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DESIGN APPROACH OF A GESTURE AND EMG(ELECTROMYOGRAPHY) CONTROLLED BIONIC ARM

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Abstract

One of the major societal issues that hasn't been fully addressed is the existence of high-precision work in the industrial and medical sectors. Furthermore, because a human hand trembles, high-precision surgery is necessary in the medical industry in particular. These normal hand tremors might have disastrous effects if they happen in the middle of surgery. We suggest a robotic arm with a 9-axis gyro sensor (mpu6050), a flex sensor, and an Electromyograph (EMG) sensor to solve this issue. Every 25 milliseconds, an Arduino program simply maps the analog inputs while reading the array step-by-step and moving the robotic arm. In order to synchronize the starting and ending locations of the arm, a programmed loop calculates various micro-steps for each servo motor to fix the motions. The robotic arm travels slower for shorter lengths and faster for larger lengths. The robotic arm is then managed by the arm movement, and the image sensor manages the claw. Flex sensors are also employed, and they are further mapped to move certain servos, enabling more precise operations. This allows us to pick up things and deposit them at the designated spot using the robotic arm. The suggested device's ability to accurately duplicate the same set of actions the user coded precisely and more quickly makes it helpful for the healthcare sector. This robotic device can carry loads in the mining and construction sectors if its dimensions are increased.

Keywords: *MPU6050, Electromyograph (EMG), Robotic arm, Flex Sensor, Arduino*

1. Introduction

The term "servo robots" is derived from servo motors [6], which transform rotational energy into linear energy. Servo motors do not rotate freely and constantly as our standard DC motors do. The DC motor rotates constantly, whereas this one has a maximum rotational speed of 1800. The capacity to replicate actions and remember them for future use is a feature of our servo robot. Through the Arduino Nano's embedded MCU (Microcontroller Unit), the actions may be modified and programmed further. It powers the Arduino and the servo motors using a 220-volt AC to DC rectifier circuit and a voltage regulator for 5-volt input. This robot's task is to lift things and deposit them in containers using a wireless manner of action.

1.1. History

George C. Devol, a Louisville, Kentucky-based inventor, built the first robots as we know them in the early 1950s. He created and received a patent for a manipulator that can be reprogrammed, known as "Unimate" from "Universal Automation". He made several unsuccessful attempts to market his product over the following ten years.

1.2. S.C.A.R.A (Selective Compliance Articulated Robot Arm)

The SCARA type provides the foundation for our robotic arm. One kind of industrial robot is SCARA. Selective Compliance Assembly Robot Arm or Selective Compliance Articulated Robot Arm is what the abbreviation means [3]. Selective compliance refers to the arm's minor flexibility in the X-Y directionbut stiffness in the Z direction according to the parallel-axis SCARA joint configuration. This is helpfulfor many different assembly tasks, such as inserting a round pin without binding in a round hole. The second feature of SCARA is its two-link arm configuration, which is articulated and resembles humanarms. Due to this characteristic, the boom may extend into constrained spaces before retracting or "folding" out of the way. This makes it easy to load or unload closed process stations or move parts from one cell to another.

In general, SCARAs outperform equivalent Cartesian robotic systems in speed. Their straightforward and undisturbed installation on a single pedestal has a modest environmental impact. However, SCARAs may cost more than equivalent Cartesian systems, and the control software requires inverse kinematics for motions that are interpolated linearly. But often this software is invisible to the end user and includes SCARA.

In 1981, Sankyo Seiki, Pentel, and NEC unveiled the SCARA robot, a brand-new idea in the field of assembly robotics. Hiroshi Makino, a professor at the University of Yamanashi, provided direction for the robot's development. He could fit the holes in the XY-axes since his arm was flexible in the XY- axes but hard in the Z-axis.

2. Methodology

SYSTEM REQUIREMENTS

1. Arduino nano 5v/16Mhz,
2. 3*mega servo motorMg996R (180 rotation),
3. 3*micro servo sg90
4. Rectifier circuit and voltage regulator (220vAC-5v DC),
5. Jumper cables,
6. Vero board
7. 3*Resistor(220ohm),
8. flex sensors*3
9. EMG sensor

