Emoticon-based Feedback Tool for e-Learning Platforms

Tarek Boutefara (*)(**)

(*) Computer Science Dept,
Faculty of Exact Sciences and Computer Sciences,
University of Mohammed Seddik Benyahia,
Jijel, Algeria.

(**) Doctoral School STIC,
National High School of Computer Sciences,
Algiers, Algeria.

t_boutefara@esi.dz

Latifa Mahdaoui (***)

(***) RIIMA Laboratory,
Computer Science Dept
USTHB, Algiers, Algeria

lmahdaoui@usthb.dz

Abstract
Emotions are strongly related to cognitive and perception process, this is why learner emotional state can easily affect his learning performance. Detection and recognizing learner emotional state is a very recent and active research field. In this paper, we propose a simplified vision to the emotional state detection; we try to avoid existent complex approaches by counting on the today user habits like as participation and feeling sharing habits strongly present in social network and web 2.0 concept in general. The result is an explicit system to allow learner to express his emotional state during a learner session.

Key words : *Affective computing, emotion recogniation, Web 2.0, Moodle, Emoticon.*

1. Introduction

Emotion is a very complex notion, yet everyone senses it every day. It's very difficult to elaborate a universal definition for emotions [1]; every thinking school has her own vision. The most known and used visions are James-Lange theory and Cannon-Bard theory [1].
James-Lange theory is one of the first emotion theory during the 19th century by Wiliam James and Carl Lange. This theory sees the emotions as the awareness of a physiological response to an emotion-arousing external stimuli. In other words, when an external event occurs and stimulates the person, the automatic nervous system reacts by a set of physiological changes (heart beating, respiration rhythm, blood pressure, etc.); the person's brain will, then, interprets these changes and the result of this interpretation is what we call emotion [1][2].
Cannon-Bard theory is another interesting theory of emotions in psychology. It was proposed in the late 1920s by Walter Cannon and Philip Bard. This theory says that the external event (stimuli) triggers simultaneously the arousal (physiological changes) and the person's experience of emotion [1][2].
In our context, both visions are acceptable : the time between the physiological responses and the brain's interpretation is so brief, it doesn't really affect online user experience. What we should maintain is :

1. Emotions appear as a reaction to external events; an event, in this context, is every environment change. Therefore, it is possible to conceive and build systems capable of inducting a particular emotion to users [3].
2. Emotions are characterized by a set of physiological changes. Therefore, it is possible to conceive and build systems capable of detection and identifying the user emotional states [4][5].
3. Emotions are strongly related to cognitive processes; the perception of the event, the choice of a reaction and the physiological state are related and can interfere with the basic cognitive processes [1][4].

These elements make of the emotion processing a natural progression in the Information Technology and Human-Computer Interfaces studies. Twenty years ago, R. W. Picard was the first to build a foundation for this progression in a research paper entitled "Affective Computing" which will constitute a roadmap for two decades of research on emotion detection, recognition, processing and modeling [4].
Picard found that *the essential role of emotion in both human cognition and perception, as demonstrated by recent neurological studies, indicates that affective computers should not only provide better performance in assisting humans, but also might enhance computers' abilities to make decisions* [4].
She justified this key affirmation by displaying

different examples and discoveries achieved about emotions in the last century. Then, she illustrated the potential applications of an effective emotion detection and recognition in different fields such as entertainment, Video/Film industry, e-Learning, environment and wearable computers [4].

In e-Learning, emotions take a particular importance for two main reasons [4][6][22]:

1. E-Learning is, as simply defined, the use of new information technologies to achieve learning and education activities; in which, cognitive processes, and by consequence emotions, are very important.
2. Distance learning, and in particular e-Learning, eliminates face-to-face communication; therefore, all nonverbal communications are lost.

The importance of emotion processing and the weakness of communication means (compared to face-to-face communication) provided by actual e-Learning platforms make the proposition and development of new approaches and techniques a priority of a particular interest.

One of the main task to achieve is the emotion detection and recognition. In fact, if the system is able to precise the learner emotional state during a learning session or activity, the tutor (human or automated system) could be able to provide a better learning exeprience [4][7].

