"I declare that I have read this report and in my opinion, it is suitable in term of Scope and quality for the purpose of awarding a Bachelor Degree in Electronics Engineering (Industry)"

Signature: ....

Supervisor Name: BADURA MUSTAFFA

Date: 9/5/06.

"I declare that I have read this report and in my opinion, it is suitable in term of Scope and quality for the purpose of awarding a Bachelor Degree in Electronics Engineering (Industry)"

Signature: ………………………………………………………

Supervisor Name: NADURA MUSTAFFA

Date: 9/5/06.

EEG ACQUISITION USING LABVIEW

MOHD FAHMIE IDZUL BIN MOHD RODZI

This Report Is Submitted In Partial Fulfillment of Requirements for the Bachelor Degree of Electronic Engineering (Industry)

Faculty of Electronic and Computer Engineering
Kolej Universiti Teknikal Kebangsaan Malaysia

May 2006

"I hereby declare that this report is the result of my own effort except as Clearly stated in the source of reference"

Signature: ....

Name: MOHD FAHMIE IDZUL BIN MOHD RODZI

Date: ....11/05/2006...

For My Family, Farahida, Lecturer and all My Friends
With them, nothing is impossible

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ABSTRACT

Electroencephalography (EEG) are primarily use for diagnosis, detect and localize cerebral brain lesions, aid in the studying of epilepsy, diagnosing mental disorders, assist in diagnosing sleep patterns and allowing observation and analysis of brain responses to sensory stimuli. To date, advance researchers have developed system that use EEG signals to decipher thoughts so that a person can communicate by means of brain activity alone.

The purpose of this project is to develop an EGG amplifier that form part of an EEG signal acquisition system. The hardware includes amplifications and filtering circuit, and a personal computer (PC) while the software includes a graphical display of patient's EEG signals/data programming.

ABSTRAK

Electroencephalography (EEG) adalah merupakan satu proses di mana ia merekod dan megukur potensi elektrik. Proses ini merekod dan megukur potensi elektri yang di hasilkan oleh otak dengan menggunakan sensor iaitu Electrode. Dengan menggunakan EEG ini kita dapat mengesan beberapa jenis penyakit iaitu epilepsy, kurang siuman, dan juga penyakit berjalan ketika tidur (mengigau).

Kini ramai penyelidik ingin membangunkan sistem EEG ini dengan menggunakan otak sebagai pentafsir sesuatu di mana seseorang itu boleh berkomunikasi melalui aktiviti otak sahaja.

Objektif projek ini adalah untuk membangunkan penguat EEG yang boleh menguatkan isyarat EEG yang sangat lemah. Untuk membangunkan projek ini perkakasan atau komponen yang diperlukan terdiri daripada penguat, litar penapis dan juga komputer persendirian yang mana mempunyai perisian yang boleh memaparkan isyarat EEG di monitor komputer.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The aim of this final project is to develop electroencephalography (EEG) machine containing hardware for analog data acquisition as well as software controls for acquisition and review of digital EEG data. The EEG signals can be capture medical electrodes placed at two points on the head C3 and P3. This project be able acquire EEG signals ranging from 50μV up to 10μV. The signal amplitude is only a few micro-volts and needs to be amplified several thousand times before it can be captured. The signal is first amplified by a high quality instrumentation amplifier, which measures the voltage difference between two locations on the scalp.

The signal strength is increased further by normal amplifiers, and passed through a low-pass filter which minimizes distortion caused by so-called aliasing that may occur when the signal is converted to digital samples. After the filtering, the signal is ready for acquisition by the analog-to-digital converter which in our case located inside the terminal block. The terminal block sends the digitized EEG to a PC via a standard serial cable and DAQ Device. Using the GUI in LABVIEW, the signal will be saved in the personal computer (PC) and display on the monitor.

1.2 Project Objective

The objective of this final project is to develop small signal amplifier circuit to acquiring EEG signals. Filtering circuit is added in to ensure that the standard range of low and high electroencephalography (EEG) frequencies from 0.1 – 70 Hz is recorded without attenuation. The circuit is then interfaced to a PC using LABVIEW software, NI Datalogger.

1.3 Project Scope

The scope of work for this project is to study of the brain function and EEG signal makeup and development of the brain signal acquisition circuit. This includes the studies of the EEG circuit which contains differential amplifiers, adjustable gain amplifiers and driver amplifiers to acquire EEG signals (with amplitude between 1uV to 100uV). Beside in scope of work for this project followed by:-

- To develop hardware and software for acquiring EEG signals.
- Development of an amplifier circuit (which contains differential amplifiers, adjustable gain amplifiers and driver amplifiers) to acquire EEG signals (with an amplitude between 1uV to 100uV).
- Development of an analog filter (Which is more efficient at preventing aliasing)

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

EEG is the neurophysiologic measurement of the electrical activity of the brain by recording from electrodes placed on the scalp, or in the special cases on the cortex. The resulting traces are known as an EEG and represent so-called brainwaves. This device is used to assess brain damage, epilepsy and other problems. In some jurisdictions it is used to assess brain death. EEG can also be used in conjunction with other types of brain imaging.

