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DESIGN AND DEVELOPMENT OF EMG SIGNAL BASED SYSTEM FOR PARALYZED PEOPLE

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ABSTRACT

In recent years, physically disabled person faces more limitation in day to-day communication. There is a demand in today's world for the development of a support system to physically disable people/paralyzed person. In this work, an EMG based control system for eye movement is proposed. Patients distressing from facial paralysis are on the risk of defacement and defeat of visualization due to failure of blink function.

Eye movements tracking is helpful for disabled people suffering from Amyotrophic Lateral Sclerosis. In this research work, an EMG based eye control system for a paralyzed person is proposed. Trapezium EMG signals are acquired, analyzed and then processed into a controlled movements (left, right, up and down) using an embedded circuits. The system allows the patient to choose a smooth independent movement in the control state or non-control state. The movements depend upon the strength of the EMG signals acquired.

KEYWORDS:EMG, microcontroller, facial palsy, OOM.

INTRODUCTION

Background

In general, 1 in 50 people are affected with some form of paralysis which may be temporary or permanent according to a recent statistics. The paralyzed and semi paralyzed people struggle for mobility. Hence in order to overcome such problems, a MODEL based on EMG signal has been developed. Similarly, EMG signal controlled studies are documented for this MODEL. The proposed system does not require any human assistance.

Facial paralysis is a common problem including the facial nerve and can significantly impact a patient's quality of life. The facial nerve is a compound nerve which comprised of motor, parasympathetic and sensory fibers. Damages to the facial nerve affects facial functions and appearance. The irregular function of facial nerve causes defeat of controlled movement of the muscles of single part of the face. Facial nerve palsy causes a feature drop down of single side of the face, incapability to crinkle the forehead, inadequacy to whistle, incompetency to close an eye and mouth's deviation toward the other side of the face. Facial nerve paralysis causes due to numerous conditions which includes infections, tumors, toxins, inherited dieses and trauma. Speech , appearance of moods, emotions and manduction are based on the capability to shift facial musculature.

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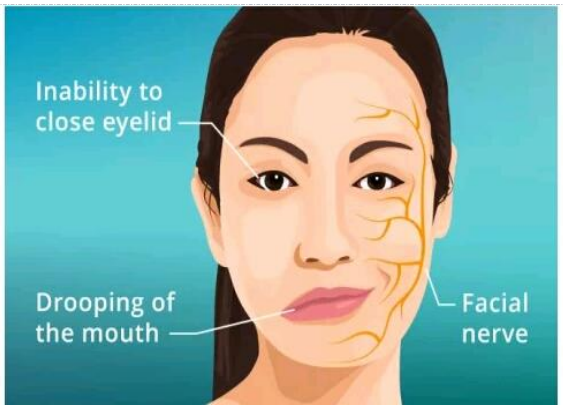

Fig 1.1 Effects of facial paralysis [Ref. 12]

Related work

Facial nerve paralysis induces visible defects such as destitution of blink. The major concern with facial paralysis is the mishap of dynamic blink of eyelid. Eyelid closure is essential for corneal problem, it acts as a shield for tiny objects and foreign materials entering into the eyes. It also prevents dry eyes, lubricating the cornea and washing away any dirt or other debris that has entered. The incapability to blink causes infections, visual impairment and dry eyes. If the superior eyelid is unable to move over the surface of the cornea, inadequate tear film coverage is maintained. This results in defective wetting of the ocular surface, leading to corneal drying and soreness. If this is left uncontrolled, ulceration can occur, most important to impaired vision (Salerno et al.,). The problem can be further exacerbated since tactile sensation on the affected cornea can also be reduced due to damage to the trigeminal nerve, which often accompanies seventh nerve damage (Hanner et al.,). Eyelid movements have previously been characterized using a variety of measurement techniques. Gordon used a steel ball bearing mounted on the eyelid to reflect light onto moving photographic paper. Other early systems used a mechanical lever fixed to the eyelid to drive a measuring system, e.g. a potentiometer (Kennard and Glaser). More recent techniques include the use of a Hall effect sensor mounted on the lower lid and a magnet on the upper lid (Hamiel et al.,),

Contribution

The goal of the research work is design a system for paralyzed person to communicate with world using EMG signals and develop real time controller that offers improved operation and simple user friendly setup without compromising the performance.