To detect and recognize the emotional state, two types of approaches are widely used :

1. Using the physiological signals : these approaches try to exploit the physiological signals which are necessarily (see the definition of emotions) associated to each emotion to recognize it [5].
2. Using cognitive traces and productions : these approaches try to exploit different cognitive traces left by the learner during a learning session; In fact, emotion can strongly affect the cognitive processes such as attention, decision-making and memory; these processes are implied in every trace (choice of words, degree of memorization, attention tracking, etc.) [8].

The main disadvantage of these approaches is their complexity. In fact, these systems make call to Artificial Intelligence or Classification and Clustering techniques to be able to process all inputs which are generally complicated (facial expressions, recorded speech, heart beating, blood pressure) or non structural (comments, blog entries, chat messages) [5][8]. Their performances depend on the additional sensors and the quality and the size of the machine learning databases used.

In general context or specialized systems, this advantage is not perceived. But, we think it becomes a very difficult barrier to overcame when it comes to upgrade an existing e-Learning platform that is a complicated system itself.

In this article, we propose a different approach to recognize the emotional state of the learner : the explicit emotional feedback. In fact, the two types of approaches try to detect and recognize the emotional state of the learner without an explicit expression from him and, sometimes, without his knowing at all. Our approach supposes that the learner may decide to express explicitly his emotional state.

It is organized as follows. Section 2 displays a literature review and related works with a particular focus on e-Learning context. Section 3 provides a detailed description and conceiving process of the proposed solution and describes a prototype implementation of the proposed solution. A summary and closing remarks conclude the paper.

2. Related works and literature review

Emotion processing in e-Learning aims to provide a better learning experience to the learner. It is justified by the strong relation between the emotional state of the learner and his performances [7][9][10].

Emotion state is used as an adaptation parameter. The learning adaptation uses interpersonal differences and personal preferences to provide a personalized learning experience for each learner [11][12]. The use of emotional state can be in two principal ways [13]:

1. Real time adaptation : the objective is to adapt the content, navigational structure or presentation mode of the current learning activity content.
2. Cyclic adaptation : the objective is the exploit collected data during learning activity to adapt the content, navigational structure and presentation mode of the next learning activity.

While the first way is simple and intuitive in a face-to-face learning mode, it becomes more complex to achieve in distance learning [16]. The real time characteristic and the multi-client nature of e-Learning platforms make this task impossible without full automation of parameter detection and content adaptation [14]. In the other side, the adaptation in the second approach can be guarantee by a human user (human tutor) if the required parameters are collected [12][13].

The emotional state can be seen as one of adaptation parameters; the first step in processing emotions is to detect and recognize it [14].

The facial expression detection approach is one of the most defended approaches [5]; most defenders state that "*The most expressive way humans display emotions is through facial expressions*" [16]. The generic proposed process is divided to several steps [15] : (i) Acquire the user image (ii) Track the face expression (face localization, border detection, eyes

detection) (iii) Recognize the facial expression (iv) Reduce data (reduce images data to correspondent numerical vector) (v) Expression classification. This technique can guarantee a real-time emotional state detection and course adaptation; but it requires a complex system, large computing resources and additional equipment [15][16].

Speech based detection approach is another important approach [5]. The speech is able to express emotion in an explicit (linguistic) message and an implicit (para-linguistic : speed, tone, errors) message [5]. The conceived systems focus on speech features [17]: (i) Fundamental frequency (mean, median, standard deviation, maximum, minimum, range (max–min), linear regression coefficients, vibrations, mean of first difference, etc.) (ii) Energy: mean, median, standard deviation, maximum, mini-mum, range (max–min), linear regression coefficients, shimmer, etc. (iii) Duration: speech rate, ratio of duration of voiced and unvoiced regions, and duration of the longest voiced speech (iv) Formants: first and second formants, and their bandwidths. Like the facial expression approach, the speech based emotion detection can guarantee a real-time detection and course adaptation; although a system using this approach is not less complex and resource consuming than facial expression detection based systems [5][17].

Physiological signals based approach is the third approach in the most used and supported approaches [5]; it was used by Rosalind W. Picard in many research projects [19][20]. Many works and many systems have been built; every system uses its own physiological signals; as an example, [21] have choosed : EEG sensor (measures voltage fluctuations from electric variations within the brain's neurons), ECG sensor (measures heart's electrical activity over a period of time, ECG signals can be interpreted as the heart rate in beats per minute) and eye tracking sensor (a device for measuring eye positions and eye movement). Systems using this approach shares the same characteristics of systems using the facial expression detection technique or the speech detection approach; they allow real time processing, complex and require large computing resources; but they are beleived to be more precise [21][26].