2.2 History of EEG

The EEG has been a clinical diagnostic tool for over a century, and until recently consisted of the continuous (analog) measurement of voltage waveform written on paper. From 1842 till 1926 Richard Caton, a physician practicing in Liverpool, presented his findings about electrical phenomena of the exposed cerebral hemispheres of rabbits and monkeys in 1875. In 1913, Russian physiologist, Vladimir Vladimirovich Pravdich-

Neminsky published the first EEG and the evoked potential of the mammalian (dog).

German physiologist Hans Berger (1873–1941) began his studies of the human EEG in 1920. He gave the device its name and is sometimes credited with inventing the EEG, though others had performed similar experiments. His work was later expanded by Edgar Douglas Andrian. In the 1950s, English physician Walter Grey Walter developed an adjunct to EEG called EEG topography which allowed for the mapping of electrical activity across the surface of the brain. This enjoyed a brief period of popularity in the 1980's and seemed especially promising for psychiatry. It was never accepted by neurologists and remains a primarily a research tool up to now.

Improvements in analog EEG recording were made by increasing the number of recording channels, refining pen-writing and improving amplifier with the used of vacuum tubes and the transistors. This technology has been replaced by digital EEG. The digital method electronically converts the continuous EEG voltage waveforms into series of numbers representing voltage values at many closely spaced points in time. It has dramatically expended our clinical capabilities by providing greater efficiency in data storage and improved data visualization techniques. Processing of digital EEG data by computer programs has also enhanced research studies of brain function. Digital EEG permits analyses of EEG features aspects are to show how information is extracted from digitized EEG data to aid in interpretation.

The waveforms recorded are thought to reflect the activity of the surface of the brain, the cortex. This activity is influenced by the electrical activity from the brain structures underneath the cortex.

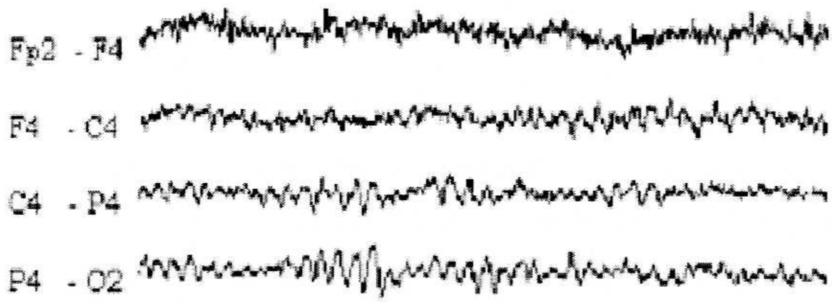

FIGURE 2.1 EEG Traces

Source: Goldensohn's EEG Interpretation: Problems of Overreading and Underreading [1]

The nerve cells in the brain produce signals that are called action potentials. These action potentials move from one cell to another across a gap called the synapse. Special chemicals called neurotransmitters help the signals to move across the gap. There are two types of neuro-transmitters; one will help the action potential to move to the next cell, the other will stop it moving to another nerve cell.

The brain normally works hard to keep an equal amount of each of these neurotransmitters in the brain. EEG activity is quite small, measured in micro-volts (μV) with the main frequencies of interest up to approximately 30 (Hz).[1]

2.3 The "10 – 20 System" of Scalp Electrode Placement

The 10-20 System of Electrode Placement is a method used to describe the location of scalp electrodes. The system is based on the relationship between the location of an electrode and the underlying area of cerebral cortex. Each point on this figure to the left indicates a possible electrode position. Each site has a letter (to identify the lobe) and a number or another letter to identify the hemisphere location.

The letters F, T, C, P, and O stand for Frontal, Temporal, Central, Parietal and Occipital. Even numbers (2,4,6,8) refer to the right hemisphere and odd numbers (1,3,5,7) refer to the left hemisphere. The z refers to an electrode placed on the midline and the smaller the number, the closer the position is to the midline.[8]