SYSTEM ARCHITECTURE

A. EMG sensor electrodes

EMG sensor electrodes are able to provide only a limited assessment of the muscle activity. Surface EMG can be recorded by a pair of electrodes or by a more complex array of multiple electrodes. The electrodes are placed close to the eyes. This electrodes detects left, right, up, down movements of the eyes.

B. Block diagram

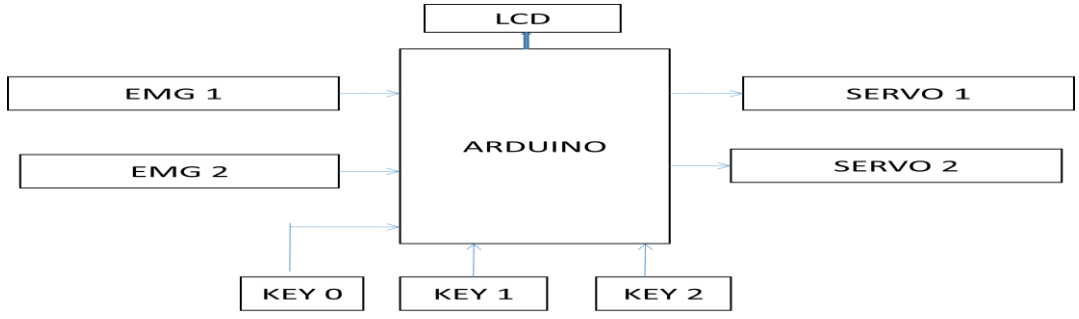

Fig.2.1Block diagram of the proposed system.

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In the proposed system 2 EMG electrode sensors are used which are interface with Arduino Uno that uses ATMEGA 328P. Signal acquisition will be displayed on LCD. To select any one EMG sensor keypad is provided. Once the particular key is pressed, respective EMG sensor is enabled and as per the movement of the eye, servomotor works**.** This servomotor is attached to the eye of hardware module. So as per the movement of eye hardware module will be controlled.

