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Android based Robotic Arm

Aroop Siddharth A.S[1], Mr. P. Arunagiri[2], Dhileep Kumar. R[3], Govindharaj. T[4]
[1, 3, 4]*IV[th] year Electronics and Communication Engineering, Sri Manakula Vinayagar Engineering college, Puducherry, India*
[2]*Associate Professor, Electronics and Communication Engineering Sri Manakula Vinayagar Engineering College, Puducherry, India*

Abstract: ***The technology keeps on evolving and the control system of instruments gets evolved and everything can be controlled under one roof. Nowadays android application is an important tool for controlling devices and instruments. In our project we choose to automate and ease the control of robotic arm which plays an important role in various industries. At present, industries use robotic arms which are controlled by individual control units and each arm needs a I individual to operate. This requires more manpower even though multiple arms have same functionality.***
As a solution to this, we propose a system in which the robotic arm is controlled by using an android application for multiple operations. The user gives the command from an android application and the command is decoded with the help of Node MCU. It has an inbuilt wi-fi module which helps to receives the various commands from the application by the microcontroller. IC L293D is used to interrupt the command from the microcontroller. The system is designed in a way where two or more robotic arms performing the same task can be operated simultaneously from an single application.
Keywords: Android Application, Node MCU, Robotic Arm

I. INTRODUCTION

A robotic arm is a type of mechanical device which can be programmed to work in a particular way. He 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 or translational displacement. At present in industries the robotic arm is operated by mechanical system. PLC (Programmable Logic Unit) is used in some advanced industries to control the arm. Microcontrollers and Micro processors are also used to control the arm. The robot body is constructed in a mechanical manner and electrical components were also used to build the robotic arm. Mostly they are controlled by using a connected network and their working space is limited. In order to overcome this the control of the arm is made wireless that is, it is controlled by Wi-Fi.

II. HARDWARE and SOFTWARE

A. Robotic Arm

The robotic arm has four main parts the base, shoulder, elbow and wrist. It has four rotational joints. The shoulder, elbow and wrist rotate around the x-axis and the base rotates around the vertical z-axis. The rotation of the joints is limited in the backwards and forwards directions but for the wrist, elbow and shoulder, and to the left and right for the base. Gravity also means that the arm's rotational velocity is not constant that is for example, rotating the shoulder joint
downwards will take less time than rotating it upwards by the same amount.

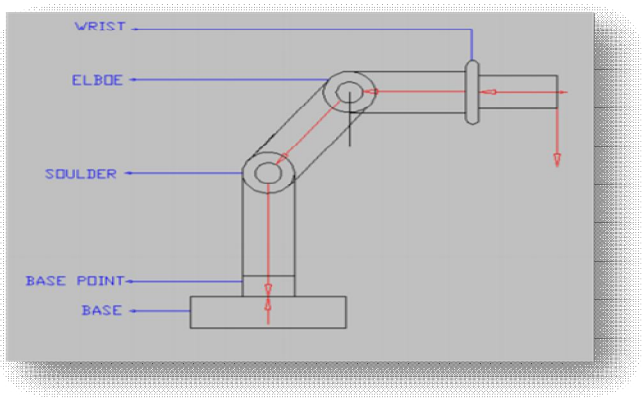

Fig.2.1 Schematic Diagram of Robotic Arm

B. Android Application

Android application is an application which runs in the Android OS build using the Android Studio. Most of the mobiles runs on the Android OS. The front end is developed by using XML language and the back end by using JAVA/ Kotlin. When a certain button is clicked in the application it generates a signal which gives control to the Arduino to move the arm in a particular direction. The Android Application acts a command center from where all the instructions to control the arm is given. The instruction is first interrupted by the Arduino and based on the instruction it controls the movement of servo motors in the robotic arm.

C. NODE MCU

NodeMCU Development Board consist of ESP8266 which is a low-cost Wi-Fi chip developed by Espressif Systems with TCP/IP protocol. The features of ESP8266 are extracted on NodeMCU Development board. NodeMCU (LUA based firmware) with Development board/kit that consist of ESP8266 (wi-fi enabled chip) chip combines NodeMCU Development board which make it stand-alone device in IoT applications. The Espressif system developed the ESP8266 is Wi-Fi enabled system on chip (SoC) module which is mostly used for development of IoT (Internet of Things) and embedded applications. The PIN description is given below:

1) *GPIO (General Purpose Input Output) Pins:* NodeMCU has general purpose input output pins on its board as shown in figure 3.8. We can make these pins to toggle between the digital low/high states which can be used to control various devices. Also, we can generate PWM signal on these GPIO pins.
2) *ADC (Analog to Digital Converter) channel (A0):* NodeMCU has one ADC channel/pin on its board.
3) *SPI (Serial Peripheral Interface) Pins:* ESP8266 which is based on NodeMCU has Hardware SPI (HSPI) with four pins available for SPI communication. It also has SPI pins for Quad-SPI communication. This SPI interface can be used to connect any SPI enabled devices with NodeMCU in order to communicate with them.
4) *I2C (Inter-Integrated Circuit) Pins:* I2C functionality support has been provided to the GPIO pins of ESP8266. Due to internal functionality on ESP-12E we cannot use all its GPIOs for I2C functionality. So, tests are carried out before using any GPIO pins for I2C applications.
5) *UART (Universal Asynchronous Receiver Transmitter) Pins:* There are two UART interfaces namely UART0 and UART1 in the NodeMCU based ESP8266. We can't use them in applications while uploading firmware/codes because UART0 (RXD0 & TXD0) is used to upload firmware/codes to board.

III. WORKING SYSTEM

The working/construction of the system is divided into three categories:

A. Construction of Robotic Arm (hardware)
B. Building of Android Application (software)
C. Interfacing the hardware and software

Smartphones are built with all the latest technologies and they can perform almost all the functions of a laptop or PC. The node MCU which is a microcontroller acts as an interface between the hardware and the software. The android application acts as an interface between the user and the robotic arm. An android application is built by using android studio 4.0 through which the user gives the control signal as the instruction/input to the microcontroller and in turn the function of the arm is controlled. Based on the instruction given the four basic movements of the arm is controlled. There are actually two type of connection to the wi-fi network of the pi Router method: In this Wi-Fi of both pi and android phone are connected to a common router. By using the Wi-Fi Direct method, the data can be exchanged directly through the local hotspot between the Node MCU and the application. The arm is equipped with 5 motors, so 3 motor driver IC are required to control all the joints/ movements of the robotic arm. A triple L293D motor driver IC is designed for the control of all the motors and is interfaced with the Arduino. The enable pin should be made high for the motor to run and by changing the values of the input pins, we can change the direction of motion of the arm. Each driver IC can control a maximum of four motors. For a motor driver IC like L293D, we need to provide separate power supply for both the IC and motors connected to it. As all the motors of the arm works at 5V, a single 5V supply is given to both the IC and the motor.
The robotic arm has four main parts the base, shoulder, elbow and gripper. It has four rotational joints which are mounted with 9g servo motor. The shoulder, elbow and gripper rotate around the x-axis and the base rotates around the vertical z-axis. The rotation of the joints is limited in the backwards and forwards directions for the wrist, elbow and shoulder, and to the left and right for the base. Gravity also means that the arm's rotational velocity is not constant that is for example, rotating the shoulder joint downwards will

take less time than rotating it upwards by the same amount. The base rotates to angle between 0-degree to 108-degree from left to right. The elbow and the shoulder rotate to angle between 0-degree to 108-degree corresponding X and Y axis. The elbow and the shoulder are used adjust the length and height of the arms respectively. The arm is constructed by using the acrylic material because they are light in weight and durable. The acrylic material is cut into required dimensions using laser cutting.

Fig.3.1 Block Diagram of overall system

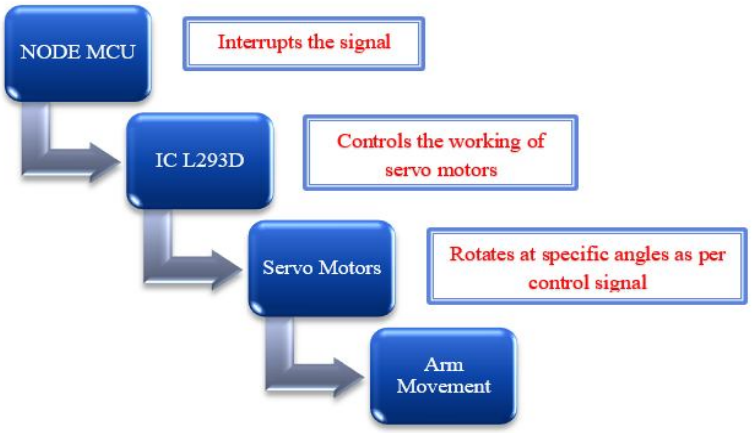

Fig 3.2 Block of Robotic Arm

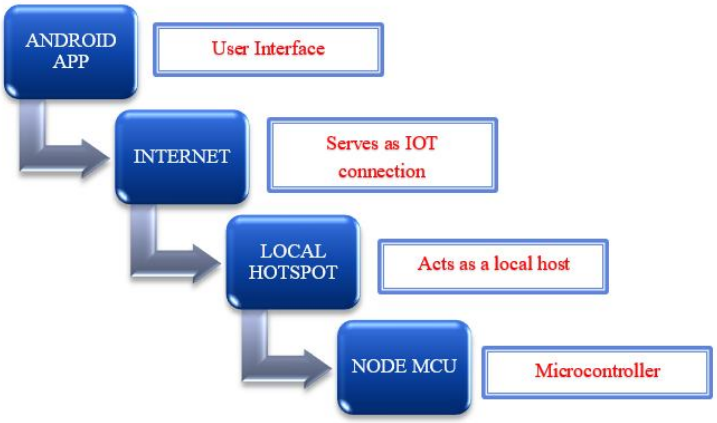

Fig 3.4 Block Diagram of Interface between the hardware and software

IV. ADVANTAGES

A. Reduces man power
B. Ease of control
C. Cost induced for control system is saved
D. High efficiency can be achieved
E. Multiple arms can be controlled from a single device
F. Can lift heavy materials with ease

