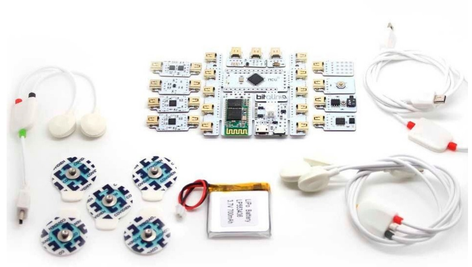
Prototypes of Arcade Games Enabling Affective Interaction

Paweł Jemioło, Barbara Giżycka and Grzegorz J. Nalepa
{pjm,bgizycka,gjn}@agh.edu.pl

Contribution

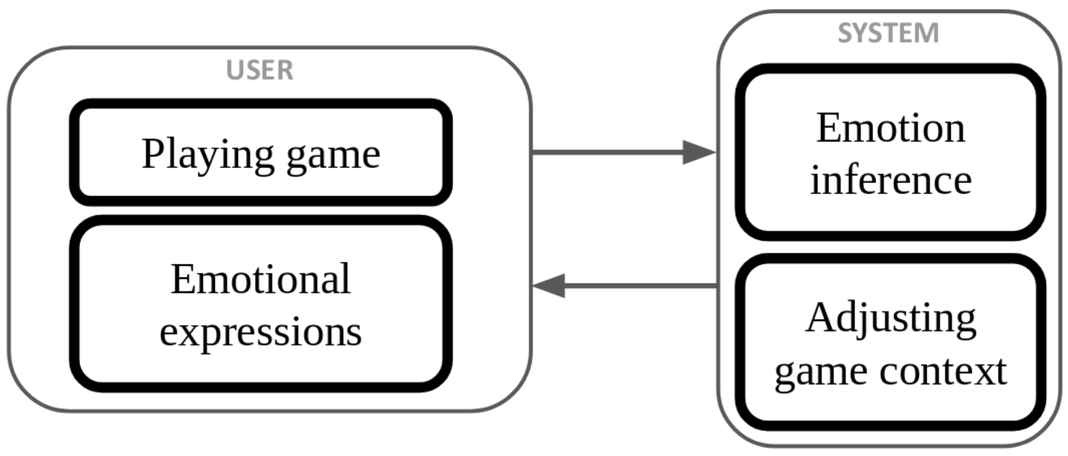
Affective Computing (AfC) is a paradigm of Human-Computer Interaction that aims at developing systems that rely on the information of human body [2] and current user context [1] in order to adapt to a specific user, in a specific emotional state. One kind of such systems are video games, which are one of the best areas of demonstrating AfC core concept - the Affective Loop. As our **main contribution**, we investigate the process of design and development of affectively adaptive games. For emotion inference, we use rule-based systems defined with linguistic terms, as well as physiological signals such as electrodermal, cardiac and muscle activity, measured with a non-medical device, to influence the game state. Moreover, we describe experiments that evaluate the emotional aspect of the prototypes, and provide a benchmark in the form of a survey. Our work follows our early ideas discussed in [3]. See also summarization of our works [4].

Hardware platform



Bitalino (r)evolution kit

Affective Loop

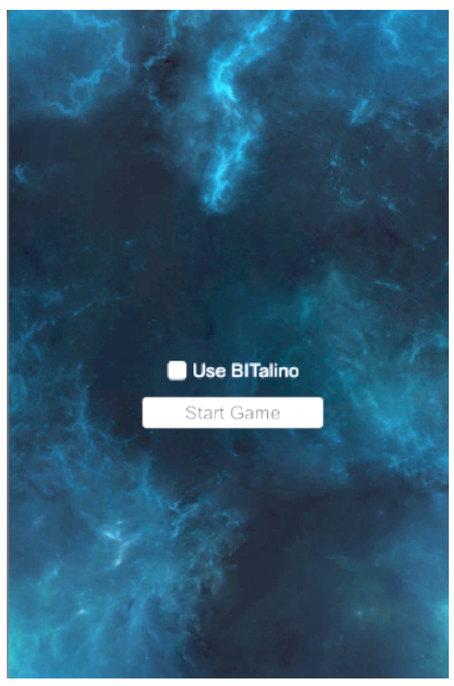


1. The user plays a video game.
2. The user's emotional state changes, according to the game content.
3. The physiological changes, accounting for the emotional state changes, are detected by the system.
4. The system processes the affective data, and changes the game content.
5. The system creates a new, changed game situation for the user.
6. The user can react to the new, changed game situation.
7. The loop repeats.

Measuring Procedure

1. Introduction.
2. Electrodes placement.
3. Calibration phase.
4. Affective version of the game.
5. Non-affective version of the game.
6. The form.

Affective Space Shooter



- Steering ship through asteroid shower.
- Calculation of baseline for signals.
- Using clenching fists to shoot.
- Adjustment of speed of asteroids using HR.
- Modification of background brightness using Emotional Index based on HR, GSR.

Freud Me Out

- Psychologically-based plot, multiple levels.
- Guidance improving explainability.
- Calculation of baseline for signals.
- Adjustment of speed of enemies using HR.
- Modification of randomness of spawning points using HR, GSR.
- *SuperPower* ability using flexion the two-headed muscle.

Conclusion and plans

In this work, we present architectures of working prototypes of affective games, based on the concept of the affective loop. We use rule-based systems defined with linguistic terms, and physiological signals such as electrodermal, cardiac and muscle activity. We presented metrics and methods used in a practical example of AfC application. We address concerns for personalization and explainability, by introducing a calibration phase to eliminate differences and a tutorial phase to extend explainability of integrated methods.

Future plans:

- Other engines besides Unity (Unreal, Godot).
- Mobile games,
- Extending signals interpretation, i.e. face recognition, HRV, etc.
- Enhancement of inference system using neural-networks and evolutionary algorithms.
- Integrating indirect behavioral feedback.

Evaluation of prototypes

Survey answers according to separate dimensions of form

	with AfC loop	without AfC loop	no difference
favourite mechanics	17	1	n/a
immersion generation	18	0	18
game level adjusting	15	2	19

References

[1] Abowd, Daniel, Dey, Anind, Orr, Robert and Brotherton, Jason. Context-awareness in wearable and ubiquitous computing. *Virtual Reality*, 3(3):200–211, 1998.

[2] Anttonen, Jenni and Surakka, Veikko. Emotions and heart rate while sitting on a chair. *Proceedings of the SIGCHI conference on Human factors in computing systems*, 491–499, 2005.

[3] Barbara Giżycka, Grzegorz J. Nalepa and Paweł Jemioło. AIded with emotions - a new design approach towards affective computer systems. *CoRR*, abs/1806.04236, 2018.

[4] Grzegorz J. Nalepa, Krzysztof Kutt, Barbara Giżycka, Paweł Jemioło, and Szymon Bobek. Analysis and use of the emotional context with wearable devices for g ames and intelligent assistants. *Sensors*, 19(11):2509, 2019.