Curiosity Cloning

Neural Modelling for Image Analysis

Utilizing Cheap Commodity EEG Hardware

Executive Summary

Authors: Graham Healy[1], Peter Wilkins[1], Alan F. Smeaton[1], Dario Izzo[2], Marek Rucinski[2], Christos Ampatzis[2], Eduardo Martin Moraud[2]
Affiliation: [1]CLARITY: Centre for Sensor Web Technologies Dublin City University, [2]Advanced Concepts Team, European Space Agency.

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Contacts:

[1]CLARITY: Centre for Sensor Web Technologies Dublin City University
e-mail: Prof. Alan Smeaton" <alan.smeaton@dcu.ie

Advanced Concepts Team
Fax: +31(0)715658018
e-mail: act@esa.int

Available on the ACT website
http://www.esa.int/act

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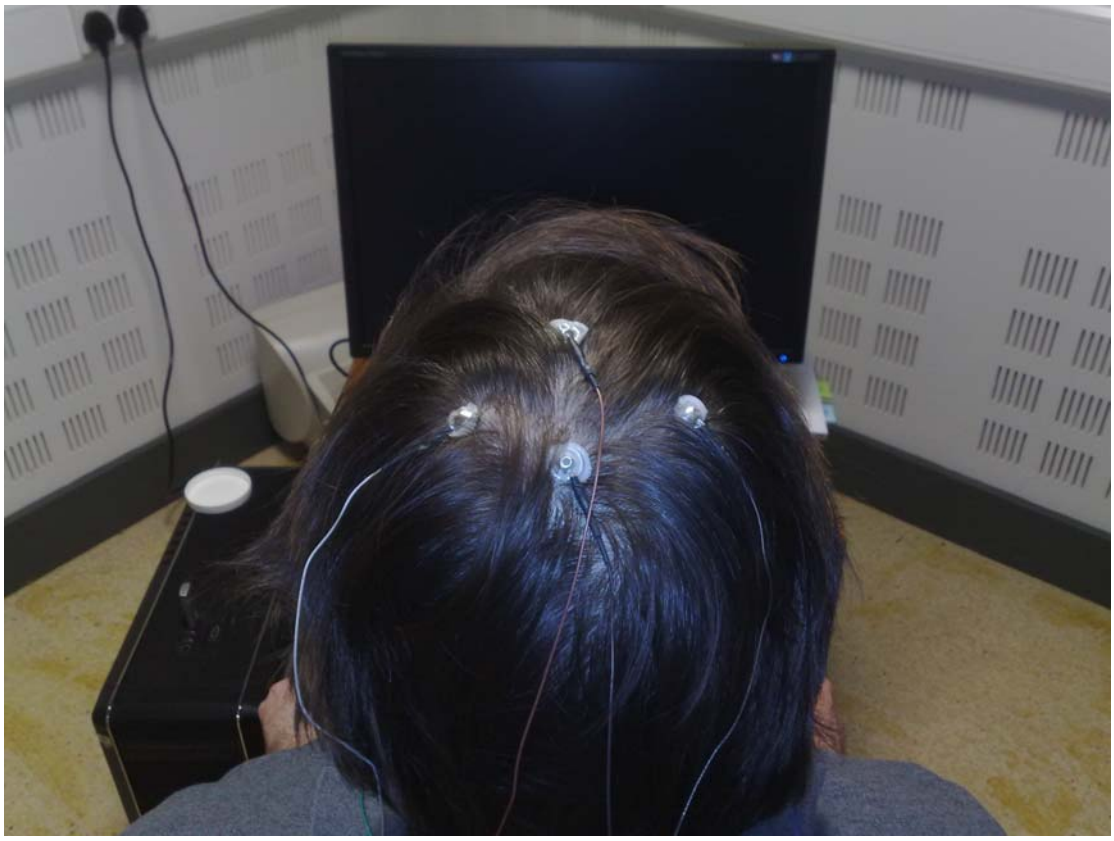
Picture:



Motivation:

Medical EEG devices are expensive, however commodity devices around $1000 USD are becoming available. We utilized a cheap EEG device to determine its applicability in support of novel neurologically based applications, which would have benefit to Space Agents.

Methodology:

Based upon previous studies which utilized EEG devices for image annotation in a visual RSVP framework. This work extended this research by creating a framework in which a subject viewed a series of images, whilst connected to our cheap EEG device. Subjects were told to count mentally the number of odd images out, where an instruction was given as to what an odd image was. EEG readings were then recorded. Based upon these readings, machine learning methods were then applied to create discriminative classifiers, such that on unseen data, the model should predict what images the subject would have considered as the odd one out. As we were using a cheap device, experimental parameters explored how fast we could present images to the subject, and other factors. We also attempted to go beyond target/non-target by utilizing expert knowledge of a subject to attempt to capture what they found interesting.

Results:

- Validation that a cheap, 4-node EEG device is capable of conducting visual RSVP experiments.
- Determining that visual presentation rates as fast as 150ms can be supported by the device, however noisier data could still be gathered at faster rates.
- The construction of discriminative classifiers based upon the EEG data which could determine if a subject found an image to be a target.
- Expansion beyond binary classification, to include a new category of 'non-obvious target', and demonstrated that a different neurological signal was generated in some subjects for this class of target. This class could be considered what a subject considered as 'interesting/curious' based upon their expert knowledge, in these preliminary experiments.

Publications:

- Izzo, D., Rossini, L., Rucinski, M., Ampatzis, C., Healy, G., Wilkins, P., Smeaton, A.F., Yazdani, A., and Ebrahimi, T.,Curiosity CLoning: neural analysis of scientific interest,Proceedings of the International Joint Conference on Artificial Intelligence 2009, Workshop on Artificial Intelligence in Space,2009.
- Smeaton, A.F., Wilkins, P., Healy, G., Ampatzis, C., Rucinski, M., and Izzo, D., Neurological Modeling of What Experts vs. Non-Experts Find Interesting, Neuroscience 2009: session number 687, Computation, Modeling, and Simulation III, 2009.
- (in submission) Izzo, D., Rucinski, M., Ampatzis, C., Moraud, E.M., Healy, G., Wilkins, P., Smeaton, A.F., Yazdani, A., and Ebrahimi, T., On the Classification of Brainwaves Associated to Scientific Stimuli, Journal of Machine Learning, special issue Space Applications.

Highlights:

The major highlight was the success of using the 4-node cheap EEG device, which at the start of the project was not certain that the device would provide useable data, particularly at fast presentation speeds. Being able to construct decent discriminative models from rates of display of up to 150ms was particularly satisfying. This demonstrated that far from being toy devices, these cheap EEG units could have serious application, particularly in Brain Computer Interface (BCI) research.