Emotional platform for marketing research

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Abstract. In order to face new social and mobile realities, Marketing has advanced towards the reinforcement of customers' relationship based on understanding consumers' behavior. Emotions, having such an important role in our lives, are a key aspect on this behavior and should be incorporated in its analysis. We present in this paper a platform based on Affective Computing technology that allows marketers to gain insights of consumers' emotional response, facilitating them with a great tool to study and design their marketing strategy, and enabling the generation of better consumers' experiences. In this paper, we describe the design and implementation of the platform, as well as the uses cases that will allow the validation of the platform.

Keywords: Affective Computing, Marketing, Emotional recognition, facial expression

1 Introduction

Marketing is continuously evolving and adapting to the new realities of e-commerce, social media and mobile expansion. Understanding consumers' behavior is a key on designing a successful marketing strategy. Emotions play a very important role in our decision-making process or how memories are store or retrieve. Hence, a decisive factor on the behavior of the consumers are emotions and getting insights of the related emotions to our marketing strategy are very valuable.

Traditionally, the assessment of consumers' response towards a topic or a product has been performed from their self-assessment using questionnaires or following an interview. However, technology can provide valuable and objective information of this response, enhancing previous assessments or even discovering a new vision of those reactions.

In this paper we present a platform to analyze consumers' response to a product, an advertising campaign or a marketing outcome applying Affective Computing technology. From the recorded image of the user through the frontal camera of a mobile device or a webcam, user's facial expression is recognized and interpreted into an emotional state that provides valid information for the marketing analysis.

The platform will be evaluated on different scenarios that show the value of the gathered emotional information to analyze different aspects of a marketing strategy.

The presented work has been developed as part of the c-Space project[1], which aims to develop a new generation of creative tools to create unique experiences.

This paper is organized as follows. Section 2 presents the related work on the field. Section 3 details the platform including its architecture, the emotional recognition process and the developed tools. Section 4 describes several uses cases. Finally conclusions and future work are presented.

2   Related work

Marketing has evolved changing its focus from the product itself to the relationship with its customers [1], increasing the interest on analyzing users' attitude towards a certain topic or product. As a result, marketing performance can no longer be only analyzed in terms of sales and should incorporate metrics of consumers' satisfaction, communication and reactions. Designing a successful marketing strategy requires to predict and model the consumers' behavior, which is greatly influenced by their emotional state [2].

From the Human Computer Interaction perspective, Affective Computing aims to develop systems and devices that can recognize, interpret and simulate human affects. Allowing the development of systems that are aware of users' emotions, interaction with computers as we currently know can be highly improved [3]. Under this emotional vision of the interaction, several technologies have been developed to estimate the users' emotions. Such recognition can be performed from the multiple modalities that humans express emotions. Our facial expression is driven by our emotional state and there is universal evidence of its correlation [4]. The text that we write or the content of our speech contain emotional attributes, and in the latter, our voice presents several paralinguistic features related to our emotional state. Our body language and posture also express our affective state and several physiological signals haven been studied to detect emotions, such as monitoring cardiovascular, electrodermal or brain electrical activities [5].

Focusing on the marketing field, Affective computing brings plenty of possibilities to understand consumers' behavior because of the effect of emotions on the different consumption-related processes [6]. Affective state is used as a metric to determine the subjective opinion of the consumer with respect to a topic, as part of what is referred as sentiment analysis. Examples can be found of linguistic-based approaches [7] as well as including facial expressions and voice analysis [8]. Moreover, affective response to marketing stimuli is analyzed in the in-lab study of consumers' behavior, as part of the research field of neuromarketing [9], using several biometrics such as the heart rate, the galvanic skin response or the brain electrical activity.

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[1]   http://c-spaceproject.eu/

