President's Research Fellowship Programme

Proposal Abstract (300 words max)

Research Core / Group	gameCore
Proposed Supervisors **1. Principal** **2. Associate(s)** **3. Adjunct (external)**	Dr. Oisín Cawley (gameCore) Dr. Greg Doyle (gameCore)
Project Title	Interpreting brain wave activity through the use of a Deep Neural Network.
Project Objectives	Electroencephalography (EEG) is widely used in brain–computer interfaces (BCIs)—communication channels that bypass the natural output pathways of the brain—to allow brain activity to be directly translated into directives that affect the user's environment. It is a highly promising medium with potentially extraordinary applications such as the direct control of prosthetics and exoskeletons. One of the most recent approaches to interpreting the EEGs is through the use of Artificial Neural Networks and Machine Learning. However, there are a number of challenges with non-invasive EEG interpretation, such as inter-subject variability, which will need to be addressed. The objective is to review the field and develop a BCI interface which would initially allow the user to play a computer game. If successful this would demonstrate a novel interface for people with physical disabilities for game play, and indeed opens a path for further research in brain interfaces for other applications both digital and physical.
Methodology proposed	- An initial detailed review of the literature on BCIs and EEG interpretation will be performed. Through this we will gain an in-depth understanding of the current state of the art and direct the empirical phase of the project. - An appropriate Neural Network architecture will then be designed and developed (potentially using python and Tensorflow). - Drawing on readily available EEG data sets, we will be able to trial some network structures.

	- Upon success with these test datasets, the project will next integrate an EEG headset for testing with this project. This will consist of test subjects playing a video game while their EEGs patterns are recorded. This data is then used to train out network. -
Expected outcomes: (e.g. deliverables & strategic impacts).	Outputs: 1. A state of the art review of BCIs using EEG readings. 2. A DNN model trained and optimised for classification of our particular EEG data. 3. Prototype simulation demonstrating functioning DNN producing game play outputs. Strategic: 1. There is renewed interest in Artificial Intelligence driven by recent advances in the field. In particular 'Artificial Neural Networks' is the current hot topic with applications in many fields. This project raises the department's profile within the field at a time when public interest is being captured by all things AI. 2. The Computing department has recently launched an MSc in Data Aalytics. In addition we have a number of AI related graduate and MSc (by research) projects. This project will add to our growing expertise in the AI domain. 3. BCI systems continue to be a research area with a lot of interest. This project has an applied focus by linking with an actual computer game, thus demonstrating something tangible.

AFFIRMATION

Signature of main college applicant: _____ **Date:** _____

Signature of Head of Department: _____ **Date:** _____

Signature of Head of Faculty : _____ **Date:** _____

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