Gesture Driven Robotic Arm Using Arduino ATMEGA 328P Microcontroller – An Analysis

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Abstract: The robotic arm is an electromechanical machine it is also called as robotic manipulator which is commonly used in industry. We had decided to design a robotic arm which works based on gesture of arm to obtain the similar operation as that of human arm. The gesture is captured by the flex sensor placed on the hand glove. The robot possess four degree of freedom with the help of dc servo motor. Thus the whole control is obtained by Arduino Nano microcontroller which will provide accurate control over the robot then joystick.

Keywords: Optical Flex Sensor, Arduino Nano atmega 328P Microcontroller, servo motor, wired.

I. INTRODUCTION

Robotics is a branch of engineering and it play a major role in industrial sector[1]. The perfection and accuracy is obtained nowadays in this field by means of the sensor intelligence. Eventhough the industries are running towards automation to obtain the finished product with uniform quality but automation face a major drawback of inflexibility and high cost. Thus the use robots is capable of performing a variety of manufacturing function in a flexible environment and at low cost. The mechanical structure of a robot must be able to control and perform specific task. Gesture means movement of hand or head. Capturing the gesture provides a path for computer to understand body language of human [2]. One of the most common effector is the mechanical gripper which consist of only one gripper which have less accuracy[3].

II. LITRATURE SURVEY

MEMS based Gesture Controlled Robot [4] in which the authors had used memes sensor and ultrasonic sensor for operation which will operate based on the gesture of human arm. MEMS based robot consist of many complication when compared to our flex sensor based robot. The Arduino Nano atmega 328P microcontroller which we had used is more compact and it is an inbuilt one which can provide overall control over the robot and which can also digitized the analog signal of flex sensor. Thus the betterment is obtained in flex sensor based design when compared to MEMS based robot. Robot controlled with 3D joystick [5] in which the authors aim to control the robot with the help of joystick and the author had used Ethernet protocol for connecting it with robot. The moment of keys can be done only by experts but the flex sensor based robot does not need a expert to operate it because it works on sensor intelligence.

III. PROPOSED SYSTEM

We had decided to design a robotic arm or robotic manipulator which works based on the gesture. The gesture of the human arm is captured using optical flex sensors. In this the whole control over the robotic arm is obtained by using Arduino Nano atmega 328P microcontroller which receives the input data from sensor and possess the output data through the communication line in digitized form for the servo motor.

The servo motor is used for obtaining the rotational motion for the arm parts

1. DESIGN OF CONTROLLER PART

The controller part consist optical flex sensor and Arduino Nano atmega 328P microcontroller placed on the hand glove. The flex sensor is placed the hand glove for capturing the gesture of human arm who is going to control and operate the robot.
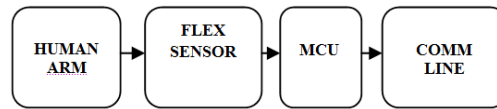
Fig 1. Block Diagram of Controller Side

a)   Flex sensor:

Optical Flexible sensor [6] which consist of Light Emitting Diode (LED) at one   end and Light Dependent Resistor (LDR) on the other end .Thus it is covered by opaque tube and it is powered using (9V) battery source or through the Universal Serial Bus (USB) because the Arduino Nano microcontroller consist of USB port during uploading the code using Arduino software. We had decided to use eight flex sensor for sensing every part of human hand.

Fig 2. Flex sensor placed hand glove

Thus the robotic arm will consist of eight servomotors. Each sensor signal is send to a unique motor. The optical flex sensor works on the principle of voltage divider and thus provide an analog signal which is digitized using Arduino Nano atmega 328P microcontroller. We had reduced the sensor cost by using the optical flex sensor instead of normal flex sensor and also the similarity in operation.

b)   Arduino Nano atmega 328P microcontroller :

The Arduino Nano atmega 328P [7] which receives the analog signal from flex sensor will possess only digital signal. It is an inburnt chip which will provide the overall control to the robot. The digitized signal is use to drive the servo motor.

2.   DESIGN OF ROBOTIC ARM

Rotational motion of the Servo motor using the microcontroller output data. The signals are carried out through connecting wire as it act as a wired system. The servo motor mechanism is so simple thus reliability can be obtained. The heart of a servo is a small Direct Current (DC) motor. This high torque operation can also be obtained using geared motor but the servo motor is more reliable and perfectly suitable. Servo motor is connected with Arduino Nano atmega 328P microcontroller through communication lines as follows the yellow wire is signal wire which is interfaced with Arduino Nano's   digital pin , The red wire is positive wire which is interfaced with 5V pin, the black wire is negative wire and it is interfaced with ground. After the code is uploaded as per the requirement to the Nano. Then the servo motor will follow the commands given by Nano.

Fig 3. Robotic Arm

IV.   WORKING

The proposed design is with five fingers similar to a human arm which will give more perfection, accuracy and flexibility when compared to gripper design. This design can hold objects with irregular shape and size. We have used Optical Flex Sensor that works on the basic principle of voltage divider. When the finger is bent the intensity of light

falling on the optical flex sensor changes which generates the voltage value linear to bending angle. As the flex sensor data is in analog form which possess only digital signal using Arduino Nano atmega 328P microcontroller. The Arduino Nano is programmed using Arduino 1.8V programmer which has all the library function to control the microcontroller. Servo motor can read the position of the shaft by means of the position sensor act as a feedback path to rectify and obtain the desired position with the help of the control signal from microcontroller. As this robotic arm can be controlled by wearing the sensor glove.

V.   CONCLUSION

This robotic design can be used in industrial field, bomb disposal etc which will provide perfection, accuracy . Robots help people with many tasks that would be difficult, unsafe for humans to work .This arm is probably the most practical complex robotic part used for exceptional cases. This design can be further modified in future based on the developing artificial intelligence.

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