3 Platform overview

3.1 System architecture

The developed emotional analysis platform is integrated in the c-Space project architecture. **Fig. 1** shows the complete c-Space architecture where involved modules and services in the presented case are highlighted. In this way, a client mobile application was developed that makes use of the affective recognition module to estimate the user's emotional state and communication library to upload results to the server. The server offers its functionality through the c-Space REST API. In this case, the Content Access Infrastructure is used to retrieve and store multimedia content being presented as well as emotional information. Finally, a web application was developed that using the affective analysis tool allows the assessment of the experiments.
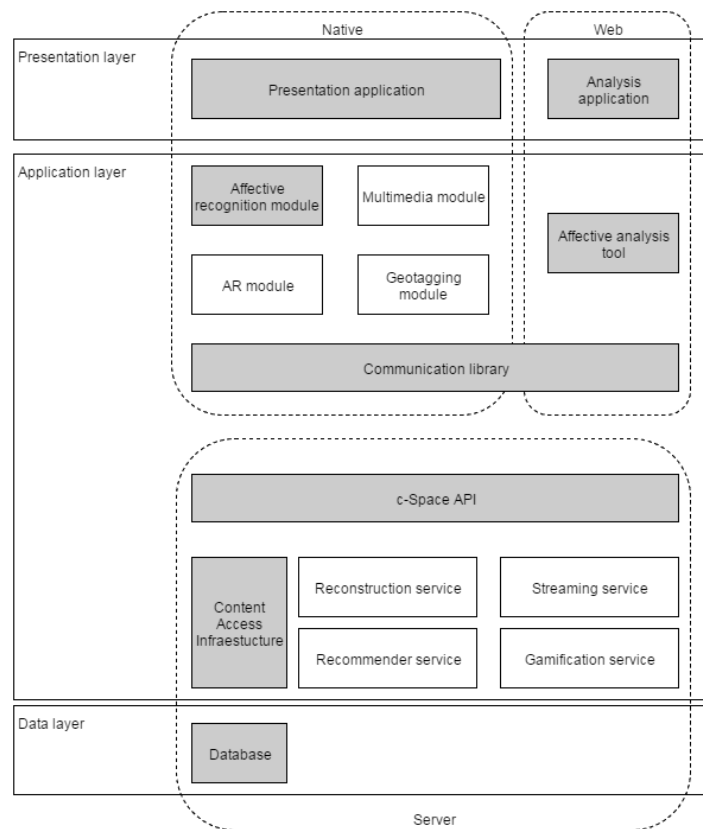

Fig. 1. c-Space architecture

3.2 Emotion recognition from facial expression

The developed facial expression recognition solution is based on Dornaika and Davoine [10] proposal for a simultaneous facial action tracking and expression recognition. This approach follows a two-step process. In the first step, the 3D head pose is estimated using an Online Appearance Model deterministic approach. In the second step, the facial expression features are estimated using a stochastic approach based on a particle filter.

As a deformable model of the face, a modified version of the Candide-3 model [11] is used for better performance in low-end devices. This model defines a set of faces and vertices, as well as different modifiers of those vertices based on the characteristics of each person's face (i.e. head size, mouth width, eyes width, position and separation) and the current expression (primarily involving mouth and eyebrow movements).

In order to calculate the 3D head pose, an incremental tracking guided by a region-based registration technique is applied. Given that, the current image is warped with previous pose and it is compared against the reference appearance model, which is based on a multivariate Gaussian with a diagonal covariance matrix of the pixel intensities of the corresponding region.

Thus, the current solution is obtained by minimizing the Mahalanobis distance between the warped region and the current appearance mean, which can be solved using an iterative gradient descent method, setting the previous solution as a starting point. It is also noteworthy that the parameters of the reference appearance model are updated with the current observation, i.e., they evolve dynamically (Online Appearance Model).

At this point the current 3D head pose and the updated appearance model are completed with the facial expression detected in the previous frame, which is considered relevant because it is assumed that for each basic expression class there is a stochastic dynamic model describing the temporal evolution of the facial actions. Thus, given all this information, the goal of this second step is to simultaneously infer the facial actions as well as the expression label associated with the current frame. In order to combine all this information, a particle filtering approach is used.

The key idea of this technique is to represent the posterior distribution of facial actions and expression state given the appearance model by a set of random samples (called particles) with associated weights. This technique is divided into two stages: particle generation and particle evaluation. In the first step, several samples of facial actions and expression are generated to simulate all possible solutions (each sample corresponds to a different particle).

Facial actions are perturbed using a second-order auto-regressive model, while expression is perturbed using a manually predefined transition matrix that defines the probability of changing from one expression to another. The particle evaluation step, in turn, is responsible of assigning a weight to each particle and selecting the correct one.

In this case, the weight of each particle is calculated by warping the current image according to the facial actions defined in the corresponding particle and comparing this warped image region to the reference appearance model. Due to the recursive nature of the particle filter approach, particles of the current frame are propagated using the particles of the previous frames.

