(WIP) Improving Game experience with an EEG based dynamic difficulty adjustment system

Thema:
(WIP) Improving Game experience with an EEG based dynamic difficulty adjustment system
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Hintergrund

Flow, the unique state of being fully focused and absorbed in an activity, is one of the biggest factor elements that create good gaming experiences, which lead to the user feeling immersion in the gaming environment, joy, engagement, and skill development. Maintaining the optimal flow throughout a gameplay session remains a challenge for current developers. It is often disrupted by factors like game difficulty spikes or monotony. A common solution to keep the flow going is to provide specific game settings, that adjust the engagement and challenge according to its current player.

Although this implementation is already working fine in several different games, the difficulty settings mostly have to be chosen by the players themselves. This can lead to negative gaming experiences until the gamer finds the correct settings for his skill level. Dynamic difficulty adjustment (DDA) is a method, that tries to eliminate these bad adjustment experiences, by automatically modifying a game’s features, behaviors, and scenarios in real-time, depending on the player’s skill. Among other things, this is done by collecting and analyzing the player's input data.

Human-Computer Interaction in the field of gaming has seen some incredible advancement over the last few years. Ranging from gyro and accelerometer data in VR headsets to eye tracking, there have been a lot of different approaches to improving the gaming experience. Besides these active input methods, there have also been big improvements in using passive biofeedback data like the heart rate or the brain waves as an input signal. Reading electroencephalogram (EEG) data directly from

the brain offers a way to assess the cognitive and affective state of the user and translate it into emotions.

These emotions can be set in direct correlation to the flow of gaming and therefore can also be used to improve a DDA system for gaming experiences. By utilizing the real-time data from the EEG headband and assessing the current state of mind of the user, the data can be used to determine the current flow state of the user. By constantly adjusting the difficulty of the game, the user should be able to keep the flow going for a longer time. If the flow I decreasing and going towards either boredom or anxiety, we need to adjust the difficulty as soon as possible and either make the game more challenging or easier.

Zielsetzung der Arbeit

The work aims to determine if the game flow can be improved by using EEG data. To reach this goal, a dynamic difficulty adjustment (DDA) system will be created. Its major input data for adjustments should be the cognitive and affective state of the user, which is determined by reading and interpreting the brain waves of the gamer with an electroencephalogram (EEG) device. This raw data can be interpreted into emotions, which will then be used to adjust the game difficulty in real time. With this procedure, we aim to show, that maintaining a positive gaming experience of the user in gaming with a DDA system can be improved by using EEG data as an input.

Konkrete Aufgaben

- Research and literature preparation
- Planning of the study
- Implementation of the BrainBit SDK in Unity & first tests with EEG Headband
- Programming an interactive computer game based on a chosen template
- Finishing study prototype by integrating the neurofeedback into the game template.
- Conducting the study
- Evaluation & Analysis of study results

Erwartete Vorkenntnisse

- Strong understanding of the Unity game engine
- Moderate knowledge of EEG and neurofeedback
- Advanced C# programming knowledge

Weiterführende Quellen

- Verwandte Arbeit: https://www.researchgate.net/publication/321469435_EEG-Triggered_Dynamic_Difficulty_Adjustment_for_Multiplayer_Games
- Verwandte Arbeit: https://dl.acm.org/doi/10.1145/3582515.3609512
- Flow: https://www.researchgate.net/publication/224927532_Flow_The_Psychology_of_Optimal_Experience
- EEG Headband: https://brainbit.com/