Emotional movie: A new art form designed at the heart of human-technology interaction

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Abstract. Innovative art forms emerge along with the development of new materials for displaying multimedia content and the new possibilities for interaction with the spectator they offer. Interactive movie in one of them; It consists in providing a personalized content by interacting with the emotional state of the spectator. In this study, we define this new form of artwork and describe how it can be implemented by providing functional criteria that will determine how different parts of the movie will be connected to form a particular scenario. We measured neurophysiological and ocular activities of 60 subjects watching an experimental short-movie realized for the “emotional movie” project, composed of 12 different scenarios. We combined an electroencephalography headset which directly provides emotional data with an eye-tracker to investigate the simultaneous positions of gaze. From our results we propose that the emotional proximity between the scenario and the spectator could be a relevant selection criterion to customize the movie.

Keywords: EEG, Eye-tracking, Emotion, Interactive movie

1 Introduction

In recent years, technology development has been accompanied by the emergence of new forms of interaction with users. The combination of art contents and new display materials, which open opportunities for innovative interactions, has the potential to lead to new forms of art which would no longer be limited to content. An artist controlling the consumption of his artwork by the user who consumes it could better transmit its artistic intent; he would have an additional way to play on the emotions of the individual.

Interactive film, as we understand it, is an art form that aims to provide a personalized scenario to each spectator. The movie is cut into several coherent sequences whose adjustment determines the particular scenario which will be viewed. The sequences articulation – and consequently the resulting specific scenario – is built based on interactivity with the spectator, depending on its reactions. At certain moments of the film, called junctions, a sequence is selected from among several possible to assign the film a specific scenario. In the “emotional” interactive movie, the particular scenario selected for a spectator is based on a measure of his emotional activity, registered in a previous sequence. Consequently, the selection of a sequence at a junction requires: 1/ to have a means for directly measuring the emotional state of the spectator watching the movie, 2/ to have relevant criteria to define how this choice will be made (for instance: "The choice of the sequence is based on arousal: the chosen sequence is that with the potential for arousal closest to spectator status at a given time), and 3/ to determine on which sequence of the film the emotional state of the individual will be taken into account for this choice. For the latter, it is necessary to select sequences where the reactions of the spectators vary and not sequences that always trigger the same reaction, to use these differences to make the choice of a scenario.

In this study, we used an EEG headset to investigate emotional activity of spectators during the viewing of an interactive movie. These researches were conducted in order to provide relevant criteria on the basis of emotional activity, to choose which sequences will be connected at junctions to form the particular scenario that will be displayed. Electroencephalography is a cerebral exploration method that measures real-time neurophysiological activity through electrodes placed on the scalp. The analysis of the recorded signal tells us about brain processes at work [1]. This technology is typically used in medical applications. However, EEG devices intended for a broad audience have recently become available, handy to use and relatively affordable [2]. This is the case of the Emotiv EEG headset used in our experiment, which directly provides emotional data (Excitement, Frustration, Meditation, and Engagement) [3]. Based on these data, we could characterize the interchangeable film sequences by their average score on each of these emotional dimensions. In addition, we could define a selection criterion for assembling sequences: sequence connected at a junction is chosen because it is the closest to the spectator emotional state (recorded on a previous film sequence).

To determine the parts of the film on which the emotional activity that would lead to the choice of scenario would be recorded, we combined EEG device with an eye tracker. The eye-tracker records with cameras eye movements of a spectator, from which can be deduced locations on the screen where he looked [4]. The purpose in using this measure was to detect the film parts where the gaze activity was more varied among the spectators. Indeed, parts of the film where the spectators reactions are quite similar have only low power to discriminate and thus to determine which scenario assign them personally.

During the analysis of synchronous EEG and eye-tracking data we looked for times when a significant ocular variability occurred with significant emotional values. The corresponding film sequences were selected for recording emotional activity of the spectators, which determine the choice of scenario.

