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Raspberry Pi Based Paralyze Attack Rehabilitation System

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Abstract - *The purpose of the design is to create a robotic hand that would be controlled easily by the user through EMG sensor in order to improve their stroke patient's life. This is less cost-effective than training and purchasing rehabilitation to use several specialized rehabilitation. Robotic arms also have a more human-like morphology, which may make them less frightening or strange to patients. So we developed a* ***Neuro-Fuzzy*** *controlled automatic interface is developed that allows a fast, protected, and harmless attachment between a robotic arm and a human limb.*

Key Words: Raspberry pi, Analog to Digital Convertor, EMG Sensor, Servomotor, Instrumentation Amplifier

1. INTRODUCTION

According to the World Health Organization (WHO), approximately 15 million people suffer strokes worldwide each year. Stroke is a very broad term and includes a variety of different types of diseases involving the blood vessels that supply the brain. Treatment depends on the type of stroke and the location of the blood vessels involved .So we develop a Non-Invasive artificial Hand for those who are unfortunate enough to move their hands due to paralyze attack or lost a hand. There are two types of stroke namely, Ischemic stroke and Hemorrhagic stroke. Ischemic stroke occurs due to the blockage in the blood vessels. The blockage occurs due to grown of tissues .Hemorrhagic stroke occurs due to the sudden burst of the blood vessels.

2. Existing Model

Due to more number stroke attack there is lot surgeries and these numbers are increasing. With more patients requiring rehabilitation, an accurate assessment of each patient is essential to manage patient workload [1]. However, currently this assessment is performed by visual observation, patient questionnaires and goniometry (measurement of range of motion of a single joint while the patient is at rest). Even when carefully performed, there is an element of subjectivity and human error possible with these methods [2]. There are two treatments in the existing system. They are oil treatment and surgery method. In the oil treatment, it needs additional help from the people around us and it also takes many years to recover. The recovery percentage is very low and unpredictable. In surgical method, it use copper like setup to remove the blockages present in the blood vessel. By this technique, majority of the blockages get removed(not completely).Another Drawback in this technique , take longer period to get cured.

3. Proposed Model

Designing and implementing a neural network and Fuzzy control prosthetic hand that would emulate the forearm of a human for stroke or paralyze patient. Thus, to create a prosthetic hand that receive the inputs from the EMG sensors and these signals amplified via instrumentation amplifier and fed through Raspberry pi for feature extraction and classification using Neuro-fuzzy. Classified appropriate action is taken from Raspberry pi controller board, then it would drive the mechanical artificial robotic arm for paralyze patient.

3.1. Working

The EMG Sensor is placed in the working hand of the patient, sense the muscle activity which is converted into electrical signal. The signal is given to ADC for getting digital signal. This is because Raspberry pi acts like a computer, so that the digital signal is given to the Raspberry Pi board .The Raspberry Pi board will compare the signal with fuzzy and pass the command to the control signal. The Control Circuit is the combination of ULN 2003 and Relay.ULN 2003 act as a IC with four transistors, which is used for providing 12V supply to the motor. The relay drives the supply to the motor. The motor accepts the supply and start to rotate according to the commands from the raspberry pi board. The motor has three conditions, which is set by us inside the raspberry pi. The three conditions are shivering, up and down movements. If the patients hand is shivering, the commands processing get stopped and motor will not rotate, so that hands cannot be moved.

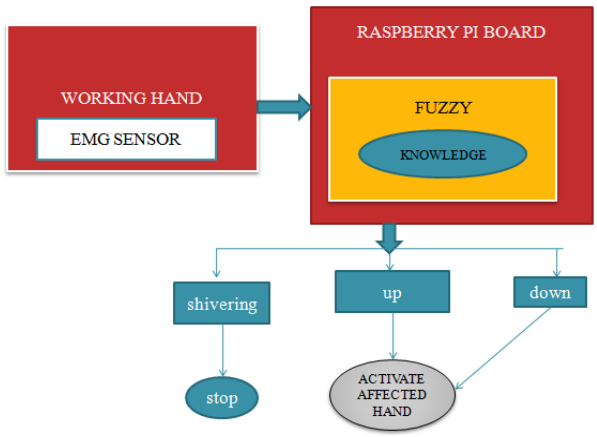

Fig -1: Working model

If the comparison doesn't match with fuzzy, it will stop the operation. In this paper, Consider three cases in the knowledge of the fuzzy (i.e.) Shivering, up and down as shown in Fig-1.

