**PlayAffect: A Platform for Using Physiological and Behavioral Measures to Create an Affective Feedback Loop for Video Games**

*Senior Project Poster Day 2013*
*Department of Computer and Information Science*
*University of Pennsylvania*

---

**Abstract and Motivation**

**Objective:**
To create an API that allows game designers to take advantage of physiological and behavioral data about users. The PlayAffect library for Unity 3D allows game designers to quickly and easily create adaptive and affective games that respond to player actions and physiological state in real time, using a sensor suite that records data such as respiration rate, heart rate, and galvanic skin response (GSR).

**Motivation:**
- To close the gap between developers and users, allowing difficulty to be customized to each player.
- To maintain an easy-to-use and adaptable interface that quickly integrates new research information regarding the physiological underpinnings of emotive response.

---

**System Design Flow**

- **Raw Sensor Data**
  - Data Pre-Processing (eliminating of noise)
  - C++/C# Pipeline
  - Basic Regression Analysis
  - Naïve Bayes Classifier
  - Developer-Used User Flags

---

**Architecture & Design Goals**

- A simple, easy-to-integrate API
- Created for an existing development platform
- Containing genre-specific information
- With multiple developer choices of significance algorithms
- Ready to integrate new training data from continued research feedback

---

**Study Results**

**Study Findings**

H0 (Null): Difficulty and performance statistics have no effect on the mean of the physiological measure of GSR.

H1: GSR is elevated during periods of concentration characterized by more difficult challenges, with each difficulty level representing a higher GSR than the previous.

H2: GSR is elevated during periods of lower performance, with GSR increasing as performance decreases.

---

**Screenshots**

- Here user is within physiological bounds and game reacts normally.
- Much higher skin conductivity was exhibited when players found gaming challenges harder.

---

**Hardware & Sensors**

- Thought Technology Ltd.
  - FlexComp Infiniti
  - Model SA7550
- Electrocardiogram (EKG)
- Galvanic Skin Response (GSR)
- Respiratory Sensor

---

**Future Work**

Based on findings from a short study conducted in the early stages of this project, it is believed there is room for further work in the following areas:

- Utilization of more robust machine learning algorithms such as density-based clustering (DBSCAN or OPTICS) to recognize additional user emotional states beyond the Bayesian calm/frustrated binary.
- Gathering of further data from users of games in separate genres from those tested, and from a user set more diverse in age.

---

**Conclusions**

- Adaptive API fully implemented, tested, and documented on Unity 3 and 4.
- Proof-of-concept model tested and showcased on demo game developed on the Unity platform.
- Initial training data gathered for two game genres, and two significance algorithms developed and supported: basic regression analysis and Naïve Bayes’ Classifier.