2 Materials and methods

In order to develop a first functional form of emotional movie, we conducted an experiment at the IVC laboratory of IRCCyN (Nantes, France). We combined EEG and eye-tracking so as to link emotional and ocular activities of the spectators of a prototype of emotional movie, which includes several scenarios. The objective was to establish clear criteria for choosing a particular scenario based on the spectator's emotional activity. In addition, we wanted to detect the most relevant movie parts for recording spectator emotional reactions – parts where the spectators' ocular reactions were the most different and the emotional reactions the most intense. The experiment will be explained in detail in the following section.

The movie used, "Mademoiselle Paradis", is a prototype made for the emotional movie initiative by Marie-Laure Cazin [5]. It lasts about 20 minutes (depending on the possible scenarios). It includes several possible concatenations, built at two junctions, corresponding to a total of 12 different scenarios. Four different sequences may be connected for the first junction (at 07: 32), and three for the second junction (at about 11:00, depending of the sequence previously connected). Outside of these sequences, the rest of the film is the same for all spectators. In our experiment, we worked on four fixed versions of the film, A, B, C and D; all possible sequences were seen by at least one spectators group.

A total of 60 people (33 males and 26 females) compensated for their participation by the University of Nantes participated in the experiment. The age ranged from 19 to 61 years, with an average age of 24,1 years. All participants had normal or corrected – with glasses or contact lenses – acuity. They were divided into four groups corresponding to the four presented versions of the film.

The experiment was conducted in a lab specifically designed and equipped for audiovisual quality assessments according to recommendation ITU-R BT.500. The film was presented on a 40-inch monitor. The screen resolution was 1920×1080. The participants were seated at a distance of 150 cm from the screen. We used an Emotiv EPOC headset [3] which has 14 electrodes. The sampling rate of the Emotiv headset is 128Hz. The headset is associated with a data analysis software which provides real-time values on five emotional dimensions: Short-term excitement, Long-term excitement, Meditation, Frustration, and Engagement. We used an SMI eye tracker to record the gaze of the human observers. The system consists of an infrared camera and two infrared light sources, one on either side of the camera. The eye tracker records gaze points (GP) at 50 GP/sec for each eye. A calibration of the system for a particular person is done using 5-points calibration screen.

3 Results

In this section, three parts of the analysis are discussed: analysis for EEG emotional data, analysis for eye-tracking data and a cross-analysis of EEG and eye-tracking data. Analyses were performed on 59 subjects for the eye tracker and 52 subjects for EEG (due to data recording problems) and focused on the description of the film shots (chosen as coherent units). Less than or equal to 3 seconds shots were excluded from the analysis. Only parts of the movie before the second junction (from which the final scenario is in place) were considered.

At first, we defined each shot in terms of mean emotional value from EEG recorded data for all participants. We considered "Short-term excitement", "Engagement" and "Frustration", but no "Long-term excitement" which is a simple smoothing from "Short-term excitement" nor "Meditation" which is the inverse of "Engagement". The results show differences for activation values of the three different emotional dimensions between all shots. Emotions conveyed by the shots are clearly different; so there is latitude for setting a quantitative selection criterion to determine on emotional base which scenario is chosen: we choose the scenario which is the closest to the emotional state of the spectator.

For this purpose, we described each unfixed sequences, corresponding to several shots, by the mean activation value for “Excitement” they generated. Then we created four categories by dividing into four groups of values our “excitement” data so that each possible sequence at a junction is within a different category. Category 1 includes mean activation values for “Excitement” between the minimum and -0.5; it corresponds to “Very low activation” category; Category 2 includes values between -0.5 and 0 and corresponds to “Low activation”; Category 3 includes values between 0 and 0.5 and corresponds to “Moderate activation”; Category 4 includes values above 0.5 and corresponds to “High activation”. Each sequence has been classified into one of these categories according to the mean excitement activation they generated on spectators. The mean excitement values for all the possible sequences (S) (determining their category membership) are as follows: at junction 1, S1=-0.69; S2=-0.27; S3=0.49; S4=1.61 and at junction 2, S5=-1.31; S6=0.02; S7=1.05. From this division, we defined the following selection criterion for connecting an unfixed sequence at a junction: “The selected sequence is the one whose mean activation for excitement match with mean excitement of the individual spectator watching the movie calculated and categorized in the same way”.