These three techniques try to exploit physiological aspects related to the learner emotional state; other approach try to use cognitive traces and production to "determine" it.

The main approach is the text based detection and recognition approach. The principle is to exploit different texts left by the learner emotional state [8]. The detection process is divided into several steps [8]: (i) Data source identification (ii) Text pre-processing (iii) Emotion model development (iv) Post-processing (v) Results.

A derived approach from the plain text based approach is the emoticon based approach. An emoticon is any of several combinations of symbols used in electronic mail and text messaging to indicate the state of mind of the writer, such as :-) to express happiness (British Dictionary definitions for emoticon). The main idea is that people have, over years, found a way to use textual signs as a facial expression support [22]. That's why [22] define emoticons as "*visual cues used in texts to replace normal visual cues like smiling to express, stress, or disambiguate one's sentiment. Emoticons are typically made up of typographical symbols such as ":", "=", "-", ")", or "(" and commonly represent facial expressions*". The most process to achieve this task is divided into the following steps [23]: (i) Emoticon detection in input (a database of emoticon symbols must be used) (ii) Emoticon extraction from input (using regular expression) (iii) Emotional state calculation (using statistical approach) (iv) Final result. The emoticon processing can be associated to a text based detection approach; in this case, the emoticon detection and extraction must be done before any text pre-processing : almost all text pre-processing techniques and algorithms (lemmatization, stemming, stop word elimination) will look at emoticon sequences as insignificant or as stop words [22].

The main advantage of these approaches is the relative simplicity compared to the previous ones. Although, their precision depend strongly to the machine learning databases used. Consequently, we can build small and fast and less precise systems or large, complex systems but more precise.

The main disadvantage is the impossibility to achieve real time adaptation using these approaches. By definition, the main source of emotion detection data is the different texts left by the learner ***AFTER*** the learning session [8][26].

Many works have been achieved on different approaches and many good results have been obtained. Therefore, we have, today, a better comprehension on the emotional behaviour of learners in e-Leanring context. But, we can extract two common disadvantages of all cited approaches :

1. The built systems have been a huge success, but as standalone systems, fully independent systems or new e-Learning platforms built from scratch [25]. As an example, the ability of integrating of a facial expression based system into an existing up and running e-Learning platform is questionable. First, the hosting of the Artificial Intelligence data (neuron network mostly) is problematic : a server side hosting may overloads it (hundreds or thousands of connected and learners), and a client side hosting require additional software to be installed which limits the mobility of the learner and directly be contradictory with one

of the most important basics of e-Learning. Second, the capture software has to be wisely conceived : as a part of the e-Learning platform which require a strong coupling between data structures used by the two systems, or as an independent, stand alone software to be separately installed and configured which may be difficult for learners.

2. The presented approaches try to detect and recognize the emotional state of non aware learner; the concept is to allow the learner to focus entirely on his learning activity. This concept can be questionable and cannot be taken as universally true for every learner and every situation. Frustration, as an example, can push the learner to stop and give up his learning activity [20]; in this case, we can consider that the learner is self-aware and he knows that he is frustrated (and that is way the use of emotional questionnaire is justified) and can (and want) to express his frustration; in a larger web 2.0 vision, the absence of an explicit channel to allow the learner to express his emotional state is not justified [24].
3. The universality axiom for used parameters is, in fact, questionable. For the text based approaches, the universality is impossible because of the huge differences between human natural languages. In the same way, the cultural and environmental elements can affect the physiological aspects [27].

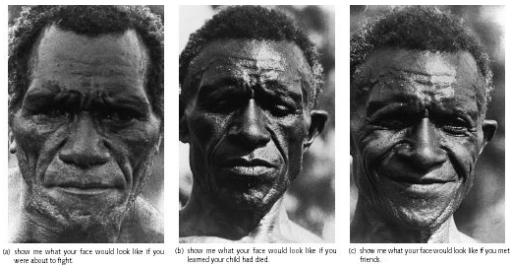

Illustration 1: Universality of facial expressions challenged [27].

Starting from these critics, we have tried to elaborate an acceptable solution to detect and recognize the emotional state of the learner.

3. Proposition

Starting from the review of the literature and related works and other recent practices on the web, social network and web 2.0, we propose a different approach (a third one) by allowing the learner to explicitly express his emotional state. We propose to conceive, build and use an emoticon-based live feedback tool to express emotional state.