3.3 Analysis tool

In order to inspect the emotional response of the user towards the marketing stimulus a visual analysis tool was developed. To allow gathering a richer insight of the consumer's emotional response different components of the affective state of the consumer are presented: i) a continuous affect represented in a bi-dimensional space of valence and arousal, ii) recognized prototypical emotional episodes categorized in 7 basic emotions (happiness, anger, disgust, sadness, fear, surprise and neutral), iii) mood, understood as a diffuse affective state of low intensity but relative long duration. **Fig. 2** presents an image of the real-time monitoring of the consumer's emotional state where continuous core affect is represented by a line graph on the top, prototypical episodes by an histogram on the left and mood by its position on the VA dimensions on the right.
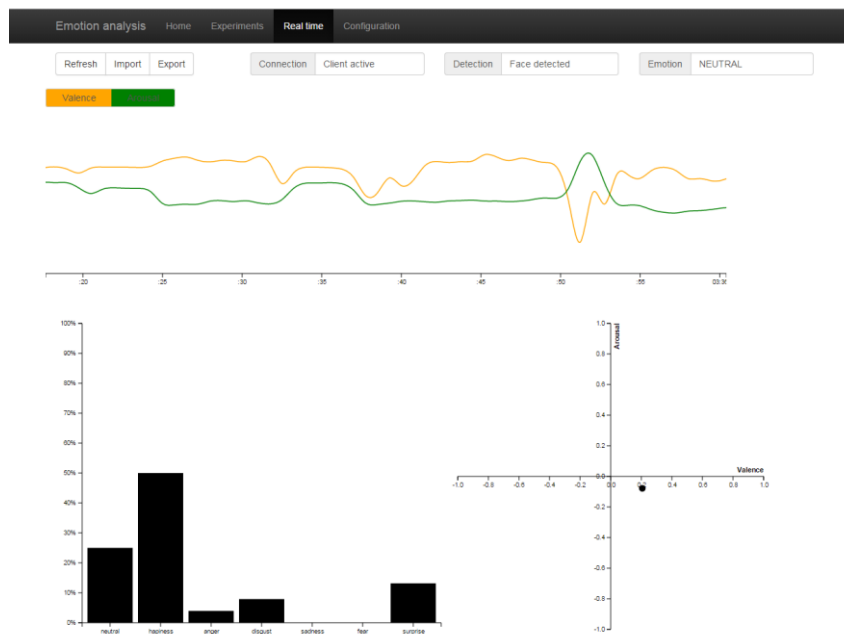

Fig. 2. Emotional analysis tool

The analysis tool allows to define experiments where a single content can be evaluated or comparisons can be established between different products or scenarios. Having performed the experiment with multiple consumers, the tool allows to visualize their combined response during the duration of the marketing content or as an accumulated value. Moreover, results are aggregated based on consumers' demographical information, allowing the user of the tool to study the differences between consumers' profiles.

4 Use cases

The effectiveness of marketing is related to a two-fold process: first the ability to create a specific feeling or opinion about a topic, then the ability to use that opinion to induce a specific behavior. The scope of the uses cases is to further explore and research the role of human affects in a purchasing decision and the extent to which emotions are affected or influenced when the audience is being immersed in a given environment or is being exposed to specific pictures or scenes: what is the emotional response to a given stimuli? How does this response evolve over time? Is the opinion globally the same inside the target group or are there different responses to a similar scene? To which extent is the purchasing process rational versus emotional? What is the impact of emotions on the purchasing behavior? What are the requirements for the entire decisional process to be completed and which external factors can influence the decision?

4.1 Advertising campaign

Marketing is an industry where novelty and innovation are playing a key role. Affective computing allows to investigate the point when viewers begin to tire of an advertising campaign, that is to say the point when further displays of the same marketing content will not only raise less attention and interest but also start inducing negative emotions. In some cases, the fatigue is related not only to the campaign but to the product itself, the design and branding of which should then be modified. Marketers and designers are therefore continuously trying the find the right balance between getting the most of their work by making it last and avoiding to offer something not enjoyable anymore to the customer, who will start feeling bored or even annoyed.

By measuring emotions expressed by a same panel of viewers over time, the platform supports decision makers in determining the timing after which a given visual should be changed as well as the effectiveness of the rebranding exercise which is being undertaken. The metrics provided by the system are feeding the decision to change something which may be well-known and efficient but also perceived as wear-out or not in line anymore with the expectations and the global "mood" of the targeted end users. The path followed by the Luxembourgish company Airboxlab illustrates this necessary process. After launching their connected indoor air pollution monitoring device, thanks to a focus group experiment, they could see that the name and design of the product were not considered appealing anymore in the long run. Moreover, the red lights triggering on the device when pollution was detected, as well as the global promotional campaign, proved to be deterrent in terms of product acquisition. They were anxiety-generating, when the emotion expected to be derived from the product in contrast was an increased feeling of security, inducing comfort and well-being. In the perception of the product, many details appeared to play a key role including the dominant colors being chosen for the campaign. A blue background had a calming effect while red or black tended to be associated with anger or fear, contributing to generate such emotions.

