Wifi controlled Robotic Arm

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Wi-Fi CONTROLLED ROBOTIC ARM

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ABSTRACT – Robotics became the greatest technology in today's technological world. Modern world relies more on automation than the manual work. Implementation of automation reduces time, manpower, cost and provides high yield. Robotics paved the way to understand automation. Robotic structures are either driven by compressed air, hydraulics or by electrical system. Usage of electronic components and new technologies can result in development of a completely designed robot. This paper gives an overview about the design and working of an arm of a robot that is being controlled using wireless communication (Wi-Fi module).

Keywords: Robotic fingers, Servomotor, ESP32, Slider.

I. INTRODUCTION

The modern definition of a robot can be an electro-mechanical device which follows a set of instructions to carry out certain jobs, but literally robot means a 'slave'. Robots find wide application in industries and thus are called there as industrial robots and also in sci-fi movies as humanoids. When we think about robotics first thing that come to our mind is automation. Robots are known to perform tasks automatically without much human intervention, except for initial programming and instruction set being provided to them. However, execution of intricate and dangerous tasks in areas such as manufacturing, space, seabed and so on.

The hands of the robot are driven by actuators that are located in a place remote from the robot hand frame and connected by tendon cables. The elasticity of the tendon cable causes inaccurate joint angle control, and the long wiring of tendon cables may obstruct the robot motion when the hand is attached to the tip of the robot arm. Moreover, these hands have been problematic commercial products, particularly in terms of maintenance, due to their mechanical complexity.

A mechanical arm is robotic, usually programmable, with similar functions to a human arm. The links of such a manipulator are connected by joints allowing either rotational motion or translational displacement. The links of the manipulator can be considered to form a kinematic chain. The business end of the kinematic chain of the manipulator is called the end effecter and it is analogous to the human hand. The end effecter can be designated to perform any desired task such as welding, gripping, spinning etc., depending on the application.

II. PROPOSED SOLUTION

After the program gets uploaded on the Arduino IDE, an IP address will be generated on the screen. When the IP address is surfed through Google, a slider will be generated. When the slider is moved on the screen, the servomotor rotates. This will make the fingers to bend based on the movement of the string attached. The main objective of the project is to design an arm of a robot that can be controlled via wireless communication.

III. BLOCK DIAGRAM

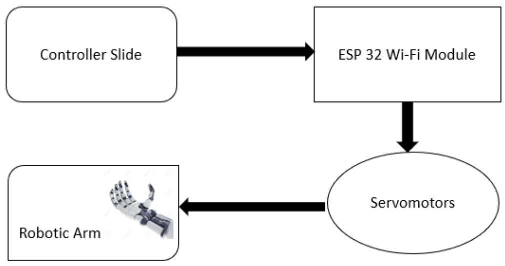

Fig.1 *Block Diagram*

The above block diagram explains the overall working of the proposed system where the ESP32 Wi-Fi module receives signal from the slider on the display screen. Data received from ESP module is sent to the servomotors. Based on the data received from the ESP module, the servomotor rotates. Now the fingers of the robotic arm tend to move since the fingers are connected to the servo via connecting wires.

IV. FLOW CHART

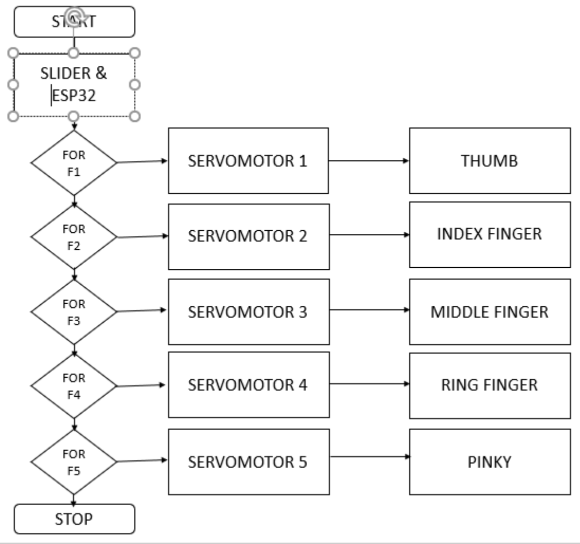

Fig.2 *Flow chart of the process*

The above flow chart will help to analyse the process flow of the robotic arm. When it receives signal from ESP module, the servomotor of the thumb finger will be checked for its value. Like the same way, other fingers will be checked. When the servomotor reaches its value, it moves and the finger bends.

V. HARDWARE DESCRIPTION

A. ESP32:

Fig.3 *ESP32 board*

ESP32 is a series of low-cost, low-power system on a chip microcontroller with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series employs a Tensilica Xtensa LX6microprocessor in both dual-core and single-core variations and includes in-built antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power-management modules. ESP32 is created and developed by Espressif Systems, a Shanghai-based Chinese company, and is manufactured by TSMC using their 40 nm process. It is a successor to the ESP8266 microcontroller.

Features of the ESP32 include the following. Processors:

- CPU: Xtensa dual-core (or single-core) 32-bit LX6 microprocessor, operating at 160 or 240 MHz and performing at up to 600 DMIPS
- Ultra-low power (ULP) co-processor

- Memory: 520 KiB SRAM
- Wireless connectivity:
  - Wi-Fi: 802.11b/g/n
  - Bluetooth: v4.2 BR/EDR and BLE

B. SERVOMOTOR:

Fig.4 *servomotor 180^o*

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. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

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.

