7

Affective Computing in E-learning

Hongfei Lin, Fengming Pan, Yuxuan Wang,
Shaohua Lv and Shichang Sun
Dalian University of Technology
China

1. Introduction

Affective Computing is a branch of the study and development of artificial intelligence that deals with the design of systems and devices that can recognize, interpret, and process human emotions. It is an interdisciplinary field spanning computer sciences, psychology, and cognitive science. Realm of this research has been extended to human-machine interface, cognition and text mining.

As a remote learning method, e-learning inevitably lacks the emotional communication between the tutor and the learner. Affective Computing aiming at making computational devices empathic provides a solution to this problem

In this chapter, we try to give an overview of the applications of affective computing in e-learning system and introduce some of the application systems.

2. E-learning and Affective Computing

2.1 Absence of Emotion in E-learning Systems

E-learning provides a convenient and economical mode for education, but separation from tutor and other students may result in a lack of timely and face-to-face communication which is just available in regular education. Students will feel frustrated, and even have emotional resistance towards learning, if learning problems can not be solved, or confusions can not be straightened out over a long period of time.

2.2 Affective Computing

The concept of Affective Computing was originally put forward by Professor Picard from MIT Media Lab in 1995, who, in his later work, defined it as "the computing that relates to, arises from, or deliberately influences emotions" (Picard, 1997). The focus of affective computing is on establishing emotion modes, based on physiological and behavioural signals that are caused by emotion and obtained by various sensors, and on developing a personal computer system, which can apperceive, recognise, and comprehend human emotions to provide intelligent, user-friendly feedbacks for user's emotions. It works well in shortening the emotional distance between machine and user, and creating a harmonious

human-machine environment. Such traits being well employed, Affective Computing, when applied to e-learning, can greatly help recuperate the absence of emotion in e-learning.
The main application of Affective Computing includes emotional perception, emotional comprehension and emotional expression. The purpose of emotion perception is, through various sensors, to obtain stimuli that express user's emotions, and use them for affective computing as pre- information, either in verbal forms (e.g. speeches) or in non-verbal forms (e.g. facial expressions, heartbeats). The method most commonly used is to estimate one's emotion by recognizing his facial expression and detecting his physiological states. Computer can have a basic understanding of the user's emotion state after perceiving, analyzing and recognizing the emotion. The essence of Affective Computing is, through various sensors, to use emotion models to recognize and analyze physiological and facial features, which are caused by emotions, for the sake of understanding human emotions and making suitable reactions. Therefore, the emphasis of this section is how to make suitable reaction to user's emotional change, according to what emotion information has been recognized. Contrary to previous study in which physiological and behavioural features tell the status of emotion, emotion expression is a reverse-process, which focuses on how to extract a given emotion status from physiological and behavioural features.
The growing research and scholarship relating to emotion and e-learning generally indicates the significant part that emotion plays in learning. Models of e-learning systems assisted with Affective Computing methods are being developed. Qualitative and quantitative research has been carried out in a range of e-learning settings to complete the theory and practice of e-learning. Figure 1 shows the application of three main Affective Computing approaches in an e-learning system.