C. System flow diagram

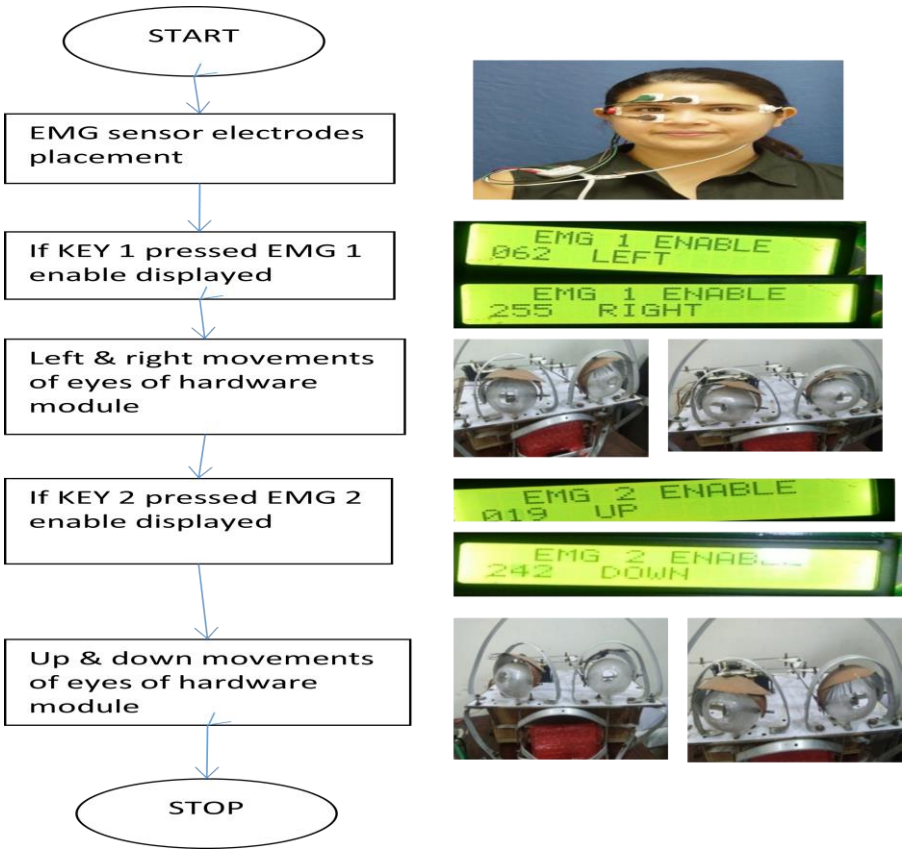

Fig. 2.2 Flowchart of working of the system

HARDWARE DESCRIPTION

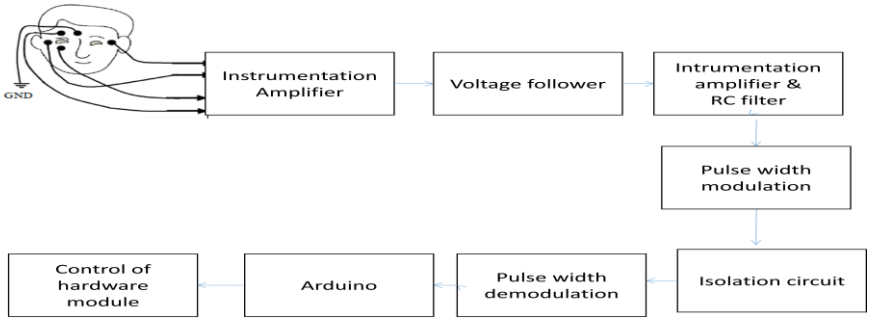

Fig3.1 Acquisition of signal and electrodes placement

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Preamplifier

The instrumentation amplifier circuit as revealed in Fig. is used as a pre-amplifier to obtain EMG signal from muscle through the non-invasive electrodes . Two op-amp was used to intensify potential difference among two electrodes to a preferential voltage for scheming purpose.

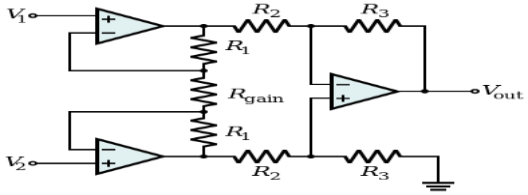

Fig. 3.2 Instrumentation amplifier

Voltage follower

A voltage follower is an op-amp circuit which has a voltage gain of 1.

This means that the op-amp does not offer any amplification to the signal. The cause it is voltage follower for the reason that the output voltage straightforwardly follows the input voltage, meaning the output voltage is same as the input voltage.

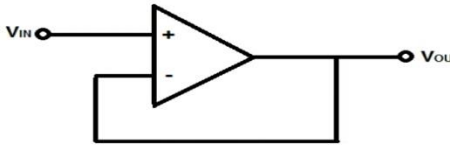

Fig 3.3 voltage follower

RC filter

A resistor-capacitor filter is an electric circuit serene of resistors and capacitors obsessed by voltage and current source. RC filter can be used to filter a signal by blocking firm frequencies and fleeting others.

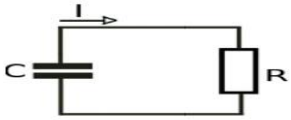

Fig. 3.4 RC filter

Pulse width modulation

PWM is a modulation technique used to encode a message into a pulsing signal. Its main use is to permit the control of power supplied to electrical devices, particularly to inertial loads such as motors.