V. CONCLUSION

The proposed system provides a solution in which multiple arms can be controlled under a single roof. The Node MCU can be used for the control of a Robotic Arm with an application. The present scenario internet-controlled robot has several disadvantages such as wired restrictions and server problems. In this smartphone technique the delay and server problems are reduced as the Wi-Fi/ node-MCU is used for the fastest transfer of control signals.

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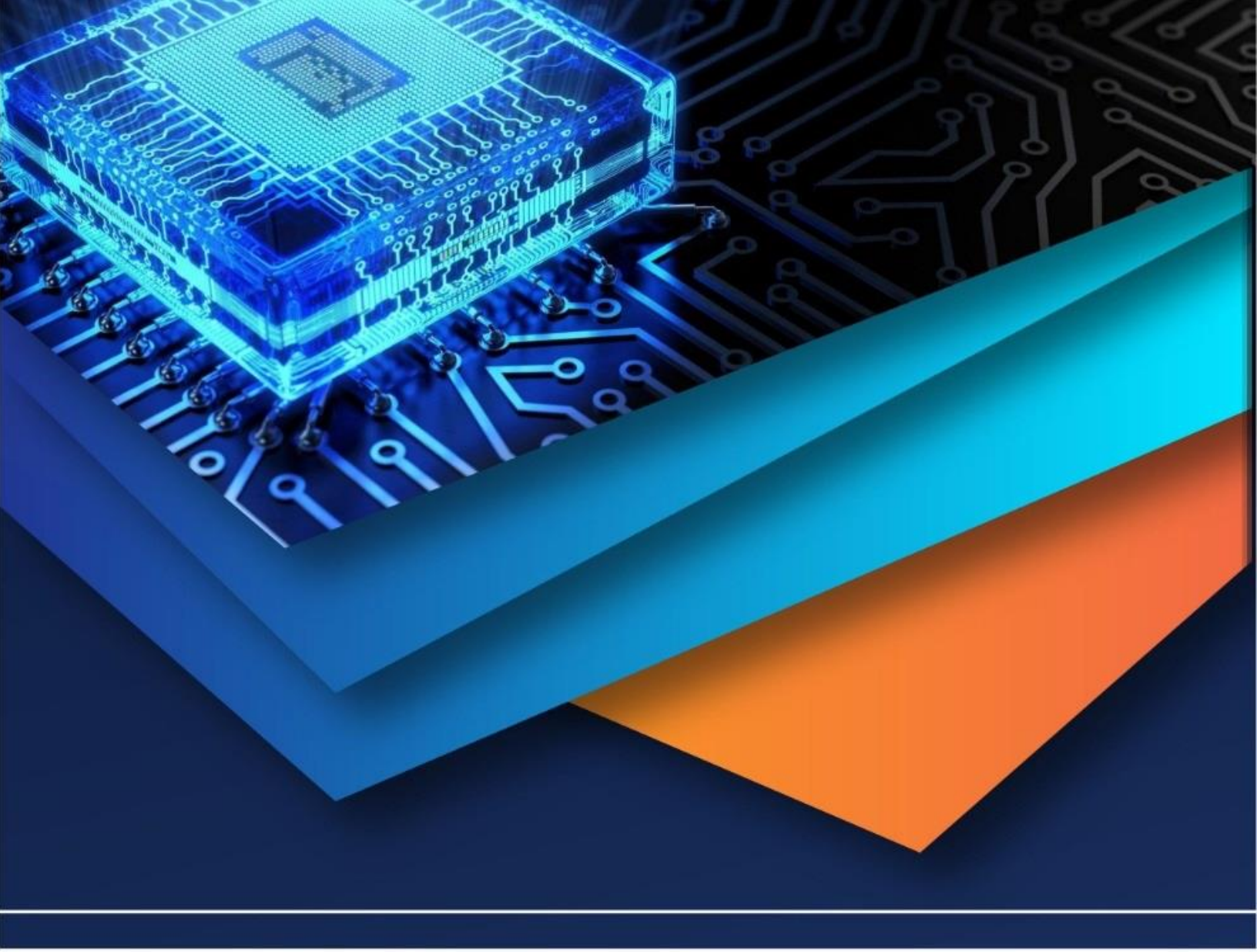

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