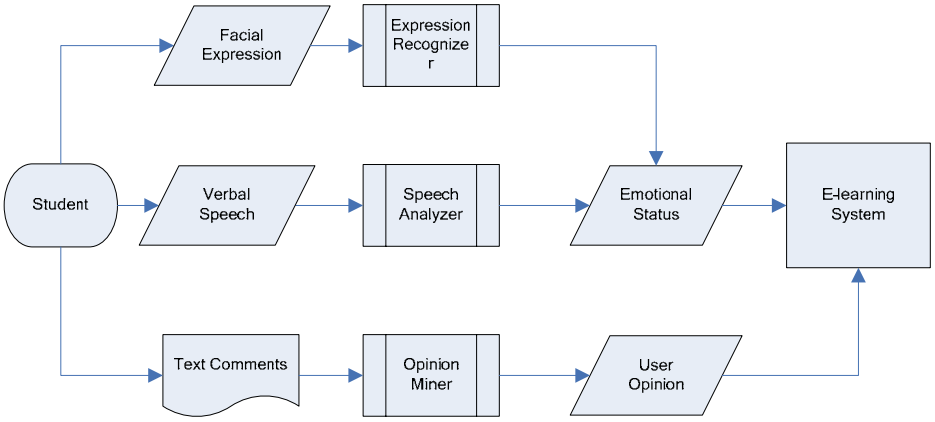

Fig. 1. Application of Affective Computing in e-learning

3. Facial Expression Recognition

3.1 Facial Expression Recognition in e-learning

Traditional e-learning systems are far from perfection. As early as in 1983, it was pointed out by Desmond Keegan (Keegan, 1983), a world- wide famous e-learning education expert, that e-learning differs from conventional education basically in that e-learning separates teachers from students and students from students. Because of the quasi-permanent separation, teachers and students are unable to make face-to-face communication in e-learning as they can do in conventional education, which leads up to the absence of emotion. As a result, modern e-learning takes enough human emotions into account. Despite its complexity, the emotion's state can be reflected in one's facial expressions, which means that in general one's emotional state can be read from his facial expressions. In an e-learning model where disadvantages are overcome of ignoring learners' moods and emotions, learners' state of emotion can be conveyed to teachers, who accordingly take effective actions to ensure that both learners and teachers can achieve the best effect in learning.

3.2 Introduction to Facial Expression Recognition

Facial expression recognition is to extract and analyze distinctive features reflected from people's facial expression. The collected information is classified and understood according to the way how human perceive and think, so that people's mood or emotion can be interpreted, by utilizing emotion knowledge acquired before to teach computers how to associate, think and reason. In a learning system, a harmonious interaction between human and machine can be realized, when computers can acquire learners' emotional state by recognizing their facial expression, helping teachers to know how learners feel and how well they learn, and teachers can accordingly employ suitable teaching approaches for the sake of high efficiency of learning. In e-learning education system, in particular, facial expression recognition can facilitate learners' adjustment of their emotions to coordinate the interaction with computers.

3.3 Facial Expression Recognition Technique

Facial expressions are various and they can be studied from dimensional-quantitative perspective and classification perspective. All human emotions are produced after being combined in a complicated way, based on six facial expressions which are classified by scientists of facial expression as happiness, surprise, fear, sadness, hate and anger. Facial expression recognition gains its improvement in recent years with two significant techniques, detection and location of faces, and extraction and recognition of faces. Compared to the simple technique of detection and location of face, the technique of extraction and recognition of face pictures is complicated, and therefore it is studied more widely and more deeply. To date, there are three methods of facial expression recognition computers can use.

Geometrics-based recognition method: facial expressions are recognized, by mapping and measuring the locational changes of eyes, nose, eyebrow, mouth and etc, and defining the features in terms of size, distance, shape, proportion and etc.

This method calls for a small input of data, but it may cause the loss of important information for the facial expression recognition and classification, as face image is only represented by limited features (Xue Weimin, 2003).

Model-based recognition method:
This method needs a physical model which can anatomically define critical features in face and compare these features to recognize facial expressions. It means that the facial expression recognition is transformed into a flexible matching problem of curved surface.
Recognition method of integrated-face-feature: facial expressions are recognized through mathematical transformation, which are performed for the whole face or for special area of it, with the PCA (Principal Components Analysis) most commonly in use. This recogniton method, based on intergrated face features, is gaining more and more attention, because, for the purpose of expression recogniton, it focuses on saving as much original information as possible, and transforming informaiton of expression shown in the whole face to effectively extract related features from face images.
Below is an introduction to two systems applied for e-learning learning.

