Remote Controlled Pick and Place Robot

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Abstract. In today’s world sales and demand for products has grown exponentially. There is always a need of the products in a huge count in terms of production, handling of such a huge count of products is not possible without automation process but the instruments used of such automation process is of high cost which is not feasible for the small scale industries to implement such a high-cost machine for their use cases. To overcome the above problem of handling the products, a low-cost pick and place robot has been designed for handling the products, this robot is designed based on RRT-R configuration for the robot body, with this configuration this robot can handle products in complex positions. This robot is featured with the six DOF (degrees of freedom) for its movement. This robot is a tele-operated robot that can be controlled using a specialized mobile application developed using MIT APP INVENTOR 2 which makes the user use this robot without any special support for controlling, this robot gives a hassle-free experience for the user who is controlling the robot. By using this robot pick and place tasks can be simplified and the process can be automated and the rate of product handling can be increased.

Keywords: Pick and Place, Robotic Arm, Industrial Automation, Bluetooth Connectivity, Degrees Of Freedom.

1. Introduction

Pick and place robots automates the pick the place operation by picking an object and placing it in other different areas. Computerizing this procedure assists with expanding production rates. Pick and place robots handle dull assignments while opening up human laborers to concentrate on increasingly complex work. Many industries started using pick and place robots for moving operations. But small industries still use laborers for pick and place operation. To overcome this problem, the authors come up with a very potentia l pick and place robot with a very low budget. Developing this low budget pick and place robot can replace human labour and automate the small-scale industries [1]. This saves time and also improves productivity. Also, operations done by humans can cause damage to the objects, but using pick and place robot can avoid such damages. This project’s main goal is to develop a pick and place robot that is embedded with a robotic arm having a gripper at its end. It is controlled through Bluetooth using an app developed in MIT app inventor 2. Robots are mainly used for doing highly dangerous jobs which couldn’t be done by human beings. Thus, pick and place robots are also a type of robot which can solve this kind of problem. The robot does pick and place operation by receiving commands from the Bluetooth transmitter and receiver. It has six degrees of freedom. Pick and place robotic manipulator can be designed in many different ways according to the application it is going to be used. The total mechanism of this robot relay upon joints [2]. The joints are used to combine the two unbending continuous bodies in a robot which can be a revolving joint or linear joint. Joints are mainly used to characterize the integration of the arm as they choose the degree of freedom.
Kadam and Hwang [3] designed a flexible and easy "Pick and Place Robot" that can be controlled. The robot utilizes two Arduino microcontrollers associated with a master/slave arrangement. The master controls the automated arm while the slave controls the mechanical base. The arm uses servomotors to give movement in the necessary pivot. The base comprises of dc outfitted engines and followed wheels for shipping the mechanical arm with the griper. The aftereffect of this task is a small scale robot that gives pick and place operations that can be utilized in a few applications by changing the program of the regulator. The structure is intended to lift light loads. A characteristic and natural approach to communicate with a robot by utilizing signals and this concept was proposed by Latif et al., [4]. As a jump movement regulator gives a straightforward and compelling technique to precisely follow the development of human hands and fingers, can be utilized to give natural control of the robot. In this work, authors show a plan of an automated stage that is constrained by hand motions being followed by the jump movement regulator. The left hand is utilized for controlling stage versatility, utilizing motions to give unique movements, for instance, pushing ahead and moving in reverse and the correct hand is utilized for controlling the arm for pick and spot errands. The created robot can be utilized for far off observing of the troublesome climate and influence changes to it through a controller's arm. Likewise, it can self-sufficiently keep away from obstructions utilizing Ultrasonic sensors. In general, the planned framework model has demonstrated its possible abilities for climate observing and observation through pragmatic exhibits utilizing motions.

A prototype, that robot pick and placed, was developed and implemented by Abdulkareem et al., [5]. Here, they intended to use an automatic arm to pick and position items with a rotative base, elbow, and wrist motions. The different parts are bound together with joints, as are the joints in the body. The administrator shall use the cell phone key to select and position the object. The mechanical arm may be pushed by pressing different keys of the mobile device, for example, in the left or right direction, wherever. With far-off phone access, the authors have used the ATmega328P, DTMF and GSM Modules. Arduino IDE for control component programming and simulation security. For pick-up and place application, Ghadge et al., [6] developed a robotic arm. An arma mechanical to pick and position products on customer's orders is developed using Arduino. It secures the collection and positioning of an object from source to goal. The responsive gripper in the arm does not impact the weight of the item. The robot is controlled and Bluetooth and Android mobile devices. Due to the customer's commands, the robot also travels. Four engines communicate with the miniature regulator at the end of the receiver. Two are also for the development of the engine and two remain for the arm. For robot power the blue control application is used.

Ongaro et al., [7] done a study on the control of untethered soft grippers for pick-and-place tasks. The undertaking is intended to build up a decision on the pick and place of a mechanical vehicle with a delicate getting gripper. For instance, it'll securely hand a bomb carefully to stay away from its blast while getting. The mechanical vehicle is golem application controlled for far off activity. All the sending end utilizing golem application gadgets, orders are shipped off the beneficiary to deal with the development of the golem either to move forward, in reverse and left or right, and so on. At the less than desirable end, four engines are interfaced with the microcontroller where two are for the body development. The golem application gadget transmitter goes about as a distance that has the upsides of sufficient change, while the recipient end Bluetooth gadget is taken care of to the microcontroller to drive DC engines through engine driver IC for essential work. From the above-mentioned, authors conclude that our robot is more unique because it is highly customizable. Authors have made the robot more user friendly by interfacing Bluetooth connectivity between the robot and the mobile app called servo. Each motor is controlled with a separate button for ensuring the movement of the desired link. Thus authors say our robot is unique from the other pick and place robot in this way. Once the circuit
gets activated the process gets started by enabling the Bluetooth module. Then the degrees of the servos are initialized to rest position. Then it waits for the command. Each servo receives a separate command from each desired button respectively. The gripper operation is a toggle operation where the open and close operation is done through the same button [8]. The degrees of movement of each servo can be changed anytime by editing the code making it customizable according to our needs. Figure 1 shows the flow chart of the algorithm.

