Project - The Game Cube®

Technologies for human-computer interactions

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1 Introduction

The goal of this project is to build a game exploring original human-machine interactions. For that, we used a galvanic skin response (GSR) sensor as the main mean of interaction and the `Blender` 3d software to create the game. In our project, we use the GSR data - which measures skin conductance - as an indicator for stress and arousal. The goal of the game is for the player to manage her stress level and relax.

2 Project

2.1 Sensor data

We started from the premise that the GSR sensor could be used as an indicator of excitement. Psychological arousal is linked with nervous activity that changes skin conductance. However, data from the GSR sensor isn't necessarily stable and skin conductance is subject to sudden changes (spikes) that doesn't reflect a general state of being.

In our game, we used a statistical analysis technique called **moving average** to smooth out the data. The advantage of the moving average is that it reduces the impact of spikes but still preserves long-term tendencies, similarly to a low-pass filter. This technique is usually used in finance and economy to represent trends over time, which is what we want with real-time acquisition of data. More precisely, we use a weighted moving average (WMA) which gives more importance to the oldest data and prevent influence from sudden spikes. It has the following formula :

$$\text{WMA} = \frac{n * p_n + (n-1) * p_{n-1} + ... + 1 * p_1}{n + (n-1) + ... + 1} \tag{1}$$

Where n is the number of data in a queue, p_x is some GSR value at point x in the queue and p_n is the oldest data in the queue. Our moving average is calculated for each new received data by adding it to a queue of size $n = 20$.

Here is an illustration of the smoothing done by moving average [1] :

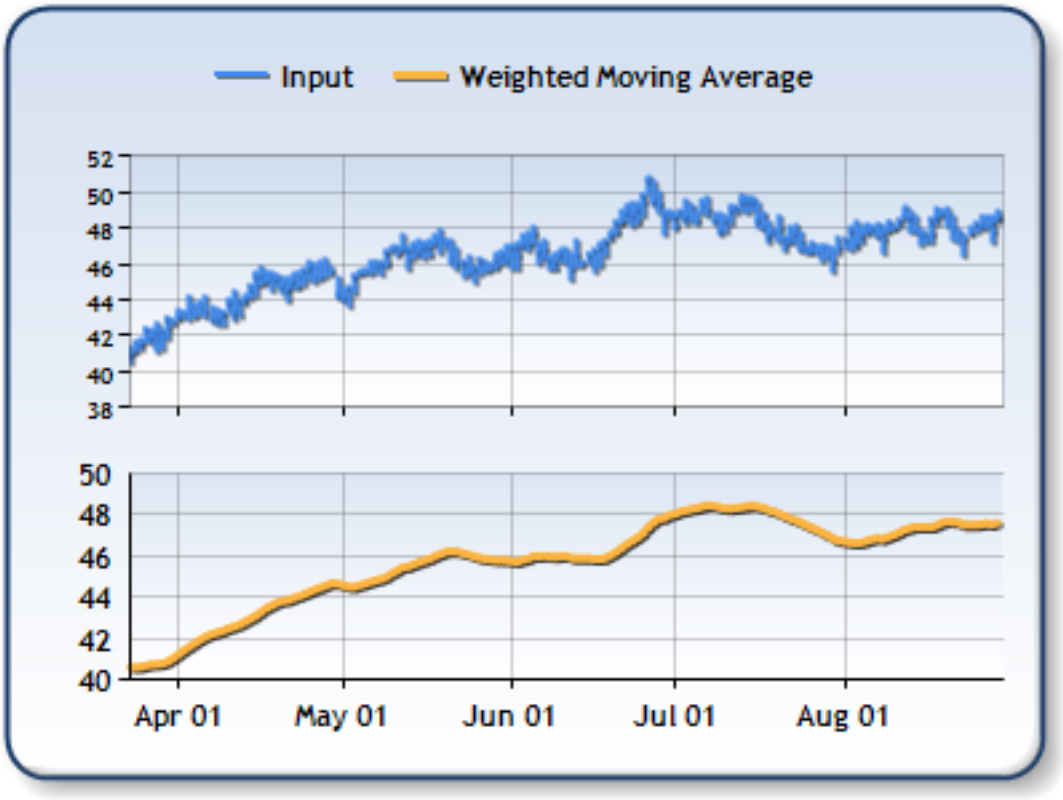

FIGURE 1 – Exemple of smoothing with weighted moving average.

The disadvantage of this technique is that there is a slight delay when trends shift, because the first few points do not have enough weight to influence the average yet.

2.2 Game design

The game consists of a cube rotating in the middle of the screen. The cube rotates according to the player's state. Getting excited results in a fast acceleration while being calm makes the cube slow down. By controlling her "emotions" (or at least her excitation), the player can then control the speed of the rotation.

The game has two modes of play. The first mode is

2 modes

relaxation mode no objective way to understand how game works how rythme works relax and sooth

1. Image taken from :
http ://support2.dundas.com/OnlineDocumentation/WinChart2003/WeightedMovingAverage.html

challenge mode, time limit, playing as long as possible win more time by completing missions once finished, score (calculated according to missions) mission types - slow down, not variate, etc randomized mission in a shuffled list (to prevent many repetitions) special events to distract player - jump scare

2.3 Blender

send data over socket

movement camera, cube HUD position

style

3 Evaluation

image jeu

objective : control emotions linked to stress

contrÃ´le du jeu - player input se calmer - peu Ãªtre facile... ou pas s'exciter en parlant - difficultÃ© jeu sans direct input

game plays better without player because point of game is to be stable (human hard to stay stable) (because excitement ; because sensor - transpiration ?)

with experience, understand how can manipulate arousal talking closing eyes focus on cube - can reduce - calm

4 Conclusion