

Design of an emotional interaction mode in e-learning

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ABSTRACT: With the advent of mobile intelligent devices, the methods used to obtain information and communicate with individuals or groups include statistical figures, images, voice, facial expression, eye and body postures, and others. Based on psychology, cognitive science and affective computing, and considering learners' emotional information in e-learning, as well as the words and pictures that they send in the process of communication, this article attempts through modelling to demonstrate how to deduce learners' cognitive state and, then, according to the result, how to provide the corresponding emotional support or emotional compensation.

INTRODUCTION

Ohmaye believes that the basis of future educational innovation is the learner's emotional body [1]. However, currently, e-learning systems emphasise *knowledge* and neglect *emotion*. As the number of on-line students is large and they are spread out across the on-line environment, it is difficult to know their emotion and mental state. The lack of emotional interaction makes learners' learning enthusiasm wane and may seriously impact on the learning effect [2]. Therefore, it appears crucial to focus on the learners' cognitive problems from the perspective of their feelings and emotional interaction. In order to meet the large-scale and results-oriented distance learning requirements, emotional compensation in some interaction scenarios needs to be addressed. This article outlines some aspects of the emotional interaction