Electric Wheelchair Controlled by EMG Signals with Obstacle Detection

[1]Sathishbalaji L, [2]Bhakkiyalakshmi R

[1]Student, [2]Assistant Professor
Embedded systems and Technology, SRM University, Chennai, India.
Electronics and Communication Department, SRM University, Chennai, India.
[1]sathishbalaji30@gmail.com , [2]bhakkiyalakshmi.r@ktr.srm.ac.in

***Abstract*— The main approach of this project is to create an assistive technology which will help for disabled persons. Here a wheelchair based approach is employed which is interfaced with an embedded technology and a bio-medical device which helps for disabled person to move independently. The device used here is EMG, which get the signals from electrode which are attached to muscle and the signal pulse generated are noted down from EMG. The signals are then amplified, digitalized and transmitted wirelessly. The signals are received at the receiver and the wheelchair is controlled with respect to the transmitted digitalized signal. Thus the wheelchair is controlled wirelessly, which makes helpful for the disabled person who is handling restricted free movements. There is also an Ultrasonic Sensor Detector which is used for detecting the obstacle.**

***Index Terms* - EMG, Assistive technology, Controller, Electric wheelchair.**

I. INTRODUCTION

Wheelchair is a medical device which came to existence during the First World War. Features of the wheelchair have been developed very vast such that it could be much easier to be handled by the person. A technology is a tool which serves for the people, here the technology used is a wheelchair where the concentration is towards helping for the person who cannot afford their daily life.

There were many trials for making the wheelchair making comfortable for the people. Finally a joystick method came into existence which paved way as a result of improvising the existing wheelchair, it became safer way for handling in the real time.

Still, the joystick can be a limiting factor since it can be used only by people who still have some sort of control, enough for manipulating it. For people who suffer from severe motor disfunction, different types of control are being researched for making it better use. One alternative way is employing electromyographic signals (EMG)[1] for this purpose. This specific type is strongly connected to the Biomedical Engineering field, which works with physiological signals analysis and processing offering resources for controlling different types of systems and interfaces.

In the previous papers EMG has been employed as alternative for the joystick method[2] of controlling a wheelchair. The mechanism were followed is to handle wheelchair by broadcast communication , the main drawback of the method is that the chair could be handled only where the communication is existing if the network fails then the whole system will be failed.

This paper presents handling of wheelchair using EMG[3] in next upgraded method and how the communication is been made by using wireless means of transport.

II. IMPLEMENTATION

The implementation process is composed of keeping the EMG[4] at the core part and handling the wheelchair in the real time. The block diagram (in figure 2, 3) will show the basic methods of how the design is been implemented. The proposed system uses surface electrodes, amplifying circuit, filtering circuit, microcontroller, driving circuit, Zigbee module and Ultrasonic Sensor Detector.

1) EMG tool

The core part of this project is EMG and how the signals are obtained from it. EMG consists of electrodes which are placed on the muscles (figure 1), here hand muscle is made as a choice. The type of electrode used here is surface electrode. During the hand movements there will be some contraction created by muscle by which some pulse signals generated. The pulse signals differ if the contraction created is more or less. The function of EMG is to record the pulse signals [5]which are obtained as the product of contraction. The output of EMG will be an analogue pulse signal which is further processed to get the required signals.

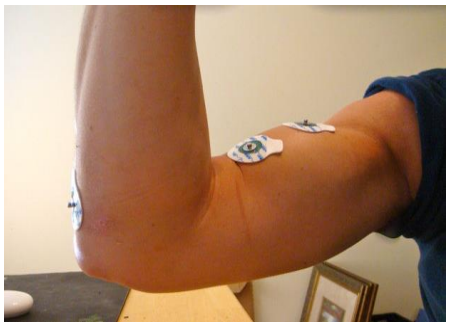

Figure 1 Electrode Placement

2) *Transmitter Block*

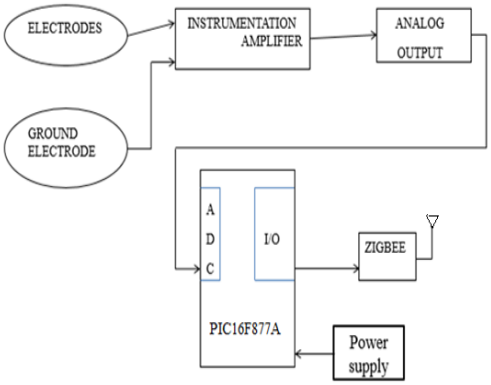

Figure 2 Transmitter Block

The above diagram (figure 2) illustrates the block diagram of the transmitter portion of the project. The device is composed of electrodes had to be placed on muscle, there is a need of amplifier to amplify the low level signal obtained from EMG.