3.4 Introduction to an E-learning System Using Facial Expression Recognition

An overview of facial detection: the popular methods employed for facial detection include PCA, neural network, machine learning, information theory, geometric model, Hough transformer and color analysis. Based on the expressive means in computation, there are two main facial detection algorithms: integrated expression algorithm and facial geometric feature algorithm. The integrated expression algorithm is effective in finding faces in images of low quality or in locating small faces in images. While the facial geometric feature algorithm performs well when it recognizes all the sides of faces (Wang & Ma, 2002). In an e-learning system, learners usually face up to a camera which is of low quality so the integrated expression algorithm is chosen in the real e-learning education system.

Facial Expression	Eyebrow's Features	Eye's Features	Mouth's Features
Happy	Eyebrow bent a little	Wrinkles appearing on lower eyelid Crow's-feet expanding to the external corner of eyes.	Corner of mouth rising up, mouth open and the teeth showing up A wrinkle stretching from nose to the corner of mouth
Surprised	Eyebrow raised up Skin beneath eyes stretched	Eyes popped up• • upper eyelid rising up Lower eyelid falling down. White of the eye showing up	Lower jaw falling down Mouth open with ease
Neutral	Nothing changed	Eyes open naturally	Mouth closed naturally

Table 1. Primary features of happiness, surprise and neutral facial expression

Learners involved in e-learning often face cameras from a single and fixed angle, so the integration method is commonly used for facial detection computation. This e-learning

education system can locate the precise position of the face in pictures with simple background by using light complement, skin color model and inflate techniques. When the system locates the entire face in the picture, recognition technique can help recognize the location of eyes, pupil, mouth and all the other expression information that learners give.
What comes next is to retrieve data of facial expression from original resource of facial expression, which can reflect what the person's emotional state is. Data retrieval of facial expression, based on the model a face represents, falls into two categories: template-based and feature-based (Zhu Aijun, 2004). Given a priority over the model, this system is built up on a transformable template for automatic extraction, which includes four models, part-combination model, eyes model, mouth model and Eyebrows model. Part-combination model, whose design and extraction is, as a matter of fact, an extraction process of subobjectives can locate and combine all the face organs that are called face parts and mainly referred to Eyebrows, eyes and mouth. Fast and reliable, the method depends on both feature location in face detection and accumulated face knowledge to build up a part-combination model and extracts face parts (Jin Hui, 2000). Eye model, mouth model and Eyebrows model all analyze images to obtain geometric images for a demonstration of geometric features, such as curvature, size and related location, so that emotional state can be detected.
Table 1 shows the relation between the mood or emotion and facial expression.
With many mature techniques, MIT Media Laboratory is playing a leading role in the field of affective computing. Though methods they used to employ performed well in facial expression recognition, human interfering was still needed. MIT media lab has recently developed a fully automatic technique of facial recognition (Kapoor, A. et al., 2003), which can be used in e-learning for our purpose.
Figure 2 shows the process of one of the techniques of facial recognition MIT media lab uses.

Fig. 2. Overview of the system

The pupil detection system, using the red-eye effect, detects pupils. An infrared camera equipped with infrared LEDs (light emitting diode) is used to highlight and track pupils. The whole unit is placed under the monitor pointing towards the user's face. The system has an infrared sensor coupled with two concentric rings of infrared LEDs to obtain needed information. What MIT does next is to identify what facial expressions these data represent, by using SVM. Even though only face recognition is accomplished, this research result can be applied to e-learning, in that affective problems in e-learning can be conquered if the technique of face recognition is able to precisely interpret people's emotional state. If so, the special separation can be bridged; time can be saved; learning efficiency can be improved.

4. Speech recognition in e-learning

4.1 The application of Speech recognition in e-learning

With the development of information processing technology of computer multimedia since the middle of and late 1990s, more importance is attached to information processing on emotions. In e-learning system, interaction between learners and system is important, as it can enable learners to study in real-life-like settings and intensify their interests, as well as giving timely feedback to the system, which can respond correspondingly, to the extent that learning efficiency can be improved.