C. ROBOTIC FINGERS:

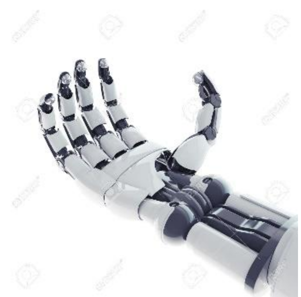

Fig.5 *Robotic Fingers*

Robotic fingers are designed by the flexible poly vinyl chloride pipe. Fingers are designed in such a way that they bend. Fingers are all attached at the bottom to a common holder. Each finger is attached with a servomotor via strings. When data is being received, servomotor rotates causing bending of fingers.

VI. WORKING OF THE ARM:

Servomotors play a key role in the field of robotics. Being a simplest actuator, it finds its application from a minor operation to a higher end automated operating device. Interfacing a servomotor with an Arduino is an easy process. But it's not with ESP32. It doesn't support *analogWrite()* function in Arduino IDE. However, various frequencies and timers can be used, allowing all the digital pins to do the work of the PWM pins and send and receive signals significantly faster than Arduino.

Connections:

S.NO.	Servomotor connection	Colour of the wire	ESP32 connection
1	Signal pin	Brown	Any digital pin
2	VCC pin	Red	3.3V pin
3	Ground pin	Black	GND pin

Then the code is uploaded in Arduino IDE. Now the servomotor rotates according uploaded. The servomotor is attached with the robotic fingers via strings. When the servo rotates, the string contracts and bends. Again, when the servo rotates in the other direction, the finger moves to its same position backwards.

SCHEMATIC DIAGRAM:

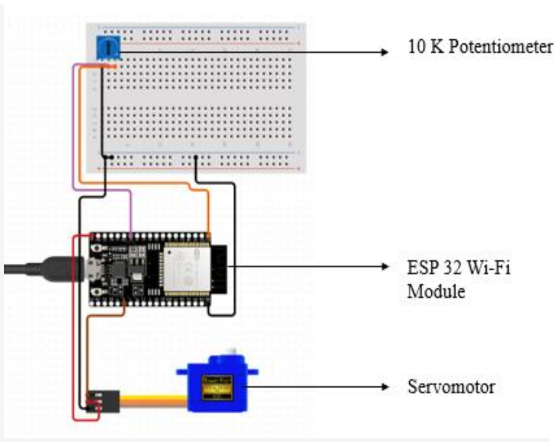

Fig.6 *Schematic Diagram*

VII. SOFTWARE DESCRIPTION

a. ALGORITHM:

i. Start the program
ii. Declare the necessary header file and variables
iii. In the void setup function, call the function ledcsetup with timer width.
iv. Call the ledcattachpin function.
v. In the loop function, check the condition i<counthigh using for loop.
vi. If the condition is true, call the function ledcwrite along with delay function.
vii. If the condition becomes false, the loop ends.
viii. Process the result.
ix. Stop the program

b. FLOW CHART:

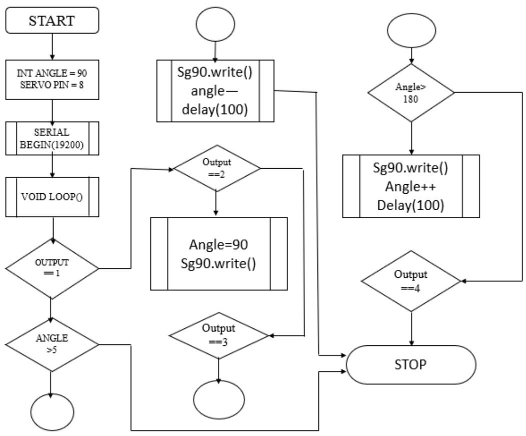

Fig.7 *Flow chart*

c. SOURCE CODE:

```
#define COUNT_LOW 0
 #define COUNT_HIGH 8888
 #define TIMER_WIDTH 16
#include "esp32-hal-ledc.h"
void setup() {
  ledcSetup(1, 50, TIMER_WIDTH); // channel 1,
50 Hz, 16-bit width
  ledcAttachPin(2, 1);   // GPIO 22 assigned to cha
nnel 1
}
void loop() {
```

```
  for (int i=COUNT_LOW ; i < COUNT_HIGH ; i
=i+100)
  {
    ledcWrite(1, i);       // sweep servo 1
    delay(50);
  }
}
```

VIII. RESULT AND DISCUSSIONS

When the servomotor receives the input, the servomotor rotates. Robotic fingers connected to the servomotor bends. Thus, the prime aim is achieved. This robotic arm finds its application in medical, electrical, chemical and military. All these fields have the same disadvantage of losing lives if there is any failure or misbehaviour in the instruments. But on implementing this, minor accidents can be reduced.

IX. APPLICATIONS:

- It can be used in chemical field as an extra hand so that we can avoid skin diseases.
- It can be used as an alternative hand for the physically challenged persons, where they require applications which involves both the hands that too of the same operation.
- It can be used in space for repair of space station.
- It can be used for diffusion of bombs where there is high risk of lives.

X. CONCLUSION

Being an extra hand, we can do many things. It finds its application in almost all the areas. Most of the people are working a lot and hard for their benefit. This hand be very helpful in doing such hard jobs. Being wireless, it works more efficiently than the wired one. There are many other communication networks that can be implied on the arm so that interaction can be improved further. Thus, this hand can be a wonderful invention, if it is implemented in the above-mentioned fields.

XI. FUTURE SCOPE

Digital camera can be placed on the robotic hand which will record the motion of the hand if a robotic hand is at a distance. Way of communication can be changed so that the interaction with the robotic arm can be increased.

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