Controlling Player Avatars and Influencing Game Worlds Using Multi-Modal Input Systems

Final Year Project Proposal: Final Proposal

# Abstract (150)

Summarise the document

# Introduction and Rationale (150: 158)

Since the inception of the video game industry, different modalities have been explored to design new experience for the player through their feedback and interactions. Recent examples of this consist of virtual reality (VR), the Nintendo Switches Labo Toy-Con, and the Wii’s motion controls.

One field the industry has been progressively advancing in is medicine, Brain-Computer Interface (BCI) and myoelectric based gaming and have become a focus for researchers looking to understand the brain and develop consumer prosthetics.

Much like the modalities that came before them, non-invasive electroencephalography (EEG) and electromyography (EMG) could become accessible for consumers. Playable games have already been developed for research purposes **[**Gaming control using a wearable and wireless EEG-based brain-computer interface device with novel dry foam-based sensors**]**. However, if a new experience could be created by combining these technologies, the industry might adopt them as mainstays like motion controls and VR. For this reason, an exploration into these technologies and their interactions for the control of virtual worlds in the context of the video game industry will be explored.

# Literature Review (300: 300)

The use of games in BCI research has been an important tool for researchers for many years. Trials that include games during stroke patient rehabilitation, showed to alleviate boredom during trials, while not impacting the success of the sessions [Effects of Gamification in BCI Functional Rehabilitation]. The same can be said for the use of EMG systems, the usage of games in rehabilitation and aiding of vulnerable people with this technology has been important for rebuilding and maintaining healthy lifestyles that comes from exercise. [DESIGN OF EMG BIOFEEDBACK SYSTEM FOR LOWER-LIMB EXERCISES OF THE ELDERLY USING VIDEO GAMES]. However, its only recently that the use of BCI and myoelectric technologies for the purpose of developing game experiences has become an interest [Games, Gameplay, and BCI: The State of the Art].

BCI in gaming has been shown to be work with success rates, and method of interaction for these games have all been quite different. From controlling the difficulty speed of Tetris [Examining User Experiences through a Multimodal BCI Puzzle Game] and the accuracy of a bow in an archery game by meditating [Gaming control using a wearable and wireless EEG-based brain-computer interface device with novel dry foam-based sensors] to moving and shooting bullets from a spaceship using motor imagery [Driving Persuasive Games with Personal EEG Devices: Strengths and Weaknesses]. Though these games work, they are limited largely by the technology they are built for. Different BCI systems outperform each other based on the sensor count and quality of the sensors conduction. It is also worth considering however, the satisfaction of the player with a given system too, a dry single sensor device will not perform as well as a 14 wet sensor device, however the user satisfaction of the systems might favour the former [Comparing interaction techniques for serious games through brain–computer interfaces: A user perception evaluation study].

Another usage of these technologies that could potentially be used in gaming comes from prosthetics. Though individually EEG [EEG-based brain controlled prosthetic arm] and EMG [The Development of Body-Powered Prosthetic Hand Controlled by EMG Signals Using DSP Processor with Virtual Prosthesis Implementation] have both been used to control prosthetics, the use of a multi-modal system has been demonstrated to give greater results then when used independently [Demonstration of a Semi-Autonomous Hybrid Brain–Machine Interface Using Human Intracranial EEG, Eye Tracking, and Computer Vision to Control a Robotic Upper Limb Prosthetic]. By taking these the same data used to drive prosthetics and instead mapping them to an avatars rig, the control of a animated character should be possible. [User training for machine learning controlled upper limb prostheses: a serious game approach].

Others work

* What the work is
* Why it relates to what I’m doing
* How they did it
* What they concluded
* Issues or what went wron

# Aims and Objectives (300)

The goal, a singular system that can be used to do specific things,

Go general

* Explore how other projects work
* Read in data from the different modalities separately
* What I can conclude from reading the data
* Applying the data or translating it
* Combining it with other modalities
* Create links to specific user actions with expected reactions
* Magic?
* Player Controller
* Adaptive Game worlds (fear, frustration / exhaustion, and fun)

# Methodology (300)

What will I control them with?

* EEG
  + Look into papers on how this works
  + Explain how I will set it up, collect the data and store it?
* EMG
* Eye Tracking
* Combined either deep learning or machine learning

# Project Plan (300)

## What’s the plan?

Work on other projects and get a feel for the technology, then in the process investigate ways of combining it and seeing what different output functions I can decipher from it.

# References:

1. Will add!!!