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DESIGN AND DEVELOPMENT OF THE SYSTEM FOR THE MOVEMENT OF PARALYZED PART OF THE LIP

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ABSTRACT

When any nerve gets injured around the mouth portion then it results into mouth paralysis. For the movement of paralyzed portion of the lips this device is designed. There are two steps for giving movement to disable portion. One is taking EMG and other is controlling a hardware through servo motor. System initiates at 5V power supply. By placing electrodes on the strongest nerve EMG signal is taken from working part of lips with the help of electromyograph electrodes. Two electrodes are used here on the either sides of the lip corner, we can add more electrodes if needed. To read the strength of the signal LCD id placed. This EMG signal is given to instrumentation amplifier on EMG amplification board to make is strong signal. Then it is given to filter to eliminate noise and then rectifier makes it D.C .Again smoothing circuit is there to make it smooth DC from pulsating D.C. then applying it on aurduino uno analog signal is converted into digital signal. This digital signal drives the servomotor to move the paralyzed potion of lips on hardware module.

KEYWORDS: electromyography , electrodes , pwm.

INTRODUCTION

Background

Lip paralysis or facial paralysis is commonly because of bells palsy symptoms. When these nerves get injured then muscles no longer sends or receive the message from nervous system. Most of the reason behind this is herpes virus. The other reason can be viral infections or else in which controlling of muscles on one side of the lip is damaged in certain injury or stroke. It results into one side face drooping or a lip corner drooping around mouth. In this case face portion becomes asymmetric and create difficulties in communication for the patient as it primarily impacts the patients lip movements. When paralyzed person tries to speak his disabled part don't supports to take movements as working part do. To overcome this problem we need to strengthen weak part and give movement to disable part. This device is applicable to control those weak nerves of Orbicularis Oris portion. The information of strong muscles is captured through Electromyography.

Related work

Author suggested that lip tracking plays an important role for audio-visual speech recognition, but the tracking of lips in sequence is challenging problem due to highly deformable feature of lip contours. So, author investigated the Construction of a hybrid tracker that makes use of both stochastic and deterministic tracking. This hybrid tracker uses particle filter and local optimization using ASM search. n order to reduce complexity author suggested to use deterministic tracker instead of stochastic tracker. Idea of Lip Mouse due to increasing need of development of new human computer interface (HCI) has also been developed by researchers. Lip gesture recognition is performed by an artificial neural network. Type of the gesture is determined by the maximum value of the ANN outputs.

Electromyography

Electromyography is detecting and analyzing the electrical signals generated from the skeletal muscle. Signals produced during muscle activities are called myoelectric signals.

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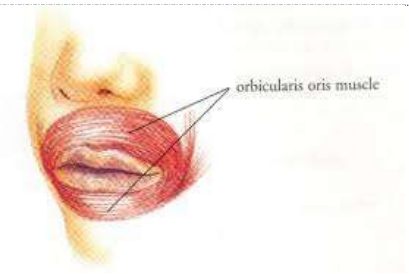

Fig 1:lip Muscle [Ref 10]

These signals are generated through the small electrical current produced by exchange of ions and identified with the electrodes.

EMG acquisition process:
Electrodes are placed on the muscles where there is a strong signal strength. Electrodes are of two types gel electrodes and dry electrodes.gel electrodes are used because they have better conductivity. As Electrode placement is very important task to capture the satisfactory information from muscle, we should aware of the characteristics of the signals.

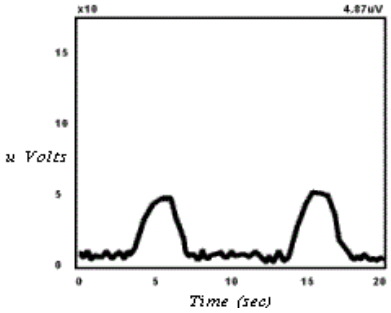

Fig 2: EMG of Muscle Of Higher Strength [Ref 11]

Placing the electrode on bicep muscle gives the strong signal. Wherever the electrodes are placed there should be strong and stable signal. Electromyography is to study the electrical signals emitting from the muscles from stable surface of the human body and analyze the signal parameters. Facial paralysis shows severe functional impact. In the biomedical stream day by day many techniques are coming into the picture to help out bell's palsy

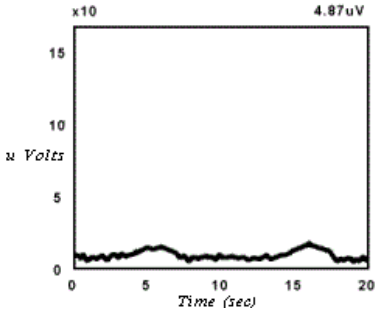

Fig 3:EMG Of Muscle Of Lower Strength [Ref 11]

problem and the technique with the minimum side effects is getting highly appreciated.

