ROBOTIC ARM USING SMARTPHONE CONTROL

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Abstract: As the daily requirements of the human beings are increasing rapidly the dependency on technology is increasing in similar way. The work done to fulfill these requirements makes the human life easier every day, and these studies are concentrated in robotics studies. Actually in the last few years scientists refer the word "Robot" to any man-made machine that can perform action or work which can be normally performed by humans, either using remote control or automatically because of this robot pervasive machine because of it is accuracy of work and doing thing that people can't do in addition robot can work in dangerous regions that human are not able work in it because of all these reason robots became one of the most popular thing that scientists are still making some changes to make more efficient and more reliable and in our project we have built a robot arm with 5 Degree of Freedom(DOF). In fact, there are several methods used to implement a 5-DOF manipulator and capable of performing pick-&-place operations. but the problem is that all the controller is relentless that means if we need to change the program of the robotic arm we have to reset and write or design another one and upload it to arm robot this way apparently is inefficient, on balance we choose a different and unconventional method to control the robotic arm.

IndexTerms – **Robot System, Smartphone Control, Degree of Freedom (DOF)**

I. INTRODUCTION

A robot is a machine designed to execute one or multiple tasks automatically with speed and perfection considering maximum efficiency. We need robots because robots are comparatively cheaper to use and deliver higher precision values and estimations over humans. In addition, it's convenient and easier to do some jobs using robots and occasionally the only possible way to accomplish some tasks and save time. Robots can explore inside gas tanks, inside volcanic eruptions, travel the surface of Mars or other places too dangerous for humans to go where extreme temperatures or defiled surroundings exist or hazardous environments. Robotics is an interdisciplinary branch of engineering and science that includes mechanical engineering, electrical engineering, computer engineering, artificial intelligence and other sub departments of these branches. Robotics deals with the design, construction, operation, and use of robots, as well as computer systems for their control, sensor information feedback, and information processing and maintenance. Robotic system has been extensively used in manufacturing, military and surgery since the robot can perform numerous advantages and used as the countermeasure for some job that cannot be conduct by the human excellently.

Robots are used in various fields such as industrial machines, military, space exploration, and medical applications. These robots could be classified as manipulator robots and cooperate with other parts of automated or semi-automated equipment and machinery to achieve tasks such as loading, unloading, spray painting, welding, assembling and manufacturing. Generally, robot system are designed, built and controlled via a computer or a controlling device which uses a specific program or algorithm. Programs and robots are designed in a way that when the program alters, the behavior of the robot changes accordingly resulting in a very flexible task achieving robot. These outcomes and functionalities of the robot are already programmed and parameters are passed to the instruction and syntax of the code. Robots can be classified by their generation, intelligence, structure, version, capabilities, usability, application and operational capabilities.

