Professional English LSP127 - Project Brief - "Mobile EEG"

John Croft & Christoffer Olsson

Background and Aim

The idea for this project was conceived by Sakib Sistek, research engineer at the *Chalmers Institute for Computer and Information Technology* (D&IT). The project has its foundation in healthcare, biophysics, computer technology and electrical engineering and is based on the diagnostic practice of electroencephalography (EEG).

EEG is a method of detecting, measuring and recording ionic currents in the brain's neurons, known as *neural oscillations*, by attaching voltage-sensitive electrodes to an individual's scalp, usually with a form of a cap or headgear. EEG is at present used to diagnose neural disorders such as epilepsy, sleep disorders, comas and general encephalopathy. Superior diagnostic methods exist in the form of MRI and CT scanners, however, the size and weight of the equipment confines their use to fixed installations. EEG technology does not necessarily suffer this limitation, hence the undertaking of this project.

A mobile EEG could theoretically be performed in other circumstances and locations than a hospital, potentially opening up as of yet unexplored avenues for future research into biophysics and other relevant fields. Another hopeful side-effect of this mobility is a reduction in cost and the time needed to apply the electrodes to a patient.

Anticipated Outcome

The goal of the project is to construct an untethered (that is, not connected to a larger computer network) system for the measurement of neural oscillations in many parts of the brain, as well as eye activity through measurement of activity in ocular motor neurons. The system must log all the data for all connected sensors, including the camera and microphone, in parallel (i.e. within one sample period) and timestamp each acquisition in order to correlate brain activity with external stimuli. Furthermore, the system must be capable of displaying captured neural waveform data. The results, however, will not be analysed by the project members.

The (pseudo)parallelism involved represents a major hurdle that will require relatively fast processing, offloading of parts of the signal acquisition onto dedicated subsystems, such as dedicated ICs or even a custom FPGA implementation.

Commented [CSH1]: John and Christoffer, good work! You have clearly followed instructions and fulfilled the requirements for the project brief assignment. Your text outlines the project in a very clear way. It holds the expected content (though as mentioned in a comment below, the aim is actually kind of missing), has a clear structure, and a nice level of detail - I get a clear overview of your project. Language runs very smoothly too. Well done!
Some comments, mostly content-related, below.
Grade: Pass (strong)

Commented [CSH2]: You don't actually state your aim in this section that should contain your aim (even though reading between the lines and the title of the text, I can gather what it is).

Commented [CSH3]: It's not really entirely clear why the second part of the sentence is a consequence of the first. You go into it more in the next paragraph of course. But some fix needed on the structure to make the meaning and connections clearer and more logical.

Commented [CSH4]: Voc (this word usually has a negative connotation)

Commented [CSH5]: Why?

On a biophysical level, moving whilst using the device will likely generate interference from motor neurons (signaling the muscles in the body). This type of problem may potentially be mitigated with some form of filtering, which, depending on the complexity, may be outside the scope of this project.

Organisation

This project will be carried out by John Croft and Christoffer Olsson, third-year students of electrical engineering (EE) and computer engineering (CE) respectively, at Chalmers University of Technology. The project will be based at the D&IT institute within the university.

The mobile EEG device will consist mainly of various sensors and electrical subsystems as well as a central control unit. The precise placement of the sensors will necessitate a semi-rigid structural frame that can be head-mounted. This will be mostly designed in 3D CAD software and will be manufactured using a 3D-printer.

Due to the untethered nature of the device and the sheer amount of sensor readings, the central control unit must be modestly powerful yet relatively efficient and lightweight. A Raspberry Pi™ single board computer is expected to fulfil these criteria, although it may be replaced with, or used in conjunction with other types of processors, such as an Arduino™, if appropriate. As such, the programming language used will also be subject to change.

A GUI will be used in order to show brain activity; the implementation will depend primarily on the constraints of the control unit and will most likely involve wireless technology (such as Bluetooth or WiFi), with the waveforms and other data shown on an external display unit connected ad-hoc (without reliance on pre-existing infrastructure, such as a router).

The inherently biological nature of the problem that this project will attempt to broach will require a fair competency in the field of biophysics, especially concerning neural oscillations and the various biological processes/conditions that give rise to and affect them. A relatively comprehensive understanding of current EEG technologies will also be required; for this purpose a visit to Sahlgrenska Hospital's department of Neurophysics has been proposed, pending approval.

Due to the multidisciplinary approach, the work will be divided according to the participants' respective areas of study, with John focusing primarily on the analog and digital signal acquisition electronics, and Christoffer on database and GUI design, though some overlap is expected to occur in instances where neither participant is more qualified, such as in CAD design.

In order to keep the project workload even, a schedule is to be written as part of a "Planning Report", outlining in detail how the project will progress and when certain milestones must be met, though the specifics have, as of yet, not been decided.

Commented [CSH6]: Ok, fair enough (was wondering where deadlines were).