To determine on which parts of the movie the spectator’s emotional activity would be recorded for comparison with the excitement conveyed by the unfixed sequences that may be proposed to individualize his scenario, we crossed EEG and eyetracking data. First, we determined the movie parts where inter-spectator reactions measured using eye-tracking were more variable. For this purpose, we characterized each film shot according to the corresponding dispersion of the gaze points (GP, calculated as the average between the two eyes). The mean dispersion of GP per frame was calculated as the sum of the distances of each GP observers from the centroid divided by the number of GP. Dispersion per shot was calculated as the sum of the mean dispersions of each frame in the shot divided by the number of frames in the shot. Then we crossed mean GP dispersion and mean activation values for excitement for all the shots (see Fig. 1.). The purpose was to determine the parts of the movie with both high excitement intensity and important GP dispersion.

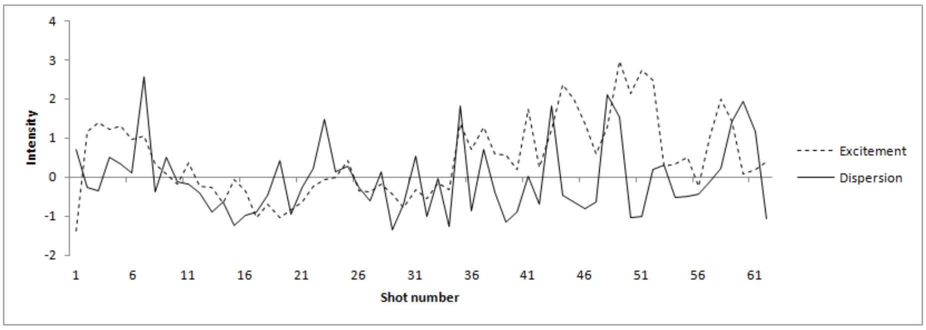

Fig. 1. Mean activation values for Emotiv EEG excitement dimension and mean gaze points dispersion along with shots according to their order of appearance in the movie (version A)

Selected shots for real-time emotional activity of spectators recording were those whose GP variability differed by more than two standard deviations of the mean (Sd=0, M=1, because the standardization of the data) and where the excitement corresponded to category 4 ("High activation"). Shots were as follows: for junction 1, the shot 7 (excitement = 1.06; dispersion = 2.57); for junction 2, shot 42 (E=1.37; D=1.83), shot 58 (E=1.29; D=2.11), shot 59 (E=2.98; D=1.53), shot 69 (E=1.43; D=1.41). Note that these shots are time-shifted for the other versions of the film (here they apply to version A) and therefore must be shifted accordingly. Thus, depending on the category wherein mean excitement of a spectator as measured by EEG in the shot 7 get into, the sequence connected at junction 1 will be the one belonging to the same category. Ditto for junction 2, for which the activity can be recorded on one of the following shots: 42, 58, 59 or 69.

4 Discussion

Our study allowed achieving a first functional adaptation of emotional film. We selected several film parts during which the real-time emotional reactions of a spectator is recorded. The artist may rely on emotional values obtained by a spectator on these parts of the film to choose to trigger a scenario rather than another to enforce his artistic intention. The choice of a scenario can also occur automatically, based on the criteria we have proposed: the sequence triggered at the junction will be the one closest to the excitement of the spectator. Of course it is possible to imagine other criteria for the emotional movie, and other types of sensor (e.g. Galvanic skin response, pupil dilatation). [6, 7]

Apart from our interest in the emotional movie, this study is exploratory in nature. It helps us to better understand the interaction between spectators and multimedia contents. In particular, we are interested in the link between memory and multimedia content. Emotional movie can open us interesting doors on interactions between memory, emotion and visual attention, especially to study effects of emotional congruence. Eventually, we are interested in the consideration of the inter-observer variability in predictive models of visual attention and memory.

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