3.1. The use of emoticons as a recent pratic in web 2.0

In a web 2.0 context, we believe that the content is not only made by website authors; users are also implied. That's why we talk today about "user participation" [24][27]. Users are allowed to comment and evaluate an existing content, or to create and share their own content [27]. Social networks are the finest example of the user content model : their entire content is created, managed and structured by thousands and even millions of users. Today users are very familiar with sharing their feelings, activities and experiences [27]. Thus, we believe that giving the learner an explicit way to express his emotional state is very interesting.
Emoticons can be seen as a comprehensible, emotionally significant almost universal text. Their advantage is their independence of the natural language [22]. Their relation to the Internet and web context is very strong; they are being widely used on forum comments and chat messages [22]. Today, they make part of the daily communication and are used in everyday marketing and even art :

Illustration 2: Art painting about negative facebook influence (the "Like" word and hand sign are considered comprehensible).

The explicit emotion expression using emoticons is more and more used on websites. Many providers are on the market and make different offers in relation with emotional data collection and analysis.

Microsoft Developer Network :

Every MSDN technical article has an evaluation form. The objective is to gather personal evaluations of the current article. The new thing, compared to other star based evaluation forms, is the use of the word "helpful" which gives an emotional dimension more than "rate this article".

Illustration 3: MSDN evaluation form.

Vicomi :

The main goal of this system is "*With one click, the Feelbacks voting platform increases engagement and makes it easy for readers to interact with your content.*"
The user can express his emotional state using a dedicated form; this form can easily be integrated as a floating box which appears following a click event. The counters will keep trace for every expressed emotion. All data are saved on the provider servers.

Illustration 4: Vicomi emotional state form.

GetSmiley :

GetSimley is a very similar system to Vicomi; his form is easily integrable to web pages, email and framework templates. It saves data on provider server; They are used to generate significant and *easy-to-read* reports.

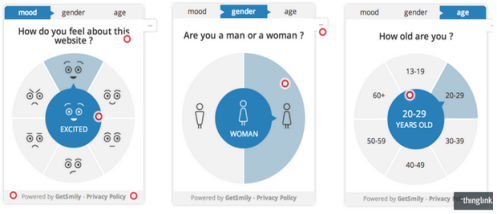

Illustration 5: GetSmiley reports.

These systems are very simply integrable in all sorts of websites and web applications including e-Learning platforms. The size, interaction mode with the user and the abilities of today Javascript APIs make it very easy to integrate the feedback banner as a fixed banner, floating div or hidden div which can be displayed by clicking a simple button; no major changes in user interface or data structures are required.
General emotion detection does not focus on a particular user; it tries to collect as many feedback as possible from different users to be able to run a global analysis. It aims to :

1. Allow the website to improve its content,
2. Allow the website to follow the global tendencies of its users,
3. Allow a better comprehension and understanding of user preferences.

In spite of the fact that these systems are very interesting as examples of online user self emotional state awareness proves, they are not directly useful for e-Learning context for the following reasons :

1. The use for one specific emotion (satisfaction) or for a global emotional model; in an e-Learning context, we aim to focus on academic emotion [19].
2. The global analysis principal is very interesting, but we aim to adapt their online learning experience for each learner, thus, we need to focus and follow the emotional state and its changes for every learner [4].
3. Sharing learners data with a third part providers is, also, questionable. The collected data is forcely not anonymous and sharing it can be seen by learners as a violation of their private life rights.

Taking these advantages, we have decided to build our own emotional based feedback system to be integrated to an up and running e-Learning platform.

3.2. Application : Moodle plate-form

Moodle is one of the most used e-Learning platform. Moodle is Open Source and with a large and active community of users and developers. Moodle "*is a learning platform designed to provide educators, administrators and learners with a* ***single robust, secure and integrated system*** *to create personalized learning environments*".
Unfortunately, the main weakness of Moodle is the poor documentation. Despite the fact that Moodle is largely used in academic and research context, there is no formalization of the concepts and approaches using to conceive and develop it.
Moodle is easily extensible thanks to block developement model.
A block in Moodle vision is a screen zone which can be positioned in the left or the right panel and can be used to provide services which are not already implemented. The new services can affect the current page, the current course, the current user account and they can be global (independent from the user). Some global services are already proposed (as timer and clock) and available to free download.
On the documentation side, blocks are, like other Moodle components, poorly documented. All we can find is building and configuring tutorials which are purely technical articles.