II. LITERATURE SURVEY

From manufacturing and assembly to automation, industrial robotic arms are one of the most common types of robots in used at machine line. Robotic arms, also known as articulated robotic arms, are fast, precise, reliable, and accurate and can be programmed to do a vast number of tasks in a variety of surroundings. They're used in manufacturing of different products, to automate execution of repetitive tasks, like spray painting to the equipment or parts of complex machines; in storehouses to pick and place, select, or sort goods from distribution conveyors belts to fulfil consumer orders; or in a ranch field to pick and place ripe fruits onto storage containers. They are used in segregation of finished goods and waste products. And as robotic technologies develop and artificial surroundings come more connected, capabilities of robotic arms expand to enable new use cases and business operation models.
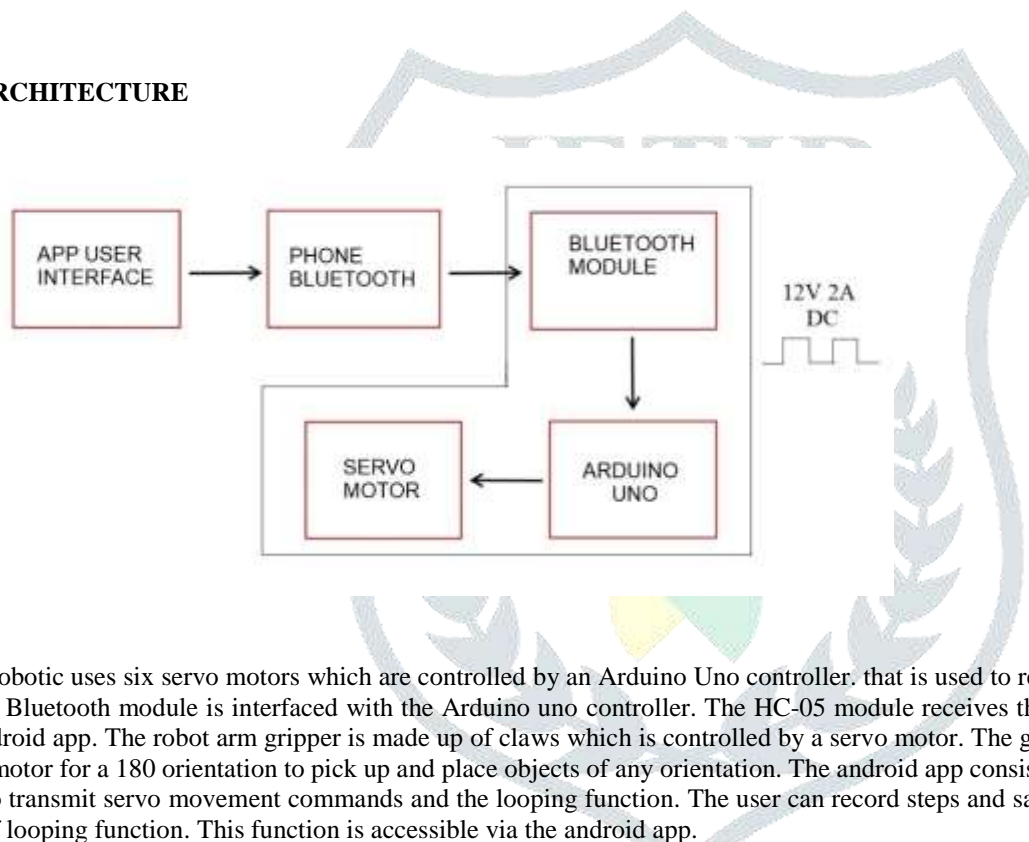
III. EXISTING SYSTEM

Most industrial robotic arms use six joints, which provide the same number of axes of rotation for movement. The degree of rotation and movement of these robotic arms are fixed and pre-programmed. Such robots are designed and constructed and told ahead of time what to do. The programs are compiled and the robots simply execute those set of instructions. They cannot alter their behavior while they are working in real time and no human is guiding their actions. Such robot systems fail to operate smoothly and provide inappropriate solutions to the real time changes and tasks of the work systems. This affects the efficiency of the working robots tremendously. It tolls a large amount of money and time to map every solution to the real time changes. Also, a large number of parameters have to be passed and predefined of all the working environmental fields for the automatic execution of the robots, which is simply impossible to do so.

IV. PROPOSED SYSTEM

Our system helps to provide solution to the real time problems faced in the manufacturing industries. The smartphone control acts like an interface between the user and the robotic arm. For instance, the proposed system helps the user to control the movement and can change the directions as desired in between the working of robotic arm to solve real time problems without modifying the program. The user can also operate the robot arm in a loop. This technology helps to increase the functionality of the robots and minimize the human work thus eliminating labor problems in manufacturing industries.
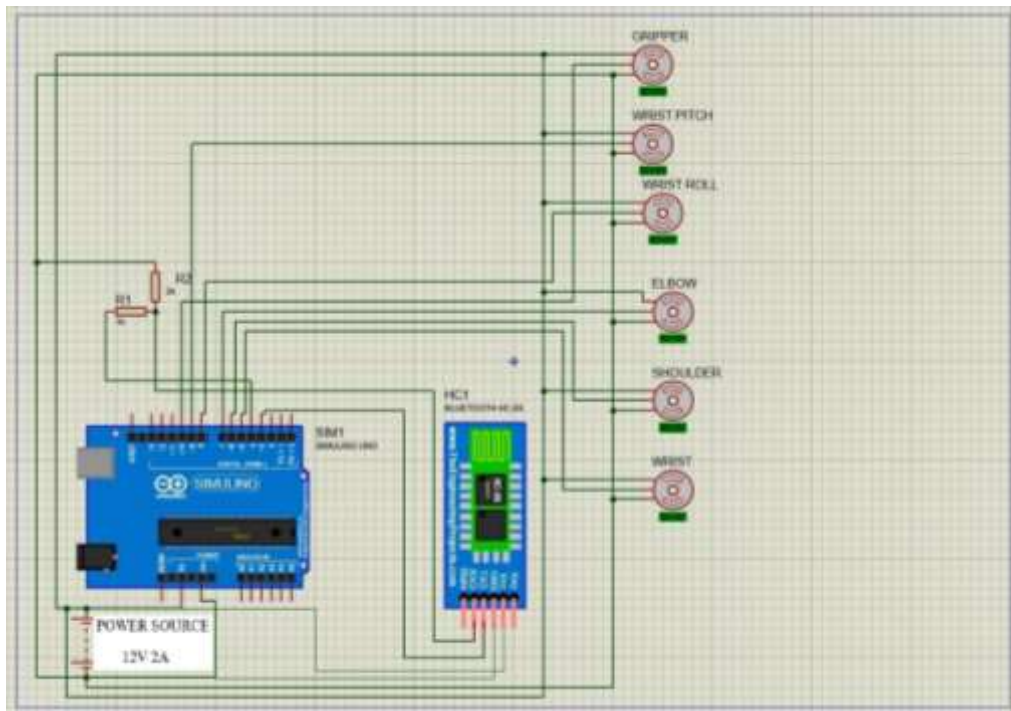
V. ARCHITECTURE

The robotic uses six servo motors which are controlled by an Arduino Uno controller. that is used to receive commands via the android app. HC-05 Bluetooth module is interfaced with the Arduino uno controller. The HC-05 module receives the commands and instructions sent by the android app. The robot arm gripper is made up of claws which is controlled by a servo motor. The gripper angle is also rotated by another servo motor for a 180 orientation to pick up and place objects of any orientation. The android app consists of an easy-to-use GUI with buttons used to transmit servo movement commands and the looping function. The user can record steps and save each step through the app with the help of looping function. This function is accessible via the android app.

The programming commands transmitted by app are received by the Bluetooth receiver and passed over to Arduino controller. The controller records movement commands of each servo step and saves it. The controller can now repeat the set of instructions so as to execute the entire movement command with desired coordination with each servo to achieve the program repetitively. Therefore, the system provides a smart mechanism to use a 360 programmable robotic arm with smartphone-controlled system.

The program code is written in C++ language which is one of the most popular and fundamental programming languages. We also developed a mobile application that will be connected to the microcontroller Arduino UNO via Bluetooth module. Control and movement of the robotic arm and all functionality will be possible by using the mobile application.
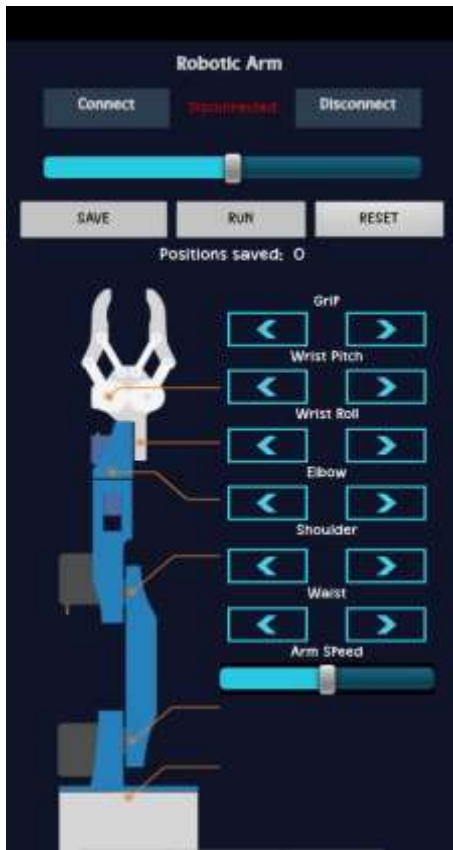
VI. CIRCUIT DESIGN

All the servo motors are connected to Arduino 12V/2A DC is given to Arduino, Bluetooth module, servo motor. Robotic arm controller app which is built using MIT app inventor is connected to Arduino with the help HC-05 Bluetooth module. With the help of robotic arm controller app, we give input to Arduino. All the servo motors are connected to Arduino. Servo motors are placed inside the robotic arm. This Servo motors are used to move robotic arm as input received from the Arduino. When user give input from robotic arm controller application with help of buttons is given to Bluetooth module. Bluetooth module receive input and send it to the Arduino. At the output pins of Arduino, we have connected servo motors. According to input from Arduino servo motors starts rotating.

Circuit diagram is actually quite simple. We need an Arduino board and a HC-05 Bluetooth module for communication with the smartphone. The control pins of the six servo motors are connected to six digital pins to Arduino board. For powering the servos, we need 5V, which come from an external power source because the Arduino is not able to handle the amount of current that all of them can draw. The power source is able to handle at least 2A of current.

VII. SOFTWARE DESIGN

By using the Arduino Programming Software Arduino Uno is programmed and compiled. It is an Integrated Development Environment (IDE) common to all the microcontroller boards which are operating both in online and offline modes. The algorithm created is easy to understand and is helpful to program for different controller.

Programs written using Arduino Software (IDE) are called sketches. These programs (sketches) are written in the text editor and are saved with the file extension. Ino The editor has features for cutting/pasting and for searching/ replacing text. The communication area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other important information. The bottom right-hand corner of the window displays the configured board and serial port.

The toolbar buttons allow you to corroborate and upload programs, create, open, cut and save sketches, and open the serial monitor. Support and application for third-party hardware equipment can be added to the hardware directory of your sketchbook directory. Platforms installed there may include board definitions and functions, core libraries, bootloaders, and programmer definitions. To install, create the hardware directory, then unzip the third-party platform into its own sub-directory. To uninstall, simply delete its directory.

VIII. RESULTS AND DISCUSSION

8.1 Results of rotation of joint servo motors

Sr. No.	Servo Motors	Maximum Rotation Angle (º)
1	Waist	0-180
2	Shoulder	0-60
3	Elbow	0-90
4	Wrist Roll	0-180
5	Wrist Pitch	0-180
6	Grip	0-90

The following results have made from this project:
- The motors are used for movement of robotic arm.
- The output from the smartphone is given to Arduino
- Bluetooth connection is stable for distances within 10m.
- The Bluetooth module operates at 2.45Ghz frequency band

The above table shows maximum rotational angle of all the working servo motors situated at the joints of the robotic arm. The robot system mechanism functions smoothly and coordinates well with the instructions given by the smartphone app to control the movement of the robotic arm. The smartphone control app controls the degree of freedom (DOF) accurately of the robot system. The looping function in the smartphone app works perfectly for tasks like pick and place of the objects. The speed of the operation of the robotic arm is average so it cannot be used to do heavy and rapid work problems. The user interface of the app is quite simple and provides customization to the user. This diversifies the usability of the robot system. The proposed system helps the user to not only perform basic functions with good efficiency but also provides solutions and some variations to the complexities derived from these functions.

IX. CONCLUSION

The objective of the project is to design the hardware and software of robotic arm. From the designing of the robotic arm, it clearly shows the moment of robotic arm is accurate, user friendly, and easy to control through smart phone and precise. The movement of the robotic arm is controlled through smartphone app which is designed using the "MIT App Inventor" platform to make it easy to control its direction. The main motive behind the robotic arm controller is to overcome the problem such as picking one object from one place to another, picking dangerous items from one place to another rapidly.

X. FUTURE SCOPE

Robotic arms can be used in machine learning and artificial intelligence. They can be used for lifting heavy machinery and cranes. They can be used for the shipment loading/unloading of containers. They are used in oil and gas pipelines. Robotic arms provide automation in medical fields in sensitive and surgery processes. Swarm robot is a futuristic multirobot system in which large number of homogenous robots are interacting inferred with each other. Such systems are often contrasted with heterogenous robots in which team members may change significantly in their capabilities. The proposed robotic system can be installed and mounted with different sensors and attachments to provide more usability to the user. Cameras can be added to the robot system which can analyze and detect the objects and products. Emerging technologies like virtual reality, image processing, augmented reality, etc. can be implemented with this robot system.

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