As speech is the most important, most effective, most commonly-used and most convenient way for communication, enhancing the speech recognition ability can significantly improve a system's performance. By detecting how students change their speeches, e-learning can recognize the changes in their moods and then respond properly, so that a more real-life-like simulation effect can be achieved.

4.2 The process of Speech recognition in e-learning

Speeches express emotions in that they contain the parameters which can reflect emotional characteristics. Changes in emotions can be detected, by an observation of the differences that occur in characteristics parameters. The speech emotion recognition in e-learning, mainly taking advantage of the methods of measuring, decomposing, analyzing and composing, intends to identify, understand and compose emotional components, so that a sense of emotion for the computer can be developed.

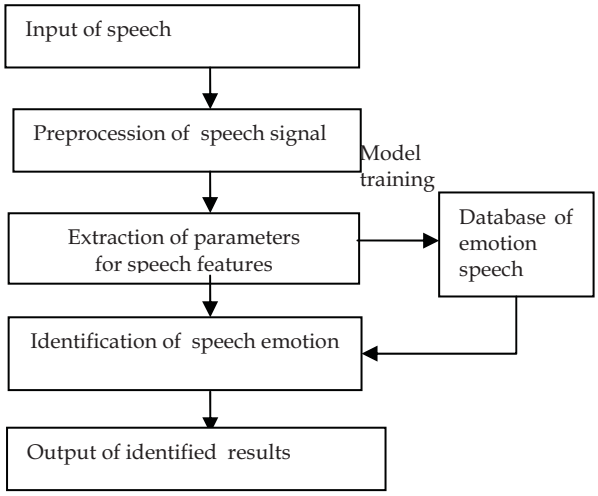

Fig. 3. Flow chart of identifying speech emotion

This research focuses on the recognition of speech emotion, combination of speech emotion, integration with other emotional information and their applications in related fields. As the basis of speech emotion recognition, speech emotion recognition helps to gain a deep understanding of the complicated relationship between the characteristics parameters in

speech and the emotions. Speakers, in different states of mood, use different speeds for talking, such as excitement calling for a higher voice than usual. Changes in emotions reflect learners' states of learning, and therefore, based on the speech speed and the duration of the address, the degree of excitement can be measured, which, in return, will instruct the system how to make responses accordingly, an example of which is that the difficulty and intensity of learning can be increased when students are found happy and efficient in learning. Similar to the feature of time, the feature of vibration and various emotions are highly related, with vibration being drastic for happiness, anger and surprise but less noticeable for sadness. The bigger the degree varies, the more the emotion changes. For example, one's pitch can be marked as an upsweep curve when he is happy, but as downward when he is sad. As a result, learners' emotion can be known based on the recognition of different speeches, so that feedbacks can be instantly given and the performance of e-learning system can be improved. In short, e-learning system is able to make adjustments after analyzing learner's learning state concluded from the emotion- expression related parameters.

The computer-aided speech recognition includes establishing speech database, extracting parameters of emotion feature, identifying speech emotion, training model and etc. The process can be illustrated below:

(a) Establishing database of speech emotion

The database of speech emotion, with a large amount of data for analyzing and modelling speech emotion, lays a foundation for model construction and provides speech corpus of training and testing for speech emotion recognition. Whether for identifying or for composing speech emotion, a real, effective and abundant database of speech emotion is needed.

Speech materials can be obtained, on one hand, by recording, for which some professional announcers or good-expressers are invited to read the specified sentences, and on the other hand, by clipping, which takes phonetic fraction from films and television. Comparatively the latter has a higher degree of reality, but it is still far from natural expression, even if it facilitates the sample collection (Douglas-Cowie et al., 2000).

It is a big issue to establish a genuine speech emotion database that enables users to conveniently add, retrieve and use speeches and parameters.