3.3. Our system

Going this far, we have all we need to start building our system.
Our theoretical foundation is the "academic emotion", which are emotions highly predicted in an e-Learning context [19].

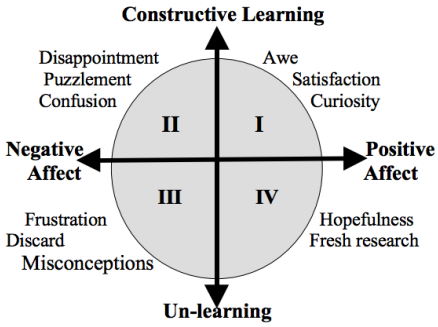

Illustration 6: Kort's learning spiral model [19].

Our system architecture is built on similar systems (Vicomi and GetSmiley). A form is made available for the learner to express his emotional state. A major and important difference is the saved data : in our system, collected data are saved on the same system (the same Moodle database). Despite the lost of the ready-to-use reporting systems, we have made this choice because we think that the privacy of learners data is more important.
The technical implementation of our system takes the shape of a Moodle Block with a "current page" scoop; the learner can show his emotional state for every page separately.

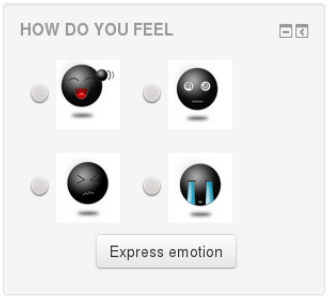

Illustration 7: Our Moodle block.

4. Conclusion

In this paper, we have proposed a third approach to detect and recognize the learner emotional state during a learning activity. The emotional state is strongly related to the cognitive processes such as memorization, decision-making and attention. This is why emotions are considered a major key to provide a better learning experience and to achieve a better course adaptation for each learner.
Our approach took, as a starting point, three major conceptual critics for the existing detection and recognition systems. First, our approach consider the learner as self-aware and able to express his own emotional state. Second, our approach tries to be more universal using emoticon concept which exists and is universal on the Internet and the World Wide Web. Finally, our approach aims to be less complicated on the technical side.
The proposed emotional based feedback system is a natural result of the adaptation of existing and recent web 2.0 approach in an e-Learning context. The proposed system is implemented as a Moodle block. Moodle is an Open Source extensible e-Learning platform thanks to the block notion.
The proposed approach needs to answer two very important questions. (i) Will learners consider it sufficient to show and share their emotional state? (ii) Is it to simplified system compared to a complex notion such as Emotions?
Two answer these questions, our next pressing step is to run a real life experiment to evaluate system performance and to recover learner impressions about it. The experiment needs a group of learners in an online learning session; emotional data will be collected using (i) A classical system (facial expression based detection and recognition system) (ii) The proposed system. The two sets of data will be compared for different aspects (size, quality, usability and correspandence). After the learning activity, the learners will be invited to answer a questionnaire about thier actual emotional states; the analysis of the answers will allow us to determine the performance of the proposed system.
Depending on the obtained results, we will try to exploit the proposed system as an adaptation tool in an existing e-Learning platform. In fact, being part of the e-Learning platform will allow us to extract benefit of the powerful sets of tools, technologies and standards (indexing services, description standards, instructional design standards and inter platform services) available on it.

References

[1] Kevin Smith. *Emotions*. 3600 Workman Mill Road Whittier CA 9060.

[2] Bruce H. Friedman. "Feelings and the body : The Jamesian perspective on autonomic specificity of emotion". *Biological Psychology*. 2010, vol 84, p. 383 - 393.

[3] Erik Geslin. *Method of induction of basic and complex emotions in video games and virtual environments*. 2012.

[4] Rosalind Picard. "Affective Computing". *M.I.T*

Media Laboratory Perceptual Computing Section Technical Report. 1995, vol 321.

[5] Zhihong Zeng, Maja Pantic, Glenn I. Roisman and Thomas S. Huang. *A Survey of Affect Recognition Methods : Audio, Visual and Spontaneous Expressions*. Nagoya, Aichi, Japan: 2007.p. 126-133.

[6] Som Naidu. *E-Learning : A Guidebook of Principles, Procedures and Practices*. Commonwealth Educational, 2006.