![Flowchart](image)

**Figure 1.** Flow chart algorithm

2. Design of Pick and Place Robot

The arm of the robot is designed with six degrees of freedom with the gripper. The manipulator is attached with 3 metal servos, one at the base, another one attaching the waist and link 1, and one attaching link 1 and link 2. The two micro servos are fixed near the link 3 and the gripper. The waist and link 4 are 360° rotatable. The other two links can go to and froth up to 180° and even more. The gripper uses a parallel jaw mechanism which is designed with two fingers. Figure 2 and Figure 3 shows the design of the arm, Figure 4 shows the design of the end effector (gripper) and Figure 5 to Figure 9 shows the 3D printed parts of the entire manipulator.
Few essential components are needed for the design and simulation of the app. The Arduino UNO is a Microcontroller Open Source Board built on and developed by Arduino [9], built on the ATmega328P microcontroller. The panel comes with collections of input / output (I/O) optical and analogue pins that can be interconnected with a number of boards and circuits. MG995 is a 180° rotary servomotor that produces an efficient 180° rotation. The servo is suitable for the construction of a robotic arm with a high motor wear. The servo is metal-conducted and can be mounted over a device such as a robot arm where motor running is immense. Strong yield strength compact and lightweight [10]. The servo is 180° (90 to each route) and operates just like the normal, but littler ones. To monitor these facilities,
you can use any servo code, equipment, or library. It can be useful for those amateurs who need to move items without building a vital motor and appliance box, particularly because it fits in places that are small [11]. The HC-05 module is simple to use and is designed for the transparently configured wireless serial link by way of Bluetooth SPP (serial port protocol). HC-05 Bluetooth Module offers master-slave mode switching, which means that it does not receive or send data. An app called servo is developed through MIT inventor 2. The app will be operated by connecting to Bluetooth. The app is developed for operating the servo motors [12]. The degrees of rotation for the servos will be given through code. The process will start when the authors trigger the start button in the app. Thus authors can operate the servos by using the app invented. The authors have separate buttons for each servo.

4. Calculations
The gripper force calculation is done for analyzing the grippe force. It is calculated using the following formula

\[ \mu n f F_g = w \]  

Where \( \mu \) = coefficient of friction of the finger contact surface against the part surface
\( nf \) = number of contacting fingers
\( F_g \) = gripper force
\( W \) = author sight of the part or object being gripped
\( \mu = 0.75 \)
\( nf = 2 \)
\( F_g = 0.75(2) \)
\( F_g = 50 \)
1.5Fg = 50
Fg = 50/1.5
Fg = 33N

5. Results and Discussion
The block diagram shows the connection and relationship between every component. It represents the importance of the components. The Arduino UNO is the processor used here. The Bluetooth module is a receiver and transmitter [13]. It receives and transmits the signals from the app to the Arduino board which makes the arm move in the desired direction. The Arduino board controls the activity of the arm as per the commands received from the app. Figure 10, shows the code for the app.

![Figure 10. Code given for the app](image)

The circuit diagram was designed and simulated in Proteus 8 Professional. As you can see, the processor is connected with each component of the circuit. The processor is connected with three servo motor MG995, two micro servo 9g, and a Bluetooth module HC 05. The power supply is given from the external source. The Bluetooth module is connected with an app developed by us [14]. The processor receives commands from the app as per the program which makes the arm move in a specified direction. Each servo motor is given a maximum and minimum degrees of movement in the coding, between which it can move [15]. Thus, the movement of the servo is controlled by the app using our mobile phones through which one can pick and place an object. Figure 11 shows the app developed in MIT APP INVENTOR, Figure 12 shows the block diagram of the interface with Arduino, and Figure 13 shows the Proteus circuit simulation.

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We have designed a unique pick and place manipulator. Our design is 3D printed and assembled manually. The waist and link 4 are 360° rotatable. The other two links can go to and froth up to 180° and significantly more. The gripper utilizes a parallel jaw system which is designed with two fingers. It can lift a weight of 50g to 75g. The overall weight of the bot is 500g. The number of autonomous ways by which a unique framework can move, without violating any constraint forced on it, is called the number of degrees of freedom. The robot has six degrees of freedom. The authors calculated the gripper force to be 33N.

Figure 11. App developed in MIT App Inventor

Figure 12. Block diagram of the interface with Arduino

Figure 13. Proteus circuit simulation

6. Conclusion
As per considering the laws of a robot, a robotic arm that is highly customizable with an end effector is designed and developed. It is developed with an adjustable gripper. The gripper jaws move in an
equal movement according to the gripper body. Utilized in and down, which through a mechanical linkage, powers the gripper jaws open and shut. The app is operated by connecting it to the Bluetooth module which is a serial port protocol. The circuit design is done and simulated in proteus. This robot can be fabricated with a very low budget. If this ideology is followed by all the industries, one could give way to the automation revolution “INDUSTRY 4.0”. The user remains near the very edge of an innovative transformation that will alter in a general sense adjust how one live, work and identify with each other. In its scale, extension, and unpredictability, the change will be not normal for anything mankind has encountered previously.

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