**Title:** Gesture Designated & Voice Controlled Robotic Hand Using Myograph Sensors

**Abstract:**

Each day in present, someone is trying to build something; a machine, which can replicate humans as nearly as possible. This replication is what we call humanoid. Here, we present the making of a necessary part of this humanoid, its hands. The hand will be functional from shoulder up to finger-tips. The fingers and palm are 3-D printed and do not use tendon for movement. Gesture is primarily used to feed data & make it learn. While major concern of voice controlling is to give orders & obtain task performance. Myograph sensors are used for fulfilling gesture recognition purpose.

**Introduction/Motivation:**

The core motivation is to build something that can have multifunctionality in accordance with the requirement basis. Robotic hand, here is a child, which if made to learn shooting, fighting, etc. will make it useful in defence sector. It can be used to assist humanity in its daily life like cooking, cleaning, etc. It can be used as a helping hand to perform rescue operations in conditions and places where humans cannot reach. If it is made to learn and identify differences in materials, functions like sample gathering, etc. it can be used to explore any corner of space under any conditions.

Mentioned above and many other countless objectives can be fulfilled with the only condition that this robotic hand system is attached to a functional mechanical body.

**Literature Survey/Prior Artwork:**

The concept of tendon-less movement of fingers has been originally developed by Festo in making its 3 fingered gripper mechanism. There are certain projects available online showing use of myograph sensors in making gesture controlled robotic hand. However, this use is constrained only up to fingers and wrist movement. Also, there are gesture controlled robotic hands developed using other sensors like accelerometer, gyroscope, neural sensors, etc. There are many research initiatives carried out globally which make robotic hand. These robotic hand systems even use complex components like pneumatic drives, electromagnetic drives, etc. Various robotic systems using artificial intelligence & machine learning are under research globally.

**Problem Statement:**

There are certain tasks which humans cannot perform and situations where humans need assistance. Also, there are several long term or repetitive operations which humans are incapable to do or exhibit it inconsistently.

**Hardware requirements:**

1. Arduino
2. EMG(Electromyograph) sensor & electrodes
3. Accelerometer
4. Microphone
5. Raspberry Pi 3B+
6. Tactile/Flex sensor
7. Stepper motors
8. Servo motors
9. Li-po batteries and connecting wires
10. Tilt pan motor brackets
11. 3-D printed fingers and palm
12. Aluminium frame/sections
13. Motor mountings
14. Support pole
15. Workspace base
16. Clamps

**Software requirements:**

1. Raspbian (OS)
2. Python 3
3. MATLAB & Simulink
4. Solidworks
5. Proteus

**Implementation:**

The human hand has got 7 degree of freedom. As this is the replica made for a human hand, it also has 7 degree of freedom. The wrist has got 3 degree of freedom, the elbow has got 2 degree of freedom as well as the shoulder has got 2 degree of freedom.

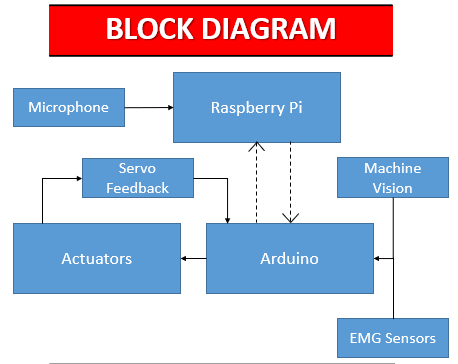
The electrodes of the myograph sensor are placed on the pre-decided positions of the forearm, upper arm and shoulder of human hand respectively. These electrodes sense the muscle movement & activities and convert them in the form of electric signals in waveform of the motion performed. This obtained signals will be send to the Arduino which is further connected to the Robotic hand. Thus, on the basis of the signal obtained, the robotic hand will perform the motion and replicate the human hand. This process is the learning procedure or the gesture designation procedure for the robotic hand.

The motion performed by the robotic hand will be saved textually as well as an audio name will be linked with it. It will be programmed such that when the audio is delivered using microphone, it will work as input for the hand and the hand will perform the motion that will be linked with that specific audio file. The storing of this audio files with its linked motion, the object files, other program sources will be saved in external memory which will be installed in the Raspberry Pi to carry out the process and procedure required in getting the whole output. This whole procedure is the part of project delivered as the Voice controlling of the robotic hand.

Here, the issue that comes in action is that if for sample purpose, “pick and place” operation is taken into consideration, the method to hold different sized and shaped objects will be different. This is where the AI & ML part comes into action. The robotic hand will be provided with its own intelligence of using Machine Vision, it will identify the size and the shape of object. Now, multiple pick & place methods will be linked with a single audio file. Using its AI, it will decide by itself that which of all the linked methods is most suitable for the operation to be performed. Thus, it will carry out the task. This process is the portion that makes the robotic hand smart.

Also, the flex sensor is used in the fingers to read the contact made between the surfaces of the object and the fingers. When the suitable reading is obtained, the current flow in the finger motor stops, avoiding exertion of unnecessary pressure on the object.

Using Machine Vision, the position of the object will be obtained. To reach that position, the forward kinematics & inverse kinematics will be implemented on the joints of the robotic hand and it will reach at the calculated position where the task needs to be performed.



**Feasibility:**

The robotic hand is easily attachable with various bodies which are differently used for various day-to-day tasks. It is more suitable to use such mechanical body at places which are hazardous for human to work at. It is aimed to be providing more dexterity compared to many other similar models available globally due to provision of its own brain using AI & ML as well as 7 degree of freedom. Gesture designated learning enables to replicate and copy human actions and style of performing tasks. It is also polymath as it can be reprogrammed according to various required scenarios independently by different operators. It can be made to perform tasks by giving simple audio commands.

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