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Gesture Control Robotic Arm

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Abstract: *In the last few decades, the robotic arm comes into practice. The robotic arm is widely used all over the world, especially in some sectors like industry uses (mainly in automotive manufacturing, food factories, and many more) also it is used in medical industries and in bomb disposal units in military operations. In today's world, the robotic arm is not just a want it's the need of humans because the robotic arm shows its work potential in such conditions where humans can't do anything. Industry robotic arms were controlled by some pre-installed software and the military uses remote control robotic arms which is an easy way of controlling such devices but like its name robotic arm, the remote-controlled robotic arm doesn't feel like an arm because it is controlled by a joystick. The control on the controller for the robotic arm is very difficult and not easily. Thus, the aim of this project is to build a 4-axis robotic arm and implement gesture control over it. By using the gesture control sensors, we collect the axis of our hand and send it to the microcontroller and the microcontroller uses those data according to its need for running these servos those are assembled in the robotic arm frame. Through this technology, we control the robot in a more accurate way and it's easy to attach to the robot's motions.*

I. INTRODUCTION

The robotic arm is something that is used in place of a living hand. It is mainly made up of steel, iron, plastic, etc. this device operates similar to a human arm. As there are joints and elbows in the human hand. Like also there is a number of joints present in a robotic arm. A human hand move in any direction with no need for calculation is required. But when we talk about the robotic arms we need to calculate the direction as well as the axis of movement. The human hand calculates its approximation by the human brain but when we work on robotic-like things we need to have its axis to do operations on it. Robotic arms are humanlike and try to imitate the same movements as human arms make. As human hands are more accurate and reliable there are many situations where human hands can't be used. For that situation, the robotic arm is used. Few situations are bomb defusing, high-end fabrication, and handling high-temperature material. The robotic arm can do small tasks as well as large tasks like moving small objects were as moving large construction items from one place to another.
Robotic arms were initially made to assist the large production in factories, most prominent in the manufacturing sector of large vehicles. It was developed to avoid accidents which are very dangerous for workers as well as for factories. At an early stage, these robotic arms were used for only repetitive tasks. As the technology grows it is also developing in robotic arms.

II. METHODOLOGY ADOPTED

The controller board is responsible for providing inputs to motor board. The input we provide to the controller board by using of hand gestures, by using varieties of gesture we can provide varieties of command as input to the controller board.

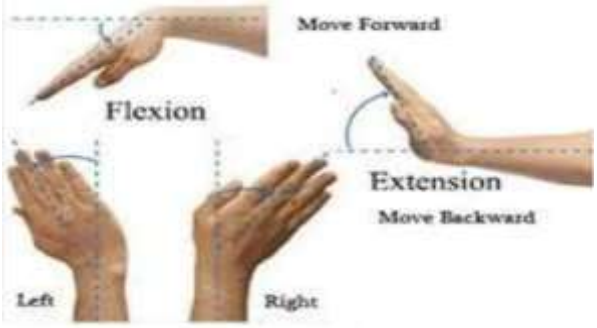

Figure1*: Gesture of Hand*

This gesture is sensed by using MEMS sensor in controller board, which measures the axis of gesture and convert it in desire form for microcontroller. The raw data which is provided as input to the microcontroller is processed through the algorithms. Now the data is ready to transmit to the receiver end which is placed at the motor board through the transmitter.
At the receiver end the transmitted data is recovered and decode it and send to another microcontroller which is placed on motor board. Now the decoded data is processed through algorithms to give desire output.

Another MEMS sensor is used on motor board to use for measuring the axis of robotic arm.

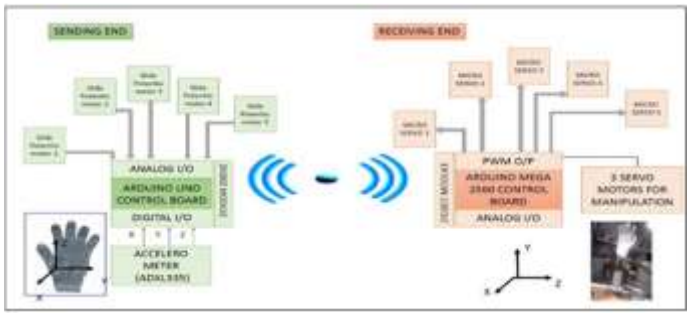

Figure 2: *Block diagram*

III.CIRCUIT ANALYSIS

(I) Controller board

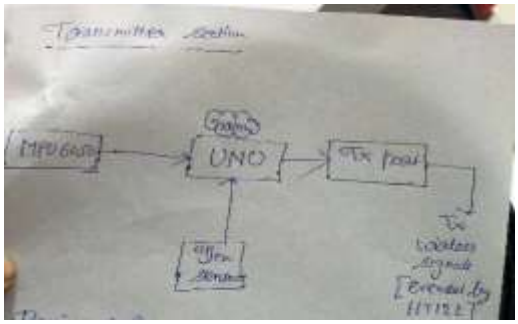

Figure 3: *Schematic of Transmitter module*

The controller board consists of RF transmitter, Arduino UNO, gyroscope module, power source.

The gyroscope module is connected to Arduino as an input, RF transmitter circuit is connected to Arduino as output.

The gyroscope module (MPU6050) is powered with 5V supply from Arduino UNO. The ground is provided to it by Arduino UNO. The SCL pin is connected to A1 (Analog pin) which provide serial clock pulse to MPU6050 for timing purpose. The SDA pin is connected to A2 (Analog pin) which enables to transfer of data through I2C communication protocols. Any sudden change in axis shall be reflected to the system which will turn varying the associated voltage to it. Then the integrated circuit has a 16-bit analog to digital converter which it uses to accurately sense these changes in voltage and stores it in the buffer. This is to be understand that the data is prepared to be read, so we use a MCU6050 to read the data from this buffer through I2C communication. The raw data is now available. Now the data is ready for further process and we process through algorithm and the data is send to RF transmitter circuit. Before transmitting the data we need to encode the data. HT12E, transmitter module and other components are used to encode the data with unique address and the radio frequency signal is transmitted.