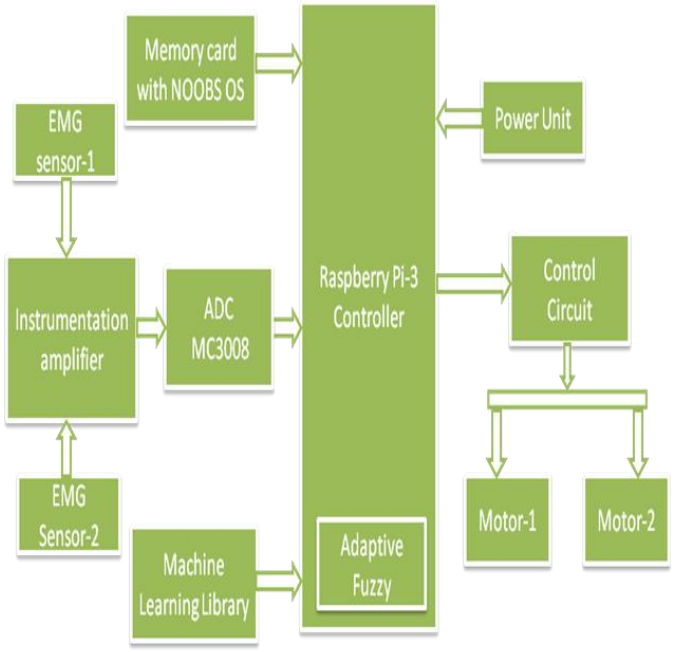

Fig -2: Block Diagram

4. Block Diagram Description

4.1. Raspberry Pi-3

Raspberry Pi 3 Model B was released on February 2016. It is bundled with onboard WiFi, Bluetooth and USB Boot facilities. As of January 2017, Raspberry Pi 3 Model B is the newest mainline Raspberry Pi. It includes an ARM compatible central processing unit (CPU) and an on-chip graphics processing unit. The Raspberry Pi may be operated with any generic USB computer keyboard and mouse. It may also be used with USB storage, USB to MIDI converters and virtually any other device/component with USB capabilities. Other peripherals can be attached through the various pins and connectors on the surface of the Raspberry Pi. It has 1GB with GPIO Pins. It has other facilities like camera interface, display interface along with micro SD slots.

4.2. EMG Sensor

Electromyography (EMG) is a new clinical Neuro-physiology medicine technique for analyzing and recording the electrical activity which is produced by the skeletal muscles. It is performed using an instrument called an electro myograph which is also used to produce a record called Electromyogram [4]. An electromyography recognizes the electrical potential generated by muscle cells, when these cells are electrically or neurologically activated as shown in Fig-2. It consists of three electrodes-two electrodes are placed on the skin and the third pin acts as ground. The signals can be analyzed to identify the medical abnormalities, activation level, or recruitment order, or to identify the biomechanics of human or unknown movement [5].