Fig 4:Facial Paralysis [Ref 12]

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IMPLEMENTATION

Design the system for paralyzed person to communicate with the world using EMG signals. In certain surgeries like mouth cancer, these patients face problems while talking, so this is beneficial device to help these patients. Figure 4 shows Orbicularis Oris muscles. Gelled electrode are used for better conductivity. This electrode uses an electrolytic gel as a chemical interface between the skin and metallic part of the electrode

Block Diagram Of The System

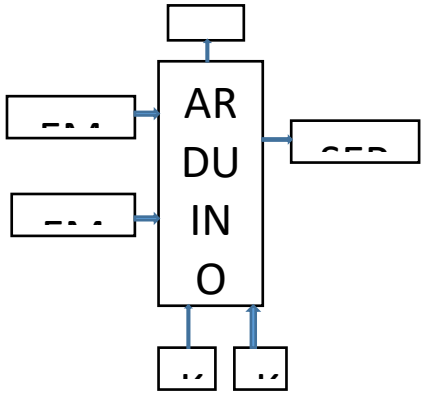

Fig 5: Block Diagram Of The System

Hardware Description

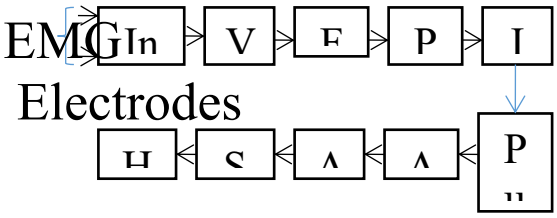

Fig 6 : Hardware

The modern electronics and amplification process of differential amplification have enabled the measurement of EMG signals of low noise and high signal fidelity i.e high signal to noise ratio. The quality of the EMG signal is depends on the characteristic of the amplification process.

The first stage of the amplification is preamplification, and preamplication is very necessary which is done at near to signal source. There are some important properties of preamplification such as High common mode rejection ratio Very high input impedance Short distance to the signal source Strong DC signal suppression. As discussed earlier, there are many concerns regarding the proper detection of the EMG signal. Once the electrode is properly placed and the signal is extracted, noise plays a major role. RC filter is used to remove unwanted signal. The signal taken through electrode is very low amplitude signal, so eliminating noise through it is a difficult task.

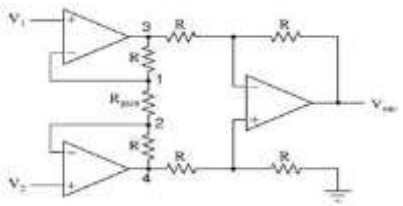

Fig 7: Instrumentation Amplifier

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Instrumentation amplifier is basically op-amp, and the property of op-amp is to convert every type of wave into square wave. As every input coming through electrode is an analoge input which is varying with time so its neccesarry to convert it into digital wave so that the variation in the wave is only at 0 and 1 with falling and rising edge respectively. If analog wave is to consider then the range will be large to make it confine its necessary to convert it into digital signal . As 8 bit microcontroller is used here the range of signal is 0 to 255 bits. As shown in the above circuit input to the instrumentation amplifier is signal extracted through electrodes placed on lip corners. Voltage follower is shown below.

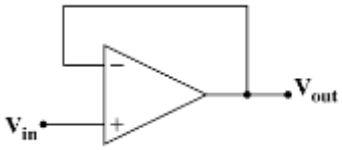

Fig 8:Voltage Follower

To keep the output voltage exactly equal to the input voltage without any amplification or attenuation this voltage follower is used. Output of the voltage follower is given to inductor to store the charge. Through thids inductor charging and discharging of two capacitors is taking place which are connected in parallel with inductor. Below is the circuit of high pass RC filter which is passing the high frequencies coming through voltage follower.

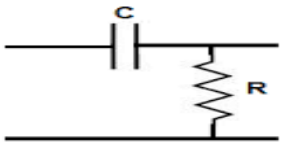

Fig 9:High Pass Filter

This filtered output needs to be converted from ac to dc , so rectifier has be connected after filtering which is shown below. And to make it smooth dc from pulsating dc smoothing circuit is also connected after rectifier.

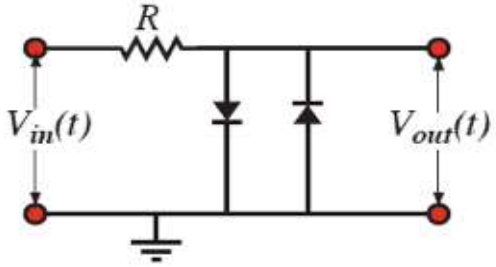

Fig 10:Rectifier

Rectification is done to use alternating current signal by converting it into direct current . Because it is necessary to convert the current sine wave into a constant frequency dc signal. Rectification makes signal to flow in one direction i.e. from positive to negative only.

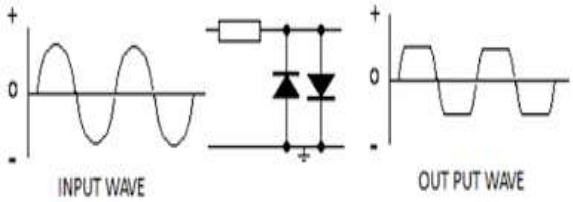

Fig 11:AC To Pulsating DC

This design is being implimented on aurdino uno microcontroller board which is readily available with pwm pins, thatswhy pulse width modulation concept is used. Thid pwm output is given to aurdino uno microcontroller board concept of duty cycle is showed below.