(b) Selecting speech emotion parameters

Speech emotion parameters can be analyzed to manifest emotional states. Nowadays, there are many research findings in the selection of speech emotion parameters, such as fundamental frequency, formant and energy, from which are also deviated some other parameters, including average, maximum, average variance ratio (Pao et al., 2003).

(c) Establishing speech recognition model

Establishing recognition model is the key part of speech emotion recognition and its core is selecting and using classifiers. Many methods of pattern recognition, such as Linear Discriminant Classifier, k-Nearest Neighbourhood, Sport Vector Machine, Gaussian Mixtures and Hidden Markov Model are applied and have obtained good results (Cowie, 2001).

4.3 Difficulty of speech emotion recognition in e-learning

Although speech emotion recognition in e-learning has a promising prospect, there are still some difficulties which prevent it from being used widely.

(a) One of the important applications of speech recognition is for identifying and understanding natural language. The first problem to be solved is to clarify the ambiguous border of basic model, because phonetic is changing when intonation, pitch of sound or words are combined in continuous speeches. An expert system, which can understand the rules of grammar and lexeme, is also needed to be built up.
(b) The changes of voice messages are drastic. Speech recognition varies both for different speakers and even for the same speaker. For example, one's voice is different when he is talking casually from that when he is talking seriously; time also influences the speech recognition, as one's voice message is different at present from that of a month later, even if he is speaking in the same way.
(c) Voice is ambiguous. Different voices sometimes sound similar, so how to classify them is a huge challenge.
(d) It is difficult to identify speech in too much noise. Speech data are all collected in an almost- ideal condition, but when being applied in real circumstances, they may cause tough problems, obviously due to the noise. This is one reason why it sometimes happens that speech emotion fails to be identified.
(e) Speech emotion recognition, as an interdisciplinary study, involves computer science, psychoacoustics, psychology, cognitive science, and signal and information processing. Distinguished from traditional information processing and with the help of machine, it intends to identify and understand the surface information of speech signal rather than to perceive the sensibility of speech signal. Part of emotional information and manual handling, it represents an advancement of traditional signal and information.
Despite a series of developments that have been made in speech emotion recognition, many problems are worth researching on its application to a real e-learning system.

5. Opinion mining in e-learning

5.1 Opinion Mining

Opinion Mining is a new and important research discipline, aiming to automatically acquire useful opinioned information and knowledge from subjective texts. It is mainly characterized by text processing of allegations and comments, which express opinions, feelings, and attitudes of individuals, groups, or organizations. Opposed to subjective text, subjective texts are expressed in natural languages, describing what individuls think of things, people and events (in group or organization). Generally found in journals (readers' comment) and on internet (BBS), this type of text, which contains opinioned sentences, either appreciatory or derogatory, is called opinion-expressing texts.
As defined by Kim and Hovy, opinion consists of four elements, namely, topic, holder, claim and sentiment, among which there is a coorelation, that is, opinion holder makes a claim of sentiment over a topic (Kim & Hovy, 2004). Opinion mining is a synthesized discipline, related to text mining, information retrieval, machine learning, natural language processing, statistics, ontology, corpus of applied linguistics, visuable technology, and etc.

5.2 Opinion mining in e-learning: Opportunities and Challenges

Opinion mining technology offers new opportunities for e-learning. Unlike other technologies, it can reflect holders' long-term and reasonable needs, when the processed information is processed more maturely by intellect and sense. The application of opinion

mining in e-learning is important, because emotions expressed by written words are more mature, specific and reasonable than those reflected by facial expression and voice. It is signigicant that the teaching effect of e-learning and improvement on the system can be achieved, if subjective opinion-expressing information relating to e-learing can be obtained from text.

Students can know how others think in two ways. In the e-learning system, through email, weblog, instant message, students can exchange information,experience, and feelings with teachers and other students.

Teachers in e-learning must be aware of students' opinions as a whole before they can give instructions in diverse ways according to particular individuals. Teachers can use more advanced materials when one has positive emotion about a topic.

