University of Technology, Sydney

Master of Engineering

(Thesis)

"Real-time EEG Classifier for Multiple Human Actions"

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CERTIFICATE OF AUTHORSHIP/ORIGINALITY

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that this thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signed, Darren J Smith

Production Note:
Signature removed prior to publication.

ACKNOWLEDGEMENT

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ABSTRACT

The purpose of this project is to develop a reliable, robust, electroencephalograph (EEG) classification system that can enable a person to switch one or more devices in a real-time environment via multiple actions.

Switching devices via physical actions such as hand and eye movements offers a high degree of certainty and is a common occurrence in our daily lives. For example, turning on a household light by pressing a switch. Conversely, switching devices by means other than physical movement is significantly more difficult and is the focus of much current research. There is a range of applications that can benefit the community at large if activation of equipment can be performed via a persons brain alone. For example, a physically disabled person activating a light or driving their wheelchair via thought patterns. Accordingly, the EEG classification system developed in this project focuses on unearthing techniques that can allow persons thought patterns to switch devices and ultimately operate equipment.

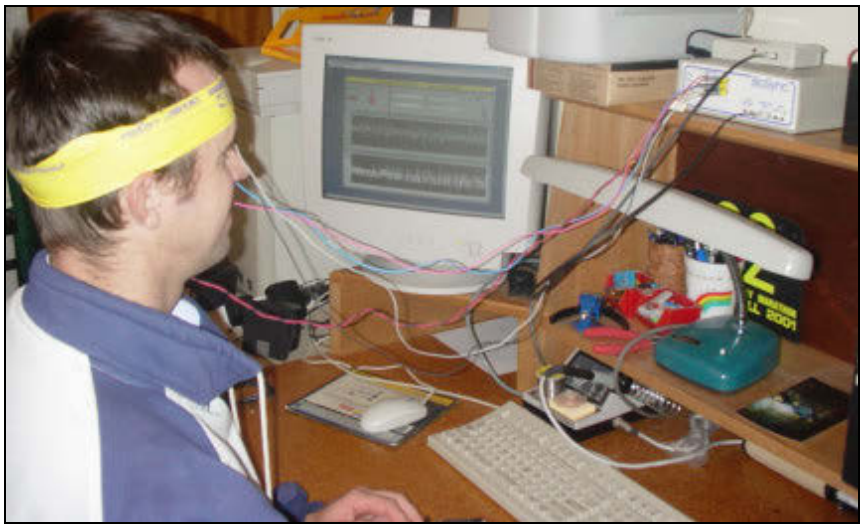
One of the main problems with existing EEG classification systems is their tendency to falsely activate the switch. This project focuses on developing robust techniques for a realtime environment that minimise the number of false switching for all physical and non-physical actions classified via EEG.

Initially, a real-time eyes closed switch is developed using a neural network classifier. This allows for techniques to be developed and tested in a realtime environment prior to being applied to more problematic mental imagination classifiers.

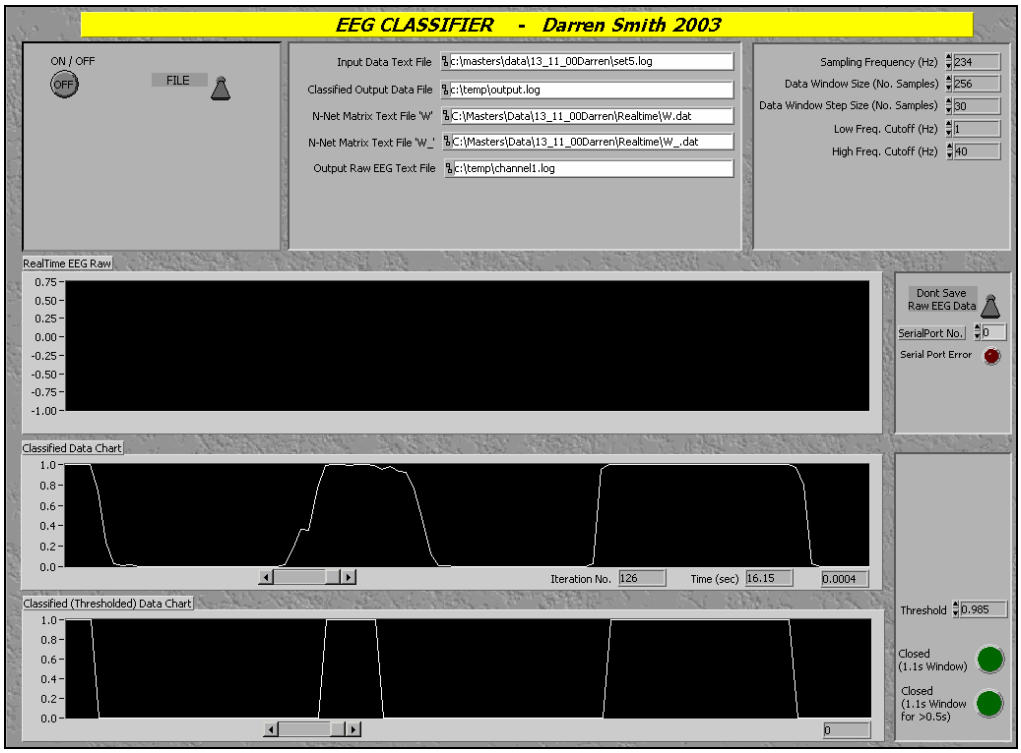
The real-time eyes closed switch classifier has been developed during the course of this project to accurately and robustly classify a person closing their eyes. The eyes closed classification success and a false switching rate is 98% and 0% respectively.

One of the major problems with developing systems to classify mental tasks is the integrity of the training data may be poor. This is due to lapses in concentration whilst recording the training data. A neural network classification system has been developed that can detect and exclude these 'artefactual' samples and consequently train a far superior neural network classification system. The result of this was successful classification of 5 mental tasks with 85% correct classification and only 1% false switching.

The real time system has been developed and implemented using a Labview graphical user interface with a compiled 'C' program for the neural network classification. Tests performed on the realtime system developed showed it is possible to have up to 5 different action classifiers all performing simultaneously on a PIII 600MHz PC running MS Windows 2000.



Test Equipment



EEG Classifier Graphical User Interface

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