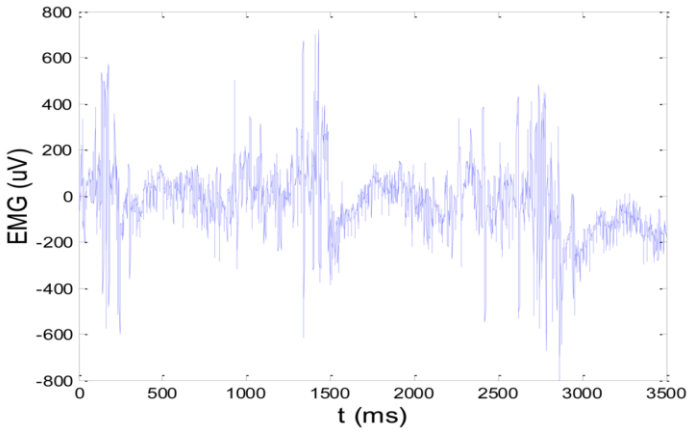

Fig -3: EMG Graph

4.3.Analog to Digital Convertor

The MCP3008 10-bit Analog-to-Digital Converter (ADC) combines high performance and low power consumption in a small package, making it ideal for embedded control applications. The MCP3008 features a successive approximation register (SAR) architecture and an industry-standard SPI serial interface, allowing 10-bit ADC capability to be Fig-3. The MCP3008 features 200k samples/second, 8 input channels, low power consumption (5nA typical standby, 425µA typical active), and is available in 16-pin PDIP and SOIC packages. Applications for the MCP3008 include data acquisition, instrumentation and measurement, multi-channel data loggers, industrial PCs, motor control, robotics, industrial automation, smart sensors, portable instrumentation and home medical appliances.

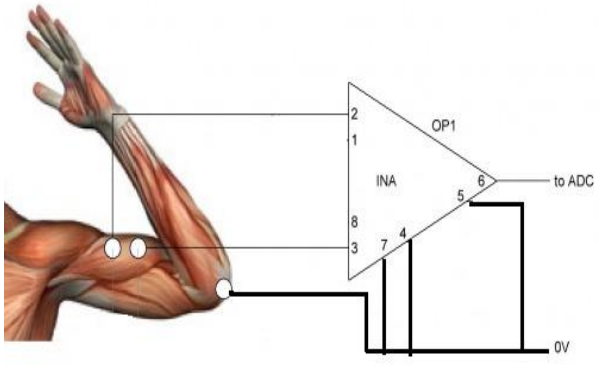

Fig -4: EMG –Instrumentation Amplifier

4.4 Instrumentation Amplifier

These devices amplify the difference between two input signal voltages while rejecting any signals that are common to both inputs as shown in Fig-4. The in-amps are

widely used in many industrial, measurement, data acquisition, and medical applications where dc precision and gain accuracy must be maintained within a noisy environment, and where large common-mode signals (usually at the ac power line frequency) are present.

4.5. Servomotor

A servomotor is a rotary actuator or linear that allows for accurate control of linear or angular position, speed. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively classy controller, often a dedicated module designed particularly for use with servomotors. It is not a specific class of motor although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system. Servomotors are used in fields like Metal Cutting and Metal Forming Machines, CNC machinery and solar tracking system as shown in Fig-5. When the shaft of the motor at the desired position is been tracked, then the power supply to the motor is stopped. If not, the motor is turned ON in the appropriate direction.

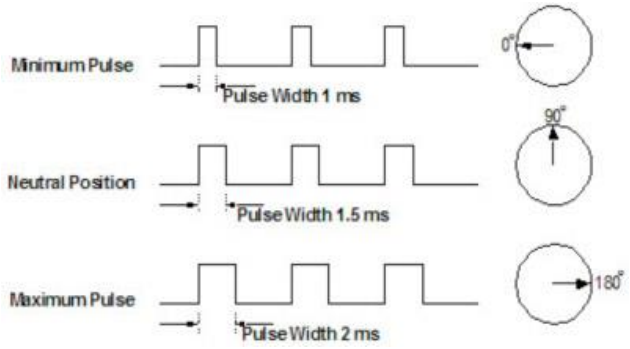

Fig -5: Variable PWM Servo Controller

5. CONCLUSION

The feasibility of the sensor is used to the sense the muscle activity of the patients. The electrical signal is converted into actions, which make the patients to use their affected hand. Sensor data has been reliably collected, transmitted and stored in a secure server application within a Raspberry Pi 3, allowing for post processing. This system would prove most useful for the paralyzed patients to take care of themselves.

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