MECHATRONICS BOOK SERIES SYSTEM DESIGN AND SIGNAL PROCESSING

VOLUME 1

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Asan G. A. Muthalif
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CHAPTER 25

An Electrooculugram Signal Acquisition for Wheelchair Motion Control

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25.1 Introduction

Tetraplegia - the paralysis that is caused by serious injuries or illness to a human that lead to a partial or total loss of lower limb as well as the torso. People who are categorized as tetraplegia are having difficulties in their mobility though wheelchair can be used due to the impairment of most of the main part of the body that generate power for mobility such as lower limb and torso. Nevertheless their parts like eyes, ears, noses, etc. are still normally working thus can be fully utilized. Therefore to help them to be independent in mobility, this paper seeks to use the eye-movement signals of tetraplegia to control the wheelchair. The signal from eye that is called Electrooculogram (EOG) is generated at different eye movement's directions. An eye movement is detected by processing the EOG signal and this signal will be further used to control the wheelchair. In this research, g. USBamp from G.TEC Medical Engineering GMBH is used to collect the eye movement signal data by using Ag/AgCl electrodes. The eye movement signal data is passed to Matlab/Simulink software for data acquisition. Different directions and level of strengths of the signal output is fed to a virtual wheelchair model in MSc Visual Nastran 4D software to study the effect of the EOG to the distanc/rotation travelled by wheelchair using different levels of eye movement. This paper has investigated that different EOG signals obtained which then leading to different distance/rotation travelled by the wheelchair detected from 4 different places (right, left, up and bottom) directions. Those four EOG signals are correspond to right and left steer, and forward backward, which will provide the different result for distances travelled and also steering. A simulation example verifies the eye movement signals could be manipulated and processed for helping tetraplegia in mobility using wheelchair at different strength of signal levels.

25.2 Wheelchair for Mobility

Over the past several years, there has been increasing interest in the wheelchair among inventors, design engineers, and the general public. The suitable wheelchair design may facilitate their ability to be out of sick bed, continuing their life, pick and place things, manoeuvre in narrow spaces and partaking of human experience [1].

The use of wheelchair has become very important for mobility among disabled as well as the quadriplegics, which may cause by road accident, falling from high position or diseases. The initial purpose of the wheelchair is aimed to give more freedom for these people to do basic things on their own, such as carrying items from one place to another and manoeuvre [2]. The mobility of the wheelchair users can be aided according to the level of injuries of a user has, or depending on the capability of the user to handle the wheelchair.

There are several techniques used to aid the disabled peoples based on the communication between the human and machine such as mouse, keyboard and joystick [3]. In addition, biopotential signal also is one of the examples of human–machine interface using of nonverbal information such as electrooculargraphic (EOG), electromyographic (EMG), and electroencephalographic (EEG) signals [4-5]. The EOG and EMG signals are caused by physiological changes; many studies have