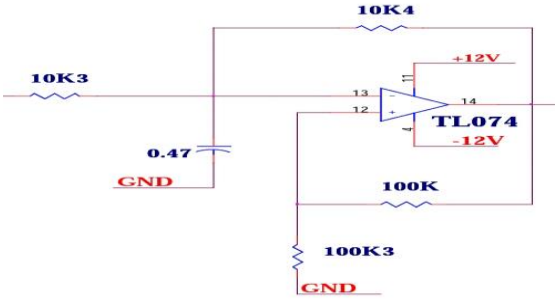

Fig. 3.5 Pulse width modulation

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Pulse width demodulation

PWD is extracting the orignal information bearing signal from a modulated carrier wave.

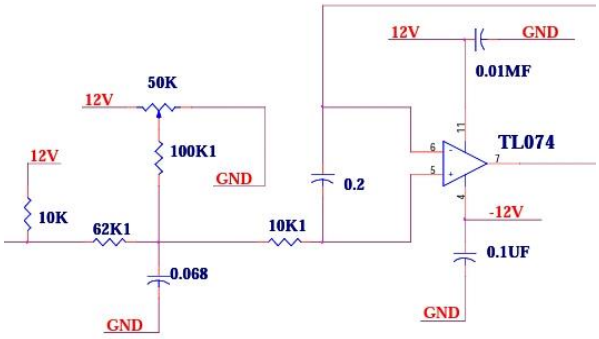
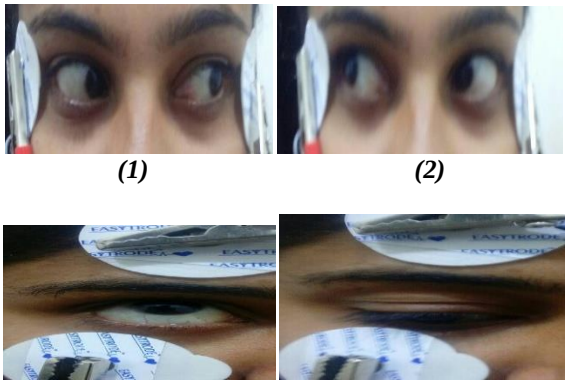


Fig 3.6 Pulse width demodulation

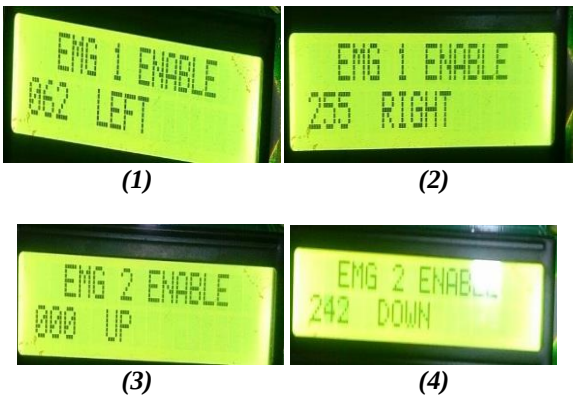
RESULT



(1) *(2)*

(3) *(4)*

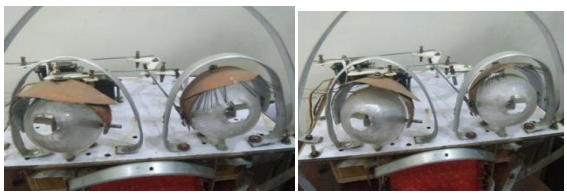
Fig. 4.1 pictorial view of left, right, up, down movements of eyes



(1) *(2)*

(3) *(4)*

Fig. 4.2 simultaneous result on LCD



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(1) ***(2)***

Fig. 4.3 movement of hardware module with the help of eyes

CONCLUSION

The purpose of this EMG system is to help paralyzed people to activate their muscle activity of the disabled part and acquire useful muscle signals for communication purposes. The EMG system consist of few major part; including a pre-amplifier, high pass filter, rectifier, low pass filter, analog to digital converter , microcontroller and a display unit. Thus this is an very supportive device for paralyzed people.

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