To e-learning providing organizations, opinion mining provides a new wayto evaluate effectiveness and efficiency in all aspects of e-learning. In Learing Forum, students can freely write down their feelings and opinions. By analyzing emotions, opinion mining can give a general and instructive comment on what is evaluated. For the purpose of teaching effect and teaching schedule, organizations can make good use of the timely feedback to direct, control and remedy the e-learning process and learning activities.

To understand, in a reliable way, the process of how students feel, will defintely bring about a better learning effect. But it's also a huge challenge to mine valuable information from learning-related text, as information is always exchanged over broad topics and in free styles. First, text mining falls into the category of data mining, but different from the regualr data ming, which mines in formated database, it is carried out on a loose structure and, sometimes, on a weak semantic link. Second, information is exchanged in a free style of text, and fewer formated rules are obeyed. Oral language often used, there are no fixed vocabularies for opinion expression, and therefore, analysis is hard to make.

5.3 Opinion Mining Procedures

The process of e-learning is to automatically identify those factors in the natural language text and define the relationship in between. Generally speaking, the sub-tasks of this process include topic extraction, subjective recognition, and sentiment analysis.

The aim of subjective recognition is to delete those objective statements, that is, to retain the texts concerned with expressions within a certain scope of topic and holder. The size of subjective recognition should match that of e-learning. For example, in 'Joan owns a clear mind and a good attitude', if the whole sentence is recognized as a unit, 'mind' and 'attitude' share the same sentimental polarity. While in the sentence 'The difficulty level of the exam is ok, but some questions are too narrow', 'difficulty level' and 'questions' share different sentimental polarity, so we cannot come to a right comment if we analyze the sentence as a whole unit.

The purpose of topic extraction is to identify and evaluate those terms related to the topic. To find out useful information in the texts, the theme of the information must be obtained, that is, the target of evaluation. The themes related to e-learning can be divided into four aspects: student, teacher, teaching content, and media. It is very important to deploy exact ontology concepts in certain areas for the themes to be evaluated completely and correctly. Such a capsulization of coments on the concept can offer the most complete information to those concerned.

To perform sentiment analysis is to determine the subjective attitude of the opinion holders,

with the research mainly focused on the appreciatory and derogatory degrees of 3 levels: word-level, sentence-level, and text-level. In terms of the degree, words serve as the basis; sentences specifically express; texts are the combination of commenter, the topic and the degree. When students evaluate a subject, evaluations for its aspects can be seen in the text, such as the courseware's structure, technique, interaction, understandability, information volume, etc. The degree on the subject can be available when several key contents on the subject are defined and the degree of the subject and content is calculated the same way as the degree of words is measured.

5.4 Applying Opinion Mining in e-learning: a

Subjective Recognition was the focus of the 2006 Blog Track at TREC (Iadh et al., 2006). To tell whether a given sentence is subjective or not, (Hatzivassiloglou & Wiebe, 2000) the effects of adjective orientation and grade on sentence subjectivity are examined. Wilson addresses the problem of determining clause-level opinion strength (Popescu & Etzioni, 2005); researchers deploy classical machine learning methods when subjective recognition is formulated as classification problem (Nigam & Hurst, 2004) (Yu & Hatzivassiloglou, 2003) . Minimum Cuts in Graphs are used to find subjective parts of a document, which can be successfully used in sentence-level and document-level analysis. To analyze subjective in small grade, researches have done in a more specific range to come up with close relations between topics and claims. For example, Turney defines the grade to analyze adjective- and adverb-having noun phrases (Turney, 2002).

In topic extraction, two strategies are taken. The first follows the properties of noun phrases, such as, Yi tested likelihood to determine a topic according to the composition and position characteristics of noun phrases. But this method has difficulties in covering most subjective terms. The second follows the co-occurrence phenomenon of candidate topics in context. Hu and Liu[10] recognize frequent and infrequent topic terms according to the co-occurrence phenomenon. Similarly, Popescu and Etzioni acquire candidate topic terms by Point-wise Mutual Information.

