arm Design

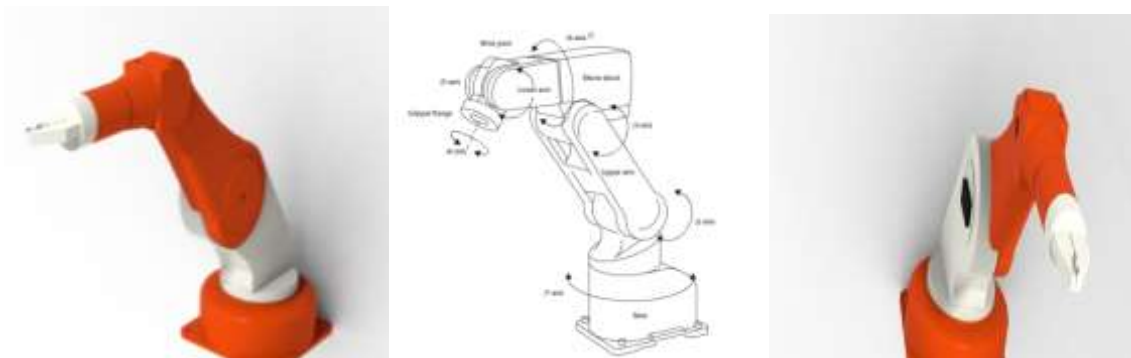


Figure 2

C) Interchangeable gripper



Figure 3

Gripper or end effector is used for holding the object which is to be manipulated. There are various types of gripper based on the source used they are vacuum grippers, pneumatic grippers, hydraulic grippers and

servo electric grippers. The second method of categorizing the grippers (mechanical) is based on the type of kinematic device used for the actuation of finger motions. It can be accomplished by anyone of these types: linkage, screw, gear and rack, rope and pulley, or cam actuation.

VI METHODOLOGY

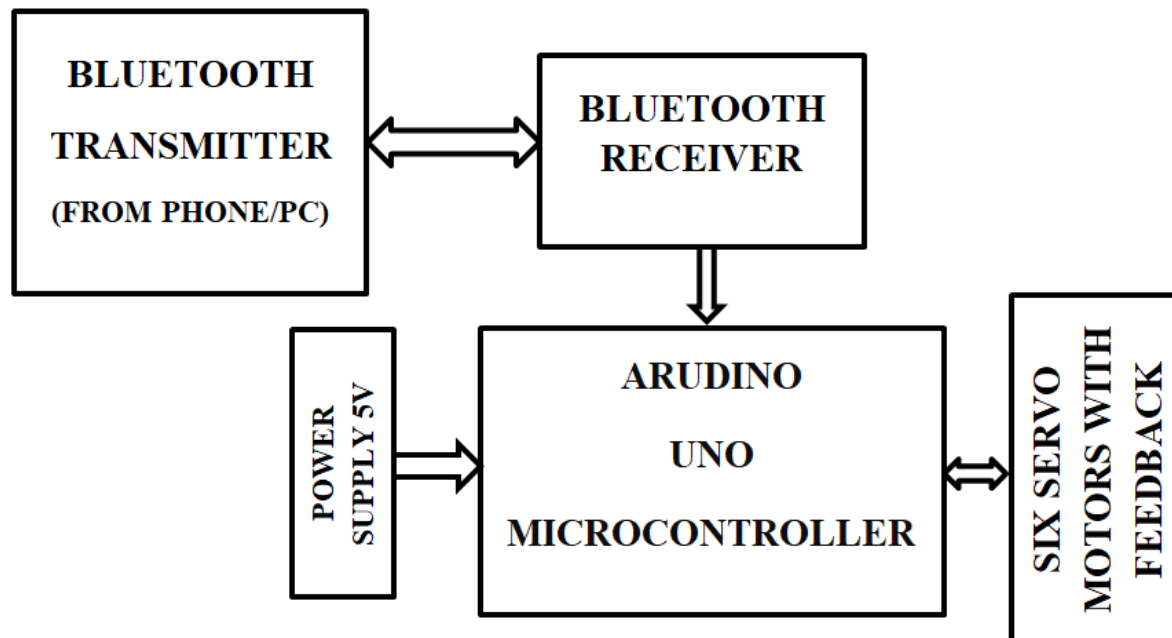


Figure 4 Block Diagram

The block diagram of the proposed system is shown in Fig 4. It consists of an arduino Microcontroller IC, Six servo motors and power supply. The pick and place robot uses four motors for arm movement, two servo motors for the gripper jaw opening and closing. There are two motors for the arm assembly, one for the up and down motion. Arduino micro controller is used. The input signal or controlling signal is given from a Bluetooth from android, which is interfaced with the microcontroller by a Bluetooth module. When the signal is sent from the smart phone it is decoded in the controller and proper controlling signal is sent to actuators (dc motors or servo motor) in the system.