[7] Calkin Suero Montero, Jarkko Suhonen. *Emotion Analysis Meets Learning Analytics – Online Learner Profiling beyond Numerical Data*. Koli Finland: 2014.p. 165-169.

[8] Haji Binali, Vidyasagar Potdar. *Emotion Detection State of the Art*. Pune, Maharashtra, India: 2012.p. 501 - 507.

[9] Kerry O'Regan. "Emotion and e-Learning". *JALN*. 2003, vol 7, p. 78-92.

[10] Aleck Lin, Shirley Gregor, Michael Ewing. *Understanding the Nature of Online Emotional Experiences: A Study of Enjoyment as a Web Experience*. Taipei, Taiwan: 2009.p. 259-268.

[11] Said Ziane. Introduction to psychopedagogy, *OPU*, 2013.

[12] Nadjet Zermiline. *A SSISTING IN THE R EUSE OF E XISTING M ATERIALS TO BUILD A DAPTIVE H YPERMEDIA*. [PhD]. 2011.

[13] Malinka Ivanova. *Researching Affective Computing Techniques for Intelligent Tutoring Systems*. Kazan National Research Technological University, Kazan, Russia: 2013.p. 611-617.

[14] Sidney D'mello, Art Graesser. "AutoTutor and Affective AutoTutor: Learning by Talking with Cognitively and Emotionally Intelligent Computers that Talk Back". *ACM Transactions on Interactive Intelligent Systems*. Vol 2, 2012.

[15] Roger Nkambou, Vincent Heritier. *Reconnaissance émotionnelle par l'analyse des expressions faciales dans un tuteur intelligent affectif*. Université du Québec à Montréal: 2004.

[16] Roberto Valenti, Nicu Sebe, Theo Gevers. *Facial Expression Recognition: A Fully Integrated Approach*. 2007

[17] Moataz El Ayadi, Mohamed S. Kamel, Fakhri Karray. "Survey on speech emotion recognition: Features, classification schemes, and databases". *Pattern Recognition*. 2011, vol 44, p. 572–587.

[18] AUSTRALIAN LEARNING TEACHING COUNCIL PRIORITY PROJECT, 2009-2010. *Web 2.0 Authoring Tools in Higher Education Learning and Teaching : New Directions for Assessment and Academic Integrity*. 2009.

[19] Liping Shen, Minjuan Wang, Ruimin Shen. "Affective e-Learning: Using "Emotional" Data to Improve Learning in Pervasive Learning Environment". *Educational Technology & Society*. 2012, p. 176 - 189.

[20] Ashish Kapoor, Winslow Burleson, Rosalind W. Picard. "Automatic prediction of frustration". *Int. J. Human-Computer Studies*. 2007, vol 65, p. 724-736.

[21] Saromporn Charoenpit, Michiko Ohkura. *A New E-Learning System Design Focusing on Emotional Aspect Using Biological Signals,* 2013.

[22] Alexander Hogenboom, Daniella Bal, Flavius Frasincar, Malissa Bal, Franciska de Jong, Uzay Kaymak. *Exploiting Emoticons in Sentiment Analysis*. Coimbra, Portugal: 2013.p. 703-710.

[23] Michal Ptaszynski, Jacek Maciejewski, Pawel Dybala, Rafal Rzepka, Kenji Araki. "CAO: A Fully Automatic Emoticon Analysis System Based on Theory of Kinesics". *IEEE TRANSACTIONS ON AFFECTIVE COMPUTING*. 2010, vol 1, p. 46-59.

[24] Paul Graham. *I first heard the phrase 'Web 2.0' in the name of the Web 2.0 conference in 2004*. 2006, http://www.paulgraham.com/web20.html.

[25] Soumaya Chaffar, Claude Frasson. *Architecture pour des systèmes tuteurs émotionnellement intelligents*. Université de Montréal ; C.P. 6128, Succ. Centre-ville ; Montréal, Québec Canada H3C 3J7: 2004.

[26] Rosalind W. Picard, Jonathan Klein. "Computers that recognise and respond to user emotion: theoretical and practical implications". *Interacting with Computers*. 2002, vol 14, p. 141-169.

[27] Paul Ekman, Dacher Keltner. *Darwin's Claim of Universals in Facial Expression Not Challenged*. 2014, http://www.paulekman.com/uncategorized/darwins-claim-universals-facial-expression-challenged/.