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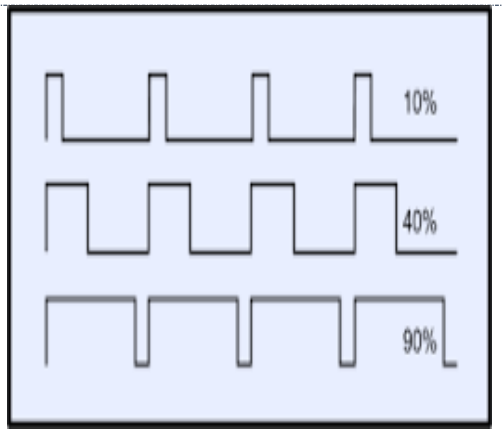

Fig 12:Duty Cycle

Between pulse width modulation and demodulation opto isolator is arranged to pass the electrical signals between two isolated circuits. Below is the circuit showing the LED transferring signal though light to phototransistor

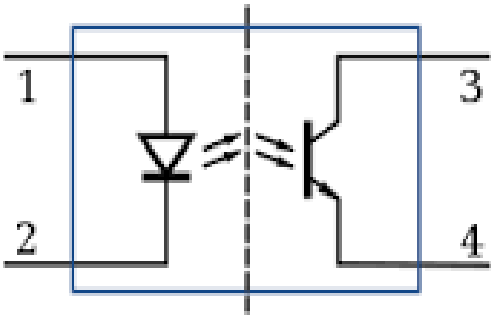

Fig 14: Isolator

Then depending upon the duty cycle generated during pulse width modulation servo motor will move the disable part of the lips at hardware module.

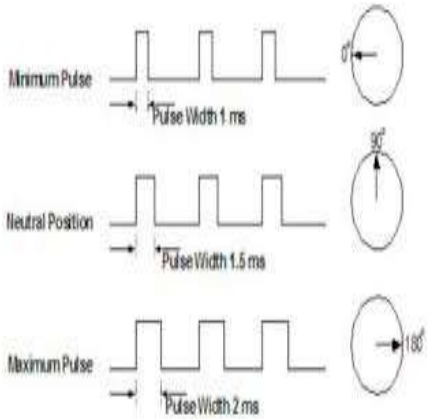

Fig 13:Pulse Width And Servo Motor Rotation

Flowchart

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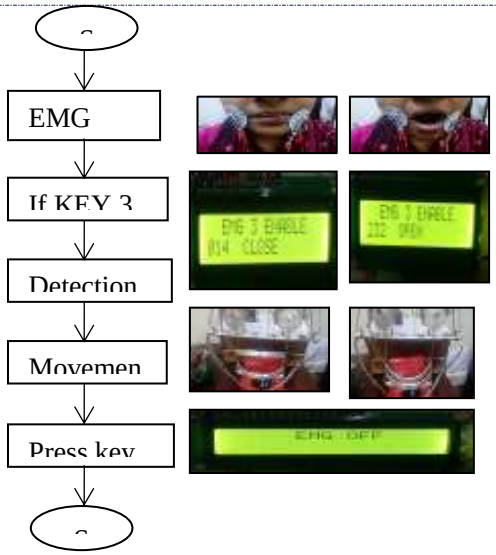

RESULT

Below is the sequence of how the system is going through all stages
Stage 1 : initially the system is off. Keypad with 4 keys are provided. By pressing key 4 to off the emg connections LCD will show the template as " EMG OFF"

Stage 2 : place the electrodes on both lip corners and press key 3. The LCD will show the template as "EMG 3 ENABLE" and it will start sensing the myoelectrical actrivities through sensors placed

If mouth is closed as showed in below picture,duty cycles will be generated in pulse width modulation and disable lips will take negligible movement .

It will completely stop moving and result is showed in below picture.

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If mouth is opened then there will be high myoelectrical activity inside the mouth muscles. And during pulse width modulation high duty cycle will be generated.

As mouth is opened LCD will display the signal strength in bytes as below.

According to the duty cycle width disable lips will take movement through servo motors output.

CONCLUSION

As the paralyzed lip portion starts recovering, the muscle reside there start to fire electrical impulses day by day. And muscles transform again into the similar tone of the muscles. Once the implementation of electrical stimulation stops then muscle lose its tone. Over electrical stimulation can cause the tightening of the muscles that contract more. This system is to solve the communication problem of paralyzed person. Due to paralysis person is not able to move 100% portion of the lips. To increase the strength of the signal stimulator therapy is provided . Facial paralysis makes the facial cells weakened due to nerve damage, so facial muscles appeared to be dropped. Due to weak muscle strength survivor face a big problem in communication, where this project device plays very important role to give movement to those weak muscles.

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