computergraphics tübingen

Funfair: EEG game control

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Figure 1: You can place a teaser here.

Abstract

Electroencephalography (EEG) is a technique for measuring brain activity. Although widely used in neuroscientific research, it has thus far only rarely been used for the purpose of computer game control. Here we show that a leightweight EEG device, the Emotiv XXX, can be successfully used to play a broad range of simple yet challenging computer games. Furthermore, we demonstrate that rather than merely substituting a mouse or keyboard, an EEG device enables the development of a new type of games which go beyond traditional means of game control. We specifically developed six games, all of which can be played by controlling one's mental activity. We anticipate our work to be a starting point for ever more complex games and a new, keyboard-free gaming experience.

1 Introduction

Give an introduction to the problem. This might start from history, motivate the problem and end with the computational demands. Motivate why to use GPUs. You should also introduce CUDA in a way that makes an average computer science student understand what it is.

2 Description of the Solution

Describe your solution to the problem in detail. I propose to spend one chapter on a general, simple solution strategy so that the reader is familiar with how to solve the problem. This could also be a summary of the paper or document you mainly used to base your work on.

Subsequently, your particular solution should be described. Spend at least one chapter on describing the (parallel) improvements you made upon the naive implementation. It might be advantageous to split the implementation description to parts, each filling a subsection, and to give an overview over those parts first.

2.1 Sensor data analysis

All data, if not stated otherwise, were analyzed using R [R C16]. Our goal was to build several sensor data classifier which, based on an analysis of the data, would be able to tell apart several menal states (`no_action, action_1, action_2, ...`). In the process of building these classifiers, we faced two key challenges: Firstly, there was no prior mapping from the 16 sensors to a mental state - moreover, we did not even know which sensor would correspond to which mental signal (like α or β waves). Secondly, the sensor data - as is the case for almost any recorded data - seemed to be noisy. We therefore approached both challenges not in a knowledge-driven, but rather in a data-driven way: We recorded data for a variety of different actions and mental commands (Fig. 2) and carefully explored and visualized the sensor data recordings. As can be seen in the Figure, some commands such as `clench fist` were barely visible in the data, whereas other commands (e.g. `shake head, clench teeth`) produced considerably con-

sistent spike-like patterns. We therefore decided to focus on the actions that seemed to be visually distinguishable in the data.

As most actions and spikes in the data lasted for a very brief period of time, roughly 1-2 seconds, we convolved all sensor data individually with a sliding window of 2 seconds, which corresponds to 256 data points per sensor since the sampling frequency was approximately 128 Hz.

2.2 Highstriker

2.3 Painter

2.4 Magic Duel

2.5 Balancing

2.6 Mastermind

2.7 Subsection

Subsections look like this. If you need more hierarchy, use paragraphs.

3 Possible Extensions

Describe possible extensions and discuss why they could be useful.

A General Infos

You don't need an appendix. The two appendix sections are just there to give some additional or general information.

This document describes roughly, what the documentation of the Praktikum project should look like.

Note that your final documentation of your project should contain 6 text pages using this template plus the cover and the empty sheet at the beginning. Within the 6 pages, at least 4 pages should be only text.

B LaTeX Infos

This section demonstrates some LaTeX features / characteristics. For a much more extensive introduction to LaTeX, refer to the PDF on `http://drzoom.ch/diplomarbeit-mit-latex.html`. For getting certain LaTeX features and keywords explained, have a look at `http://en.wikibooks.org/wiki/LaTeX`

You should refere to images like the one in Figure 3 from the text instead of trying to place figures close to the text parts where they are mentioned. You cannot force LaTeX to place images on certain positions but only give it some hints, so make sure that your document is understandable independently from figure placement.

Beside figures, you can also label sections and tables and refer to them.

For references, extend the `bibliography.bib` file and cite papers like [Mil95]. The easiest way to edit the `.bib` file is to use a tool like *Jabref*. You may also find ready to use bibtex tags on the web which you can directly copy to the `bibliography.bib` file.

For building this document, you should use

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1 pdflatex reportTemplate.tex
2 bibtex reportTemplate.aux
3 pdflatex reportTemplate.tex
4 pdflatex reportTemplate.tex
```

to be sure that all citations and references within the document are correct. In some weired cases, it might be necessary to run pdflatex even more often.

Remember to change your LaTeX source in small steps - this makes error tracking quite easy.

References

[Mil95] George A. Miller. Wordnet: A lexical database for english. *Commun. ACM*, 38:39–41, November 1995.

[R C16] R Core Team. *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing, Vienna, Austria, 2016.

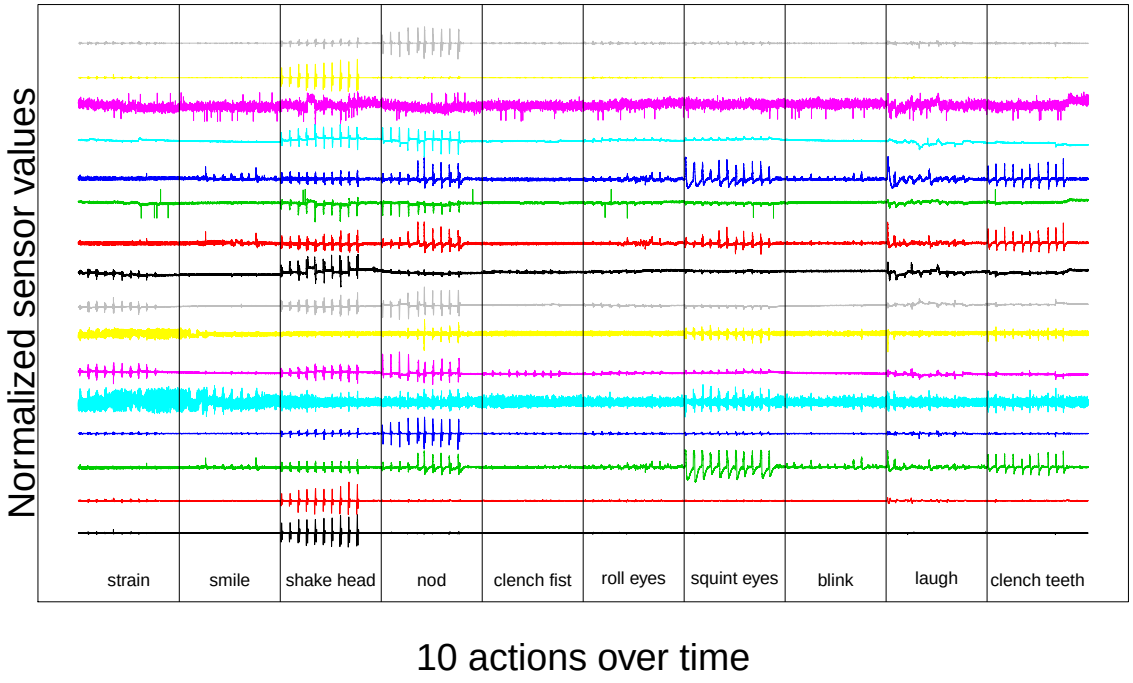

Figure 2: Raw sensor data for ten different actions and mental commands. All data are normalized to lie within [0, 1]. Every sensor has a different offset here for better visibility. Sensors from top to bottom: `Y, X, F4, FC6, AF4, F8, T8, P8, O2, O1, P7, T7, F7, AF3, FC5, F3`. Every action corresponds to one minute of data recording, during which over the first 45 seconds the action was briefly executed every five seconds, followed by a short break until the next type of action began.

Figure 3: This is a figure.