The obtained analog signal is passed through controller, which has an inbuilt A/D converter will gets out the digital signal. Thus the portion of the transmitter is finished and its passed through Zigbee which acts as the wireless transmitter.

3) *Receiver Block*

In the figure 3, it demonstrates the receiver section of the project. The digital signals which are transmitted from EMG are obtained from the Zigbee of receiver section, the signals are passed to controller.

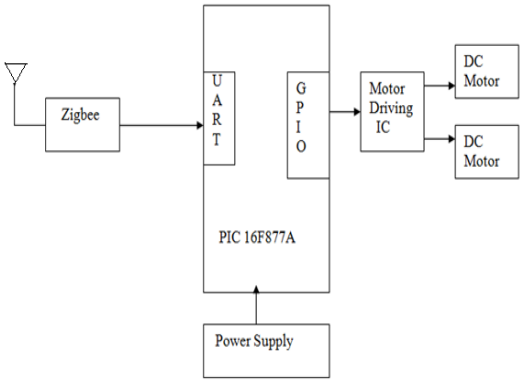

Figure 3 Receiver Block

The controller is interfaced with the Motor Driving IC, thus the motor will be operated in accordance with the signal that has been transmitted from the transmitter portion. The communication is been made until the receiver receives the signal transmitted from the EMG attached on the transmitter portion.

4) *Wheelchair control*

The wheelchair is to be controlled wirelessly, here the Motor Driving IC (L293D) is used[6]. There are different commands used for operating the chair [7]. Each signal should be different from the rest of the signal transmitted thus the digital signal will

be useful for differentiating the other signal. The commands used will operate forward, reverse, left, right and stop movements [8]. This project is also added with Ultrasonic Sensor which is used for detecting the obstacle in some programmed distance, here the obstacle could be detected from 2 to 500cm.

5) Ultrasonic Sensor Detector

This project is mainly adapted for people who are suffering with disabilities. For those people in certain conditions problems could be occurred while handling the devices, during certain condition so in order to prevent it Ultrasonic Sensor Detector 40Hz can be used so it could avoid from obstacle hits. The Sensor used in here can detect obstacle from 2-500 cm of distance and try to stop the wheelchair if conditions are in favour.

III. TESTING

The whole process is been tested by using a volunteer. The electrodes were attached to hand muscle, there are three electrodes. Surface electrodes get the pulses from the contraction of muscle and it's been amplified by the amplifier circuit. The resultant signal is allowed to pass through a filter circuit. It produces the noise free output signal and it is converted to respective digital samples by controller. Zigbee is a wireless module which is used to transmit and receive the data wirelessly to the destination. Receiver module receives the data and analyses it, as per the input command driver circuit is used to drive wheel chair.

The controller is programmed accordance with stress created from the muscle, if the produced stress appears in some range then it will cause some pulse. Thus the commands to wheelchair will vary with respect to the pulse.

IV. RESULT

The signal received is digital signals, so the controller has to be programmed with digital values. The digital signal obtained is the voltage obtained from muscle contraction, the corresponding digital value of voltage produced is shown in display. If there are changes in transmitter then the controlling should be varied accordingly. The coding dumped into controller are hex files .If the values are not suitable for the person, because the contraction level will change in between two people in that case the values could be programmed accordingly. The below table 1 indicated how the moves are classified.

Table 1 Movements classification from received signals

Received Digital Values	Movements
20 to 50	Stop
60 to 100	Forward
110 to 300	Backward
400 to 800	Right
900 to 1000	Left

V. CONCLUSION

Thus the paper presents different ways of controlling of a wheelchair, here EMG is used as an alternate tool for the developing a user friendly machine, which could be used as an alternate method by disabled persons. More volunteers should be experimented and has to study and observed their response because, they obtained value from others can be varied in their measures. Overall the results have came out in success, thus combination of Bio-Medical Device[9] and Embedded Technology paved the way together for newer means of transport for the people suffering with disabilities. The project could be further extended by improvising EMG and make it simple, compact for people. There is some delay are observed which could be further improvised.

VI. REFERENCES

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