2.1 Connection Diagram:

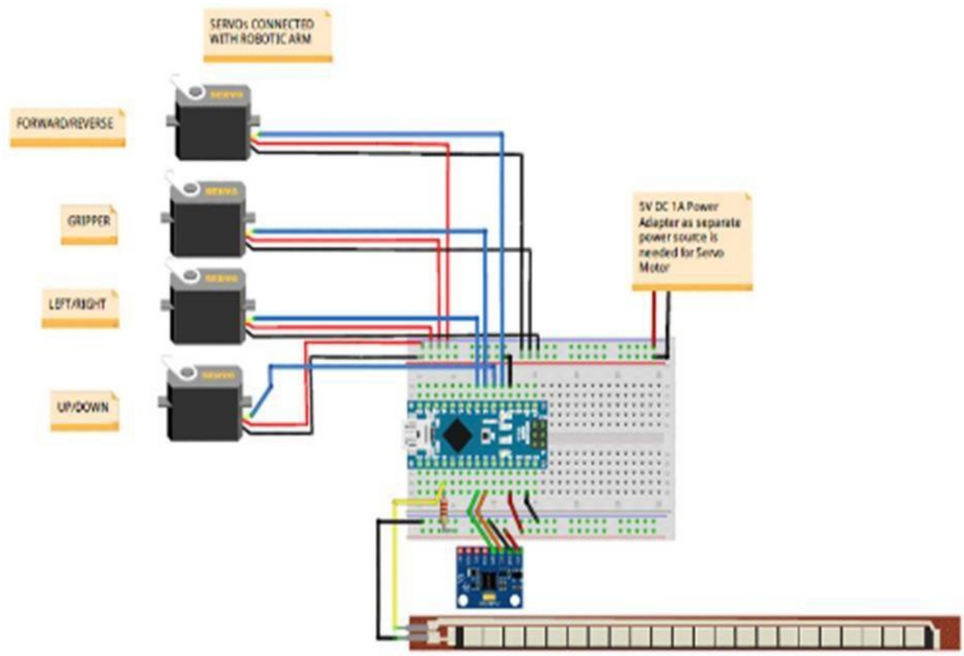

Fig.1: Connection Diagram

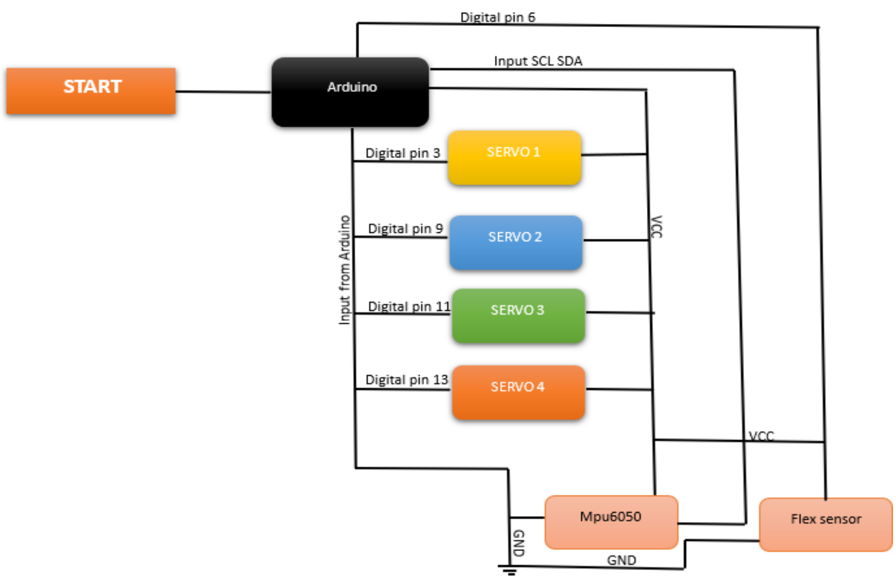

Fig 2: Working of the Robotic Arm

Result:

The 6-axis gyro sensor mpu6050 [4], the flex sensor, and the EMG sensor are the three most often utilizedsensors on the robotic arm. The button on the circuit that duplicates the actions of the robotic arm mustbe double-pressed. The Arduino code then iteratively scans the array and moves the robotic arm every25 ms while only transferring the analog inputs. A programmed loop calculates several micro- steps foreach servo motor to synchronize the starting and ending locations of the arm in order to fix the motions.The robotic arm travels slower for shorter lengths and faster for larger lengths. The arm then uses the inbuilt Arduino code to copy the action and display the motors' voltage and RPM on an LCD screen. The robotic arm is then controlled by the arm movement and the claw is controlled by the EMG sensor [1][2].Furthermore, flex sensors are used [5], which are also further mapped to move specific servos, which can lead to more precision work. Through this, we can use the robotic arm to pick up objects and place themat the given point.

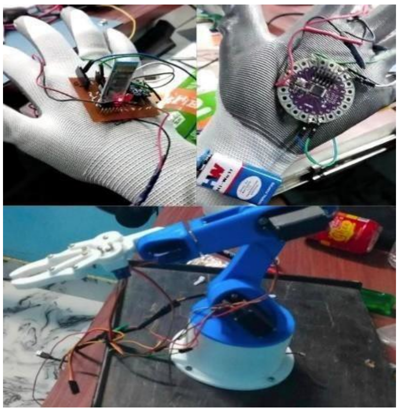

Fig. 3: Hardware Prototype

References:

1. 1.Matsubara, T., Hyon, S. H., & Morimoto, J. (2011, September). User-adaptive myoelectric interface for EMG-based robotic hand control. *Neuroscience Research*, *71*, e409. https://doi.org/10.1016/j.neures.2011.07.1793
2. Unanyan, N. N., & Belov, A. A. (2021, January 1). *Low-Price Prosthetic Hand Controlled by EMG Signals*. IFAC-PapersOnLine; Elsevier BV. https://doi.org/10.1016/j.ifacol.2021.10.463
3. Mashhadany, Y. A. (2012, January 1). *SCARA Robot: Modeled, Simulated, and Virtual- Reality Verified*. Communications in Computer and Information Science. https://doi.org/10.1007/978-3-642-35197-6_10
4. Neto, P., Pires, J. N., & Moreira, A. P. (2009, September 1). *Accelerometer-based control of an industrial robotic arm*. https://doi.org/10.1109/roman.2009.5326285
5. Syed, A., Agasbal, Z. T. H., Melligeri, T., & Gudur, B. (2012, January 1). *Flex Sensor Based Robotic Arm Controller Using Micro Controller*. Journal of Software Engineering and Applications; Scientific Research

Publishing. https://doi.org/10.4236/jsea.2012.55042

6. Shulhan, S., Astwensa, F., Fauzan, F. R., & Bukhori, I. (2021, April 12). *Robotic Arm Using Servo Motor and Arduino Uno Controlled with Potentiometer*. Journal of Electrical and Electronics Engineering. https://doi.org/10.33021/jeee.v3i2.1488