Mastering Video Gaming with Machine Learning and Flow Detection

Bachelor/Master project "Information Systems"

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1: Project Overview

Background: Among many gamers, a feeling of being completely absorbed and immersed in the video game can be observed. This state, also known as flow state, is of particular interest for gamers themselves, game designers, and business stakeholders.

Project Goal: Developing a machine learning-based system to classify flow states through data that includes both physiological and questionnaire data.

Highlights: Implementation of a machine learning pipeline; handling large datasets; close cooperation with the chair

2: Project Background

Esports has developed into a global phenomenon with substantial economic and cultural relevance. The global esports market was valued at approximately US$2.6 billion in 2025 (Grand View Research, 2026). Its reach becomes especially tangible at flagship events, such as the 2025 League of Legends World Championship, which peaked at over 6.75 million simultaneous viewers during its final, with a prize pool of $5 million (Esports Charts, 2026).

Many professional and non-professional gamers report experiencing a state of complete immersion during gameplay, accompanied by a loss of track of time (Nah et al., 2014). This state of optimal experience, also known as flow state, is closely related to peak performance and results in positive and rewarding feelings after the activity (Harris et al., 2020). This flow state is of particular interest to game designers, who seek to evoke it in order to maximize player engagement (Nah et al., 2014), to players looking to enhance their performance, and to economic stakeholders in professional esports, who profit from that improved performance.

Thus, current research focuses on the measurement of the flow state while gaming. Recent studies have demonstrated an underlying relationship between flow and physiological data, such as heart or respiration rate. Moreover, associations have been identified between flow and parameters measured via eye- and face-tracking, such as head orientation, using a face-reader software with consumer-grade cameras (Berger et al., 2021). These findings open up the possibility of detecting flow through non-obtrusive devices, such as electrocardiogram (ECG) chest belts and cameras, that can easily be integrated into existing gaming setups. However, while linear associations can be identified, the underlying relationship appears to be more complex, indicating the need for more sophisticated mathematical models (Nadj et al., 2023). Machine learning methods that can detect these patterns provide a promising solution for facilitating flow classification in the gaming context.

3: Project Objective

The objective of this specific Bachelor/Master project is to classify flow states based on physiological data. To achieve this, students conduct an experimental study to collect data that will subsequently be used to train a flow classification model. The study design follows existing approaches, where participants wear an ECG chest belt (Rissler et al., 2020), while playing Tetris (Harmat et al., 2015), and complete questionnaires about their flow state, which serve as labels for the classification model. In addition, this project integrates face-reader software to capture head movements and facial expressions. Because the study collects sensitive physiological and video data, a data protection and ethics concept has to be developed by the participating students. An ethics application will be submitted to the responsible ethics committee, and data collection may only start once approval has been granted.

Students will get access to measurement equipment, such as ECG chest belts and face-reader software, and to results of previous student projects, including study design, measurement system, and data.

The **objectives of this specific project** are the following:

- Review of relevant literature on flow in the gaming context
- Review of the current study design, measurement system, and data
- Analyze improvement potential of the current study design and measurement system
- Conducting the user study
    - Improvement of current study design and measurement system
    - Acquisition of participants
    - Measurement of participants
    - Adjustment of the setup based on pre-test results
- Preprocessing of data, e.g.:
    - Data labeling
    - Filtering and processing of physiological signals
    - Feature extraction
- Training and testing of different machine learning algorithms, e.g.:
    - Implementation of selected algorithms
    - Evaluation of algorithms via performance metrics
- Evaluation of algorithm performance in the context of relevant literature

Depending on group size, adjustments to the project scope can be made. Adjustments will be announced at the kickoff and/or in subsequent milestone meetings.

Each finished artifact has to be properly documented to facilitate understanding and further development by students in follow-up projects.

4: Project Registration and further Information

All Bachelor- and Master students interested in this IS-project may apply via our online application form. The link to the application will be **available here** (Link hinterlegt) as of the start of the application period on **Monday, 28.09.2026.** The deadline for the application is **Sunday, 11.10.2026, 23:59.**

For successful completion of the project, Master students receive 12 ECTS (corresponding to 360 working hours) and Bachelor students receive 6 ECTS (corresponding to 180 working hours)

- Master students will invest 18 hours per week into the project.
- Bachelor students will invest 9 hours per week into the project.

In addition to project-specific deliverables during the process, we also require some fixed deliverables from each group. On the 04.12.2026, the project team needs to submit a one-page management summary on the current state of the project. A template will be provided by the Chair. As final deliverables, the project team has to submit four items by 28.02.2027. These are (1) a 5-minute video presenting the results (video for orientation), (2) a scientific poster summarizing the results (whether the poster will be considered for presentation will be determined by our Chair, and a final centralized vote among the Information Systems Chairs), and (3) a project report along with the (4) project code. The project report will contain the final results on 20 to 50 pages (Bachelor) or 30 to 60 pages (Master). The exact number of pages depends on group size and the number of bachelor and master students and will be communicated at kickoff. A template is provided on the WIPRO page. The (4) code needs to be accessible as Open Source via GitHub with appropriate documentation. We want to put up the best posters of each semester (2) at the Chair's premises to highlight your achievements. For outstanding projects, the final video (1) and a link to your code (4) will be shown on the Chair's page.

5: Project Schedule (Dates are to be announced)

Kickoff	Kickoff with accepted participants Clarify project scope and responsibilities
Milestone 1	Identification of important literature
Milestone 2	Review and improvement of the current study design and measurement system
Milestone 3	Conducting the user study
Milestone 4	Evaluation & Implementation of the classification model
Milestone 5	Submission of one-page management summary, project poster, report, code & 5-minute video illustrating the project

6: Grading

The final grade will be calculated as following based on the sum of the milestones:

- Milestone 1: 10%
- Milestone 2: 15%
- Milestone 3: 20%
- Milestone 4: 15%
- Milestone 5: 40%

7: Sources

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- Kutt, K., Drążyk, D., Żuchowska, L., Szelążek, M., Bobek, S., & Nalepa, G. J. (2022). BIRAFFE2, a multimodal dataset for emotion-based personalization in rich affective game environments. *Scientific Data*, *9*(1), 274.
- Nadj, M., Rissler, R., Adam, M. T., Knierim, M. T., Li, M. X., Maedche, A., & Riedl, R. (2023). What Disrupts Flow in Office Work? The Impact of Frequency and Relevance of IT-Mediated Interruptions. *MIS Quarterly*, *47*(4).
- Nah, F. F. H., Eschenbrenner, B., Zeng, Q., Telaprolu, V. R., & Sepehr, S. (2014). Flow in gaming: literature synthesis and framework development. *International Journal of Information Systems and Management*, *1*(1-2), 83-124.
- Rissler, R., Nadj, M., Li, M. X., Loewe, N., Knierim, M. T., & Maedche, A. (2020). To be or not to be in flow at work: physiological classification of flow using machine learning. *IEEE transactions on affective computing*, *14*(1), 463-474.

Recommendation:

- Knierim, M. T., Rissler, R., Dorner, V., Maedche, A., & Weinhardt, C. (2018). The psychophysiology of flow: A systematic review of peripheral nervous system features. *Information Systems and Neuroscience: Gmunden Retreat on NeuroIS 2017*, 109-120.