Fig. 3. Initial vs redesigned product campaign

4.2   Price negativity

Beyond comparing the impact of different campaigns and designs over time, the emotion analysis platform can be used to compare the perceptions and feelings induced by a specific campaign or offer among different communities of stakeholders. Groups of end users from different countries are invited to interact with the same online marketing content. Reactions are being monitored and the results of the tests are communicated to the entrepreneurs. In some cases, a specific step during the purchase procedure is being perceived by the potential client as a negative "event" arising in the process. That is reflected as a peak or change in the graphs generated by the emotion analysis system. This is often related to the disclosure of the price to the customer. That emotion is not utterly out of the control of online marketers, who can make modifications not only to the pricing itself, but also to the way it is being displayed to the customer. Research indicates for instance that "prices are obviously important in consumer decisions but whether the price is seen before or after the product seems to change the way the product information is processed.

With the support of the emotional platform, marketers can test different processes online and optimize their product and price information, as well as the way those are being disclosed to the final client. Comments and feedback are being sought in case of divergent views among the communities of clients to better understand the context and the reasons why an offer is not leading to a sale and the tests are typically being performed on different geographical markets. The results allow to detect cultural specificities and differences of opinion in terms of product's perception. The value and features of a specific product can thus be adapted to expectations on a specific foreign market if the local clients tend to express surprise, sadness, disgust or anger when a specific offer is showcased, while the national consumers tend to be happier or neutral.

4.3 Technical products

Advertising is at the crossroad between the provision of information about a product (news) and the induction of pure emotions and desires (art). Where to put the cursor is not an easy decision for marketing departments, especially when having to promote highly technical products. In order to efficiently promote some wood scanning machines for instance, to which extent should the emphasis be put on the functionalities of the machine and to which extent on the global industrial process, including the quality of the final output? Which combination between the two is likely to produce the best results in terms of marketing? Recording of emotions while performing technical demonstrations to clients and when performing less product-oriented campaigns allows to compare the two approaches and find the right balance. Tests performed with video material from LuxScan Technologies and the marketing department of its mother company Weinig demonstrated that industrial engineers, though highly interested in the technical performance of a given machinery, were also touched by a broader message, highlighting the value of their work and the beauty of the final products. It is therefore relevant for industrial marketing departments to produce a very wide range of marketing material, promoting brands in a generic way to create a positive image about their firm but highlighting as well the technical innovations embedded in their products and their enhanced performance versus competition. The emotional analysis platform can provide a very valuable measure to find the correct balance between both approaches.

4.4 Novel interfaces

Last but not least, affective computing allows to understand to which extent the emergence of new displays in particular is having an impact on the perception of a campaign by the final end users. Marketing is fast changing, in line with the emergence of new media and consumer-oriented ICT technologies. The monitoring of emotions when the people are interacting with street furniture, augmented content and immersive environments allows to understand to which extent those new tools are enhancing the impact when being introduced in a campaign and to which extent they are perceived as complex or intrusive by the consumers, creating new challenges to overcome for the advertising sector. Beyond marketing and advertising, the emotion recognition system provides information on the way people react to a changing environment and more or less easily adapt to the emergence of new technologies. In a number of market segments, such as smart cities, smart homes, educational tools and entertainment, the use of emotion recognition in combination with new hardware offers a strong testbed for emerging services and consumer applications. Affective computing thus supports and enhances innovation and transformation in a number of industries, paving the way towards a world where the frontier between virtual and real environments is expected to be more and more blurred, and providing key information about the market readiness of emerging concepts in terms of consumer acceptance.

5 Conclusions

Understanding consumers' behaviors, attitudes and sentiments can provide a relevant tool for marketing, and what is more important from the consumer point of view, lead to better customer experiences.

In this paper we presented a platform based on Affective Computing technology, that being easily incorporated in the marketing evaluation procedures can provide valuable information of the consumers' emotional response. From the image of the consumer's face recorded for example by the frontal camera of a smartphone, the platform estimates a rich emotional state of the customer, allowing the marketer to gathered information of how a product or an advertising campaign is perceived.

Four different scenarios have been envisioned where the developed platform can provide very valuable insights of the consumers' behavior: i) evaluation of an advertising campaign, ii) study of perceived price negativity, iii) balance of technical content and iv) analysis of novel interfaces effect. The evaluation showed the capability of the platform to provide marketers with an effective tool on analyzing consumers' behavior.

The on-going project is starting its evaluation phase, where the presented platform will be validated in the context of the presented uses cases. Future work will be focused on extending emotional recognition from other modalities of emotional expression and on incorporating further analysis tools to allow marketers to share and compare collected information, enhancing their knowledge on consumers' behavior.

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