Sentiment Analysis system often starts from the word level. As little is used as "excellent" for appreciation and "poor" for derogation, the sentiment polarity is just captured from a large corpus library, like on Internet. Baroni and Vegnaduzzo use Point-wise Mutual Information to recognize the sentiment polarity of adjective words (Baroni et al., 2004). The orientation of the pronoun between two adjectives is exploited using graph algorithms (Hatzivassiloglou & McKeown, 1997). Some researchers use Naive Bayes, Max Entropy, and SVM to do classification experiments(Pang et al., 2002). The features, including unigram, bi-gram, adjectives POS and position, are examined, improving the accuracy rate up to 86.4%, with the additional help of a subjective classification pre-processor to filter objective sentences.

In Dalian Univ. of Technology(DUT), comments and remarks related to e-learning are collectively published in the Bulletin Board System, providing language data for opinion mining. The test corpus consists of 213 review articles in the learning domain of the university DLUT's BBS (3,617 sentences). Their first step is to represent an opinion as a tuple < Subject, Content, Term>. 'Subject' means which subject the opinion observes on, for example, 'Computer science' and 'Law'. 'Content' means which aspect of the subject the opinion comments on, for example: 'teacher' and 'course-ware'. 'Term' means which sentiment terms the user uses in the opinion. To identify the subject corresponding to a

given value expression, two simple heuristics are used. First, if there is any subject expressions preceding the given value expressions, the one nearest to the value is selected. Second, in other cases the first one of those following the value expression is chosen. To simplify the sentiment polarity determination, a maximum distance is defined between the sentiment term and its degree adverb. If the distance between a sentiment term and a degree adverb is smaller than the maximum, the degree adverb is considered as the sentiment term's modifier adverb, and the product of the intensity of the sentiment term and the intensity of the adverb as the strength of the opinion. In a word, this example empirically examines opinion mining in Chinese e-learning documents.

6. References

Picard, R. (1997). Affective Computing, MIT Press, ISBN: 9780262661157, Cambridge, MAKeegan, D. (1983). Six distance education theorists, ZIFF, Fern University Press, Hagen: Fernuniversität

Wang, W. & Ma, J. (2002). The Common Method and Development Status for Face Recognition, *Ordnace Industry Automation*, Vol.01, 4-51, (Jan., 2002), ISSN:1006-1576.0.2002-01-019

Kapoor, A. & Picard, R. (2002). Real-Time, Fully Automatic Upper Facial Feature Tracking. *Proceedings to 5th International Conference on Automatic Face and Gesture Recognition*, pp8-13, ISBN: 0-7695-1602-5, Washington D.C., May 2002, IEEE Computer Society, Washington D.C.

Douglas-Cowie, E. (2000). et al. A new emotion database: considerations sources and scope, *Proceedings of the ISCA ITRW on Speech and Emotion*, Belfast, pp.39-44.

Pao, T.; Cheng, Y.; Chen, Y. & Yeh, J. (2007). Performance Evaluation of Different Weighting Schemes on KNN-Based Emotion Recognition in Mandarin Speech, *International Journal of Information Acquisition*, Vol. 4, No. 4, Dec. 2007, 339-346,

Cowie, R; Douglas-Cowie, E.; Tsapatsoulis, N.; Votsis, G.; Kollias, S.; Fellenz, W. & Gtaylor, J. (2001). Emotion Recognition Human-Computer Interaction, *IEEE Signal Processing Magazine,* Vol.18, No. 1, (Jan. 2001) 32-80, ISSN: 1053-5888

Kim, S. & Hovy, E. (2004) Determining the Sentiment of Opinions, *Proceedings of COL ING04, the Conference on Computational Linguistics,* Geneva, Switzerland, 2004

Ounis, J.; Rijke, M.; Macdonald, C.; Mishne, G & Soboroff, I. (2006). Overview of the TREC-2006 Blog Track, *Proceedings of the 15th Text REtrieval Conferenc*e (TREC 2006), 2006

Hatzivassiloglou, V. & Wiebe, J. (2000). Effect s of Adjective Orientation and Gradability on Sentence Subjectivity, *Proceedings of 18th International Conference on Computational Linguistics,* New Brunswick , NJ , USA, 2000.