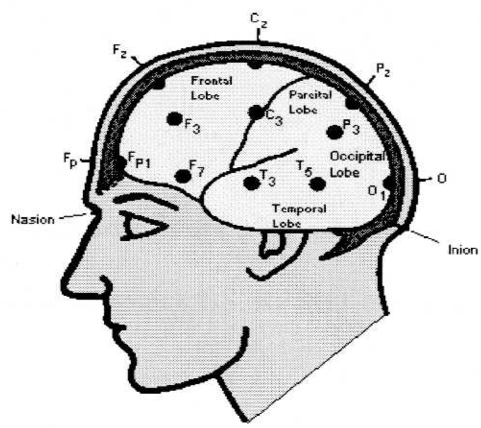

Figure 2.2 (a) Point between Nasion and Inion

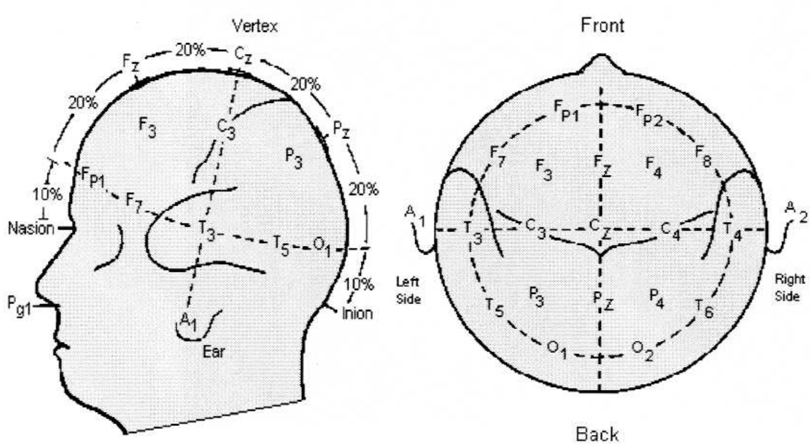

Figure 2.2. (b) The "10" and "20" Placement.

Source : D.G.Domenick BS, RPSGT copyright 1998 [2]

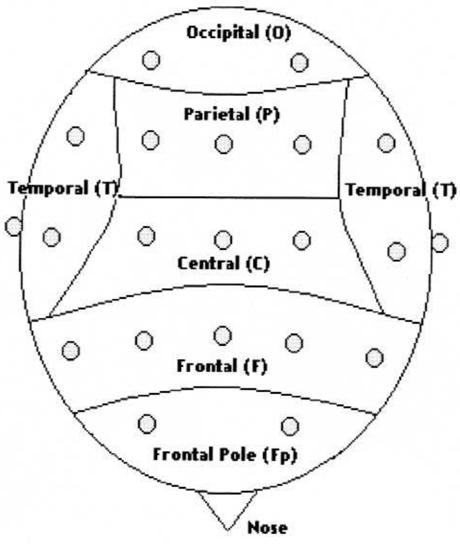

Figure 2.3 Anatomic landmarks are used for measurement purposes only.

Source : D.G.Domenick BS, RPSGT copyright 1998 [2]

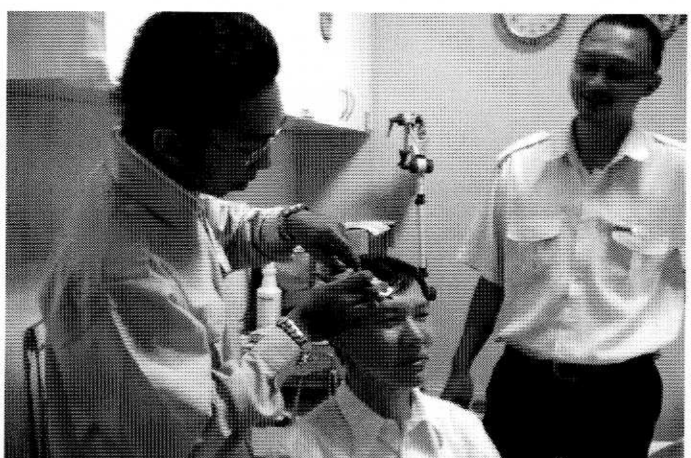

Figure 2.4 Head Measurement at Hospital Melaka

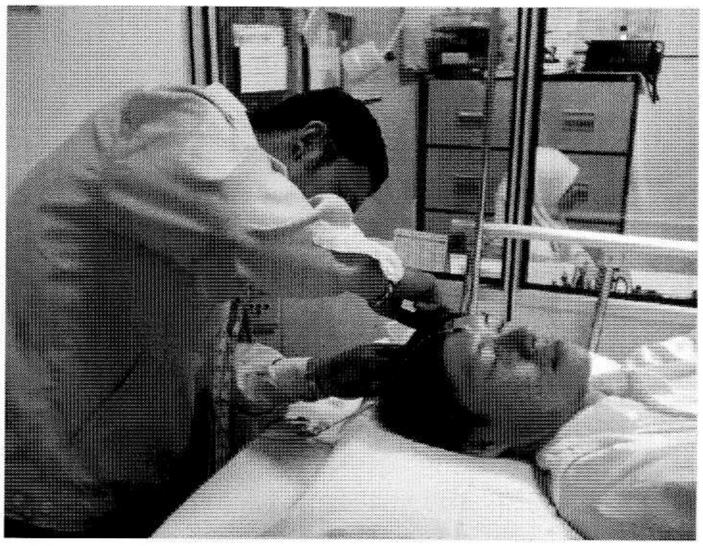

Figure 2.5 Electrode Placements at Hospital Melaka

2.4 Montages

EEG machines use a differential amplifier to produce each channel or trace of activity. Each amplifier has two inputs. An electrode is connected to each of the inputs.

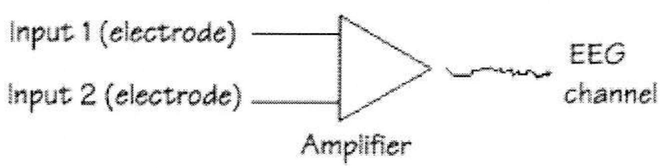

Figure 2.6 Differential Amplifiers

Differential amplifiers measure the voltage difference between the two signals at each of its inputs. The resulting signal is amplified and then displayed as a channel of EEG activity.