Curation of A Low-Cost Scalable BCI System

Amrita Ruperee#, Ajay More*, Omkar Samant**, Yash Kumthekar***
Department of Electronics & Telecommunication Engineering
Vidyavardhini's College of Engineering & Technology, Vasai.

***Abstract*— EEG (Electroencephalography) is a non-invasive technique through which brain impulsive activity can be recorded. There are various invasive techniques which are used to record the brain activity by measuring the individual neuronic impulses and analyzing them by placing electrodes by penetrating in the scalp. Our aim is to design a low-cost EEG system which measures the Electroencephalograph of pulses as an application of the Brain Computer Interfacing (BCI). For doing initial testing, we preferred designing our system using an Arduino platform along with a signal conditioning mechanism and shields employing (Digital to Analog Converter) DAC along with minimal external hardware. The conceptualization behind this system was giving it the ease of access so that its replication by students can be done seamlessly. Emulation of results from the above system are compared to professional grade equipment and achieved results close to it.**

Keywords: EEG, BCI, Arduino, Mental Ailments

I. INTRODUCTION

A Brain-computer interface is a technology which enables brain signals to be read and analyzed by a human interaction machine. The growth in research in this field has been exponential and has attracted attention from researchers all over the world. Its application primarily lies under biomedical instrumentation which has an integration of computer science. This technology employs the ideology that human brain signals can be quantified and measured. This collected information can be processed and then used to command the computer perform actions accordingly. This communication bridge is the underlying principle on which BCI functions.

There are various invasive techniques which are used to record the brain activity by measuring the individual neuronic impulses and analyzing them by placing electrodes by penetrating in the scalp. Post-synaptic summation of impulses from thousands of neurons are analyzed to conclude various parameters. There are various obstacles in the form of hair, skull and tissues that act as an interface between the source of the electric energy and the electrode terminals that cause high impedance.

We aim to design a low-cost EEG system using Arduino, low-cost electronic amplifiers, and MATLAB processing. And we demonstrate here the results of our work, comparing it with a high-end laboratory device.

II. MATERIALS AND METHODS

The acquisition of the signal is done through Ag-AgCl electrodes, placed directly on the scalp, using Electrolyte paste for EEG for fixation and better conductivity. The placement of the electrodes is very important because if its poorly placed it can highly decrease the signal-to-noise ratio. The signal is then amplified, the amplifier used in this project is a Single Lead Heart Monitor AD8232[2], which is a sensor for Electrocardiogram (ECG), but can serve the same purpose as an EEG sensor. Three electrodes are wired in it. One for the signal, one for reference, and another for ground, the placement of these electrodes will depend on the intended application.

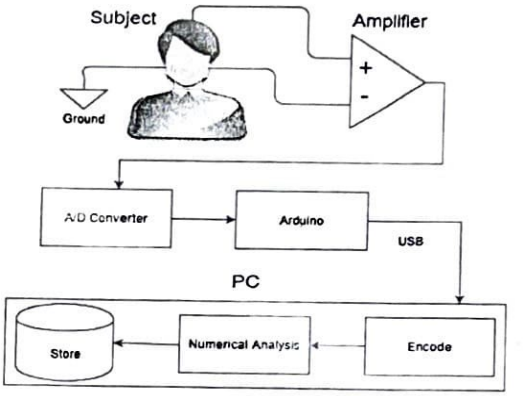

Figure 2: System Diagram

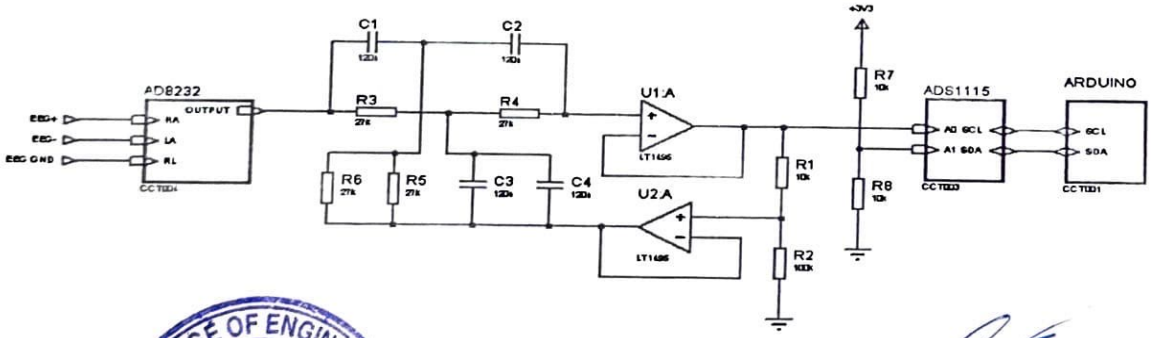

Figure 1: Circuit Diagram[2]

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