Popescu, A.; & Etzioni, O. (2005). Extracting Product Features and Opinions from Reviews. *Proceedings of HL TEMNL P05, the Human Language Technology Conference/ Conference on Empirical Methods in Natural Language Processing,* Vancouver , Canada, 2005.

Pang, B. & Lee, L. (2004) A Sentimental Education: Sentiment Analysis using Subjectivity Summarization based on Minimum Cuts. *Proceedings of the ACL 2004*. Barcelona, Spain, 2004.

Nigam, K. & Hurst, M. (2004). Towards a Robust Metric of Opinion, *Proceedings of the AAAI Spring Symposium on Exploring Attitude and Affect in Text: Theories and Applications*. Stanford, USA, 2004.

Yu, H. & Hatzivassiloglou, V. (2003). Towards Answering Opinion Questions: Separating Fact s from Opinions and Identifying the Polarity of Opinion Sentences, *Proceedings of EMNL P03, 8th Conference on Empirical Methods in Natural Language Processing*. Sapporo, Japan, 2003.

Turney, P. (2002). Thumbs up or thumbs down? Semantic orientation applied to unsupervised classification of reviews. *Proceedings of ACL-02, 40th Annual Meeting of the Association for Computational Linguistics*, pages 417–424. Association for Computational Linguistics.

Baroni, M. & Vegnaduzzo, S. (2004). Identifying subjective adjectives through web-based mutual information. *Proceedings of KONVENS-04*, 17–24, Vienna, AU, 2004.

Hatzivassiloglou, V. & McKeown, K. (1997). Predicting the semantic orientation of adjectives, *Proceedings of ACL-97, 35th Annual Meeting of the Association for Computational Linguistics*, 174–181, Madrid, ES. Association for Computational Linguistics.

Whitelaw, C.; Garg, N., and Argamon, S. (2005). Using appraisal taxonomies for sentiment analysis. *Proceedings of MCLC-05, the 2nd Midwest Computational Linguistic Colloquium*, Columbus, US.

Song, D.; Lin, H. & Yang, Z. (2007). Opinion mining in e-learning system, *International Conference on Network and Parallel Computing*, 2007

E-learning

Edited by Maja Jakobovic

ISBN 978-953-7619-95-4
Hard cover, 312 pages
Publisher InTech
Published online 01, February, 2010
Published in print edition February, 2010

E-Learning is a vast and complex research topic that poses many challenges in every aspect: educational and pedagogical strategies and techniques and the tools for achieving them; usability, accessibility and user interface design; knowledge sharing and collaborative environments; technologies, architectures, and protocols; user activity monitoring, assessment and evaluation; experiences, case studies and more. This book's authors come from all over the world; their ideas, studies, findings and experiences are a valuable contribution to enriching our knowledge in the field of eLearning. The book is divided into three sections. The first covers architectures and environments for eLearning, while the second part presents research on user interaction and technologies for building usable eLearning environments, which are the basis for realizing educational and pedagogical aims, and the final last part illustrates applications, laboratories, and experiences.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Hongfei Lin, Fengming Pan, Yuxuan Wang, Shaohua Lv and Shichang Sun (2010). Affective Computing in E-learning, E-learning, Maja Jakobovic (Ed.), ISBN: 978-953-7619-95-4, InTech, Available from: http://www.intechopen.com/books/e-learning/affective-computing-in-e-learning

INTECH
open science | open minds

InTech Europe
University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China
Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821