A) Arduino Microcontroller

The Arduino Uno is a microcontroller board based on the ATmega328. It has 20 digital input/output pins (of which 6 can be used as PWM outputs and 6 can be used as analog inputs), a 16 MHz resonator. The operating voltage is 5V. The boards are equipped with sets of digital and analogue input/output (I/O) pins that may be interfaced to various expansion boards ('shields') or breadboards (For prototyping) and other circuits.



Figure 5 Arduino Uno Microcontroller

The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers can be programmed using C and C++ programming languages. In addition to using traditional compiler tool chains.

B) Servo motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing. A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analogue or digital) representing the position commanded for the output shaft.



Figure 6 Servo Motor

The motor is paired with some type of position encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and the motor stops. The servo turn rate, or transit time, is used for determining servo rotational velocity. This is the amount of time it takes for the servo to progress a set amount, usually 60 degrees.

For example, suppose you have a servo with a transportation time of 0.17sec/60 degrees at no load, this means it would take nearly half a second to rotate an complete 180 degrees

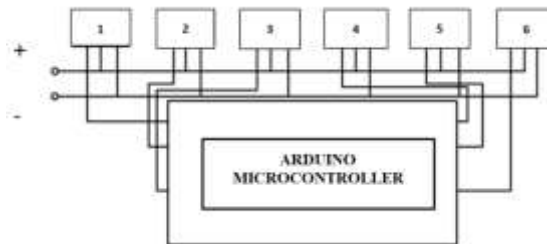
C) Axis Capabilities

SERVOS LOCATION	MAXIMUM ANGLE(°)	SPEED	TORQUE (N/mm)
BASE	360 °	0.17 s/60°	0.92
WAIST	180 °	0.17 s/60°	0.92
ARM 1	180 °	0.17 s/60°	0.92

ARM2	180 °	0.17 s/60°	0.92
GRIPPER (2)	270 °	0.17 s/60°	0.92

D) Circuit Connection

ARUDINO micro controller can only provide 5v output voltage it is not sufficient to power all six servos so an external power supply is given to power the servo motors.



1. Base servo
2. Arm 1 servo
3. Arm 2 servo
4. Wrist servo
5. Gripper up/down servo
6. Gripper opening/closing servo

E) Android application

Android devices becomes more and more popular for software developers because of its powerful capabilities and open architecture, also it's based on the java programming language. Because Android uses the Java programming language getting started with the Android programming interface (API) is easy; the API is open and allows easy access to the hardware components. Android devices provide numerous communication interfaces like USB, Wi-Fi and Bluetooth, that can be used to connect to the robot. It is a great platform for a robotic system control, because it's much cheaper than any other ARM-based processing unit.

F) Bluetooth

This project uses Bluetooth to connect and send direct commands from the mobile phone to control the robot based on direct Commands Communication Protocol. The typical sequence of events when a user runs the application. This sequence diagram assumes the user already has the software on his phone and the robot and it represents an abstract level of the interaction between the system components (mobile application and the robot). HC-05 embedded Bluetooth serial communication module has two work modes: order-response work mode and automatic connection work mode. When the module is at the automatic connection work mode, it will follow the default way set lastly to transmit the data automatically. When the module is at the order-response work mode, user can send the AT command to the module to set the control parameters and sent control order. The work mode of module can be switched by controlling the module input.

G) Path record and playback

Playback robots use a more sophisticated control. The robot is taught a series of positions or motions, recorded into memory and then repeated under its own control. The procedure of teaching and recording into memory is called as programming the robot. Playback robots have a feedback to ensure the robot has reached the positions that have been taught. Playback robots are classified into two categories: Point-to-Point Control (PTP) and Continuous Path Control (CP).

V. HARDWARE SETUP

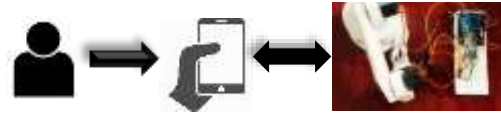


Figure 7

VI. CONCLUSION

The proposed concept of pick and place robot using Arduino is implemented via Bluetooth control. It is found that, the robot so implemented has the ability to locate itself to the location where the object to be lifted is available with the help of arms and six servo motors. Further depending upon controlling action provided to servo motor it lifts the object and locates the same at required destination.

VII. FUTURE SCOPE

The robot so programmed for pick and place operation can be made versatile and more efficient by providing the feedback and make it operate on its own thought without any human intervention. The robot can be used for automated assembly lines , welding purpose, sorting .etc.,.

REFERENCES

- [1] Pick and Place Robotic Using Arduino Harish K , Megha D , Shuklambari M , Amit K , Chaitanya K Jambotkar.
 - [2] Industry Based Automatic Robotic Arm
Dr. Bindu A Thomas, Stafford Michahial, Shreeraksha.P, Vijayashri B Nagvi, Suresh M
 - [3] Er. R.K.Rajput, „Robotics and Industrial Automation“, S. Chand Publications, 2014.
 - [4] Design Analysis of a Remote Controlled “Pick and Place” Robotic Vehicle by B.O. Omijeh
 - [5] <https://howtomechatronics.com/>
-