Title: Brainwave Controlled Computer Games Using Brain-Computer Interface Technology

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Project Description
In the Intelligent System Research Centre (ISRC) at the University of Ulster a team are currently focused on the development of advanced neural signal processing algorithms, software and hardware to create sophisticated brain-computer interface (BCI) products which translate brainwave activity into useful communication and control signals. This project is aimed at building on existing research to integrate BCI technology with computer games where users use the BCI to control and interact with specially designed games via their brainwaves. This will involve investigating and developing novel concepts for computer games that can be appropriately controlled using brainwaves recorded from a person's scalp and will entail integrating knowledge from three of the current most challenging, exciting and popular R&D fields – biosignal processing, computational intelligence (CI) and computer games development.

Rationale/context of the project
Integrating BCI with computer games poses many additional challenges in terms of developing games which are exciting to play but playable via brainwave control. Exciting computer games should evolve and adapt to each individual user so that they can become immersed in the game and so that there is fluency in the interaction between the brain and the game.

Brief methodology
The successful candidate will become experienced in brainwave recording procedures which include applying electrodes, amplification, digitization, data analysis, classification and neurofeedback and will gain an appreciation for the complexity of the problem but also experience the potential to control a computer using the mind alone. Once the candidate is aware of the limitations of BCI he/she will begin developing simplistic 2D games which can be used with the limited bandwidth provided by brainwaves but these simplistic games will be made as engaging as possible by incorporating highly intelligent algorithms to deal with erroneous communications (which is expected from brainwave control) to make the brain-game interaction as fluent as possible. This will involve incorporating intelligence in the transition of game scenery and covert game control. For this project the main focus will be on simple, consciously controlled gaming concepts but the BCI-games program within the ISRC is intended to address issues in complex BCI-games which involve conscious and subconsciously controlled gaming environments.

Anticipated Outcomes
This is an exciting project and the student will learn from experienced researchers in the field and will gain experience in many fields of computing, intelligent systems and games development. BCI R&D is multidisciplinary and involves elements of engineering, cognitive and computational neuroscience and psychology. BCI-based games R&D is a novel field of research and has the potential to produce new technology. There will be strong focus on creating entirely novel BCI-games applications.

Resources Needed
The student will have access to state-of-the-art BCI hardware and software facilities and games development packages.

See http://isrc.infm.ulst.ac.uk/coyle for references and details
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