(II) Motor board

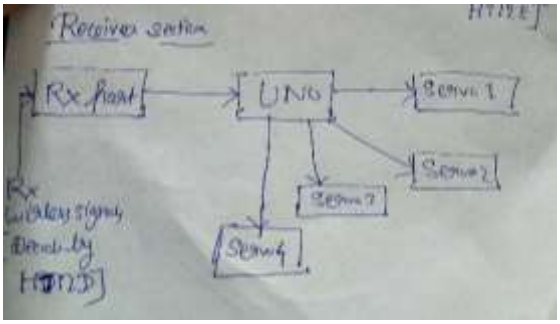

Figure 4: *Schematic of Receiver module*

The motor board consists of RF receiver, Arduino UNO, gyroscope module, motor driving IC and power source, motor. The Transmitted data is received through the receiver system which contains HT12D, receiver module, address bus, etc. The Address bus is set the same as in the transmitter system address bus which makes the system transmit and receive the data uniquely. The receiver module receives the radio signal and sends it to HT12D to decode and recover it. The system sends the data to Arduino UNO and it is processed through an algorithm. The MPU6050 is also connected as an input to Arduino UNO which is used to provide self-balancing to it by the motion of motors.

The MPU6050 contains the MEMS sensor which measures the axis of the robotic arm and it is sent to Arduino UNO and it is

processed through an algorithm. If the robotic arm is in unbalance condition. The two devices are connected as an input to Arduino UNO. The microcontroller should process the data simultaneously so that gesture command and self-balance situation can be achieved at the same time.

Figure 5: Robotic arm

IV.RESULTS

The sensor data which is got from hand motion is converted into electrical data by the means of conversion. The flex sensor is connected to that circuit which divides the voltage, provides the analog value to it. These data is converted to digital by analog to digital converter in the controller circuit board. These small packet are send, which has flex sensor value associated to it.

```
17:43:28.007 -> 283.3733.44278.9237
17:43:28.054 -> Sent:283.3733.44278.923737
17:43:28.332 -> 290.0063.09305.6437
17:43:28.332 -> Sent:290.0063.09305.643737
17:43:28.609 -> 70.9582.1221.8537
17:43:28.654 -> Sent:70.9582.1221.853737
17:43:28.931 -> 275.5482.24305.4437
17:43:28.931 -> Sent:275.5482.24305.443737
17:43:29.254 -> 291.4383.05342.7437
17:43:29.254 -> Sent:291.4383.05342.743737
17:43:29.531 -> 270.4989.66325.0637
17:43:29.576 -> Sent:270.4989.66325.063737
17:43:29.856 -> 331.869.98288.2037
17:43:29.856 -> Sent:331.869.98288.203737
```

Figure 6: *Flex sensor values & Gyroscope values*

```
17:52:35.012 -> Received:x:
17:52:35.058 -> 99.51
17:52:35.058 ->  y:
17:52:35.058 -> 90.94
17:52:35.058 ->  z:
17:52:35.058 -> 5.62
17:52:35.104 ->  angle:
17:52:35.104 -> 47
17:52:35.104 -> Movement in F/R = 148°
17:52:35.104 -> Movement in Up/Down = 49°
17:52:35.151 -> Movement in Left = 225°
17:52:35.197 -> Movement in Right = -315°
17:52:35.289 ->
17:52:35.289 -> Received:x:
17:52:35.335 -> 104.19
17:52:35.335 ->  y:
17:52:35.380 -> 91.38
17:52:35.380 ->  z:
17:52:35.380 -> 5.43
17:52:35.380 ->  angle:
17:52:35.380 -> 44
17:52:35.380 -> Movement in F/R = 156°
17:52:35.426 -> Movement in Up/Down = 52°
17:52:35.472 -> Movement in Left = 226°
17:52:35.472 -> Movement in Right = -313°
```

Figure 7: *Received Values & Movement direction*

The MPU-6050 has come with gyroscope and accelerometer. The x, y and z axis angular changes values from gyroscope and the acceleration values from the accelerometer are stored always create register address 0x30 in mpu6050. These values are converted to 16 bit values of all 3 axis by the use of analog to digital converter in MPU6050. Therefore we have 3 set of 16-bit values of angular change & 3 set of 16 bit acceleration data. In total there are 108 bits of data which has to be transmitted in order to perform an action.

V.CONCLUSIONS AND FUTURE SCOPE

The most developing field of Engineering allied robotics & artificial intelligence and machine learning will grow rapidly because it is the desire of human being. The inventors are very passionate toward its field to invent new things. These is the everyone dream to make machine more smart than before. Our project is a robotic arm that mimics the hand gesture. Mimicking robotic arm is a common project. The improvement that we had done to it is the freedom of motion. The shadow arm not only mimics the movements but also moves to certain distance. The major advantage is that it is wireless. Our unique project can be very helpful in industrial robotic systems. We mainly focus on military and medical fields. In medical fields, contagious diseases like COVID 19 is a nightmare. The disease rapidly spread through contacts. Since our project is gesture mimicking and even it is free to move, it can be used to assist patients. Our project doesn't have camera application. If we overcome this by modifying it with camera application, then it can be easier for the user to operate it with maintaining distances. Same opinion comes in military field also. If camera is embedded in the robotic arm the soldiers can ensure more safety from explosion and bomb diffusion.

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