Android Application Controlled Robotic Arm using Bluetooth Module HC-05

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Abstract: *Robotics is the current emerging field in the era of modern technology. Robotics has become more significant as it requires low cost, low maintenance and is more accurate as compared to human work. This paper has proposed a technique to replicate a human arm by controlling it via smart phone. The smartphone uses an application built using the android platform. This project is designed with an aim to operate the robotic arm with a single touch on the android application. To accomplish the following, we develop a Human Machine Interaction System (HMIS) based on a smartphone. The command center for the robotic arm is the android application. The bluetooth module (HC-05) forms the interface between the smart phone and the robotic arm. The robotic arm will have 3 DOF which will enable efficient movement.*

I. Introduction

Now a days, everything around us is correlated to machines and internet. Robotics is the branch associated to various engineering fields. It has immensely impacted on various industrial areas and has reduced a large amount of human work. A Robotic arm is nothing but a programmable mechanical arm which has similar functionality as the human arm. A robot is basically a machine designed in order to perform any desired task depending on the program fed to it. The use of Robotics is increasing rapidly and is being used in many applications from industries to household. The main aim is to make the system more dependable and autonomous[1]. The proposed work will also help people in their daily life in many different ways. We have developed a robotic arm which is wirelessly controlled using a smartphone[2]. This arm will be very useful in situations where direct human contact is not possible. The input to the arm is provided using an android application[3]. The command buttons on the android application enables the motion of individual servo motor. Depending upon the inputs fed to the microcontroller we achieve the movement of the respective finger and the arm. The range of the Bluetooth module is approximately 10 meters in open space.

II. Literature Survey

This paper proposes an android application controlled robotic vehicle using Bluetooth module HC-05. A motor driver is integrated with the circuit for swift communication. The HC-05 module ensures serial communication. The input is provided to the microcontroller via smartphone[4].

In this paper the servo motors are controlled using accelerometers. An algorithm was prepared to achieve the 3 axis rotation smoothly. The system was proposed for industrial robots for pick and drop mechanism. Six degree of freedom is provided[5].

This paper has introduced a Bluetooth controlled spy robot. The robot is controlled using an android application. Various sensors such as motion sensor, heat sensor, depth sensor etc are used also a night vision camera is implemented on the driver unit[6].
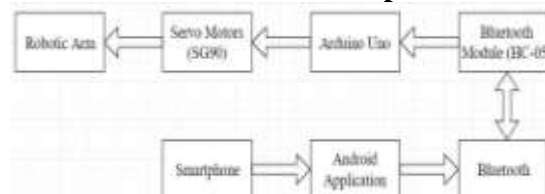
III. Technical Description

Fig. 1: Block Diagram of Robotic Arm

The android application used in this project is developed using MIT App inventor. The UI of this application consists of many buttons which performs various actions. For instance the pick/drop button is

for complete grip movement of the fingers. This application is connected to the microcontroller using a Bluetooth Module. The Bluetooth Module used is HC-05 which provides a range of 10 meters in open space. It is serial port protocol module which ensures a swift serial communication. It has two communication pins Tx and Rx for transmitting and receiving signals respectively. It is powered using the onboard 3.3V pin of the arduino uno. The Arduino Uno microcontroller is an ATmega series microcontroller. It is a 8-bit microcontroller with 14 digital pins and 6 analog pins. The programs are uploaded to the board via Arduino IDE (Integrated Development Environment) using a type B USB cable. It can be powered by a USB cable or by an external battery. The motion of the fingers and the arm is achieved using Servo Motors. SG90 servo motors are used for this as they provide a torque of 2.5kg/cm and only requires a 5V power supply. The model of robotic arm is designed using a 3D printer.

IV. Working

The Robotic Arm is designed in such a way that it consists of five fingers, a rotating elbow and a rotating base[7]. This motion is achieved using servo motors which are connected to the microcontroller. The microcontroller receives commands form a android application in a smartphone via Bluetooth. An android application is designed to give commands to the board which results in the rotation of the motor further give moments to the robotic arm.
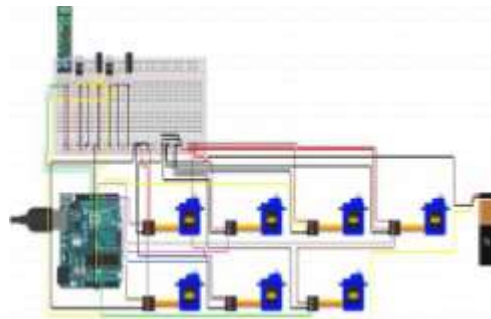

Fig.2: Circuit diagram of robotic arm.

The servo motors are connected to the digital pins of the microcontroller arduino uno. The Tx and Rx pins of the Bluetooth module HC-05 are connected to the Rx and Tx pins of the arduino uno respectively. The servo motors SG90 are connected to the arm using strings. The servo motors are powered using an external 6V power supply which is achieved by a voltage divider network. The program is compiled and uploaded to the board using Arduino IDE software. The android application has 7 buttons for the independent movement of all the 7 servo motors. It has a pick/drop option for a complete grip. The up/down option gives a vertical movement of the hand and the left/right button for the horizontal movement.

Fig.3: UI of the Android Application

V. Applications

The main application of robotic arm is to carry out tasks in areas which are not accessible to humans. Wireless robotic arm can be used in various military applications such as bomb defusal etc. It can also be used in order to deal with hazardous chemicals which will help to save human life. Robotic Arm can be used in medical purposes to carry out detailed surgical operations. It can be used in industries for various 'pick and drop' tasks. It can also benefit in many painting, welding, and metal cutting operations.

VI. Conclusion

From this paper it can be concluded that a two-way communication can be established between the android application and the robotic arm. This would enable any non-experienced user to manage the robotic arm for efficient functioning. To obtain more range, Bluetooth module HC-05 can be replaced by WiFi or Zigbee module. The functioning of the robotic arm using a smartphone via a wireless standard such as Wi-Fi or Bluetooth module helps us to 'pick and place' a specific object to any desired location[8].Another application of robotic arm in defense purposes can be done by placing the arm on a vehicle with wireless camera in order to trace the motion of the arm. For advanced functioning, images of the object can be fed as input to the arm instead of giving the commands. The robotic arm can be operated via voice using an android application. The purpose of this project is to gain control of a robotic arm with 4 degrees of freedom using a microcontroller and Bluetooth module with android application. [9]. Pharmacy based drug injecting robotic arm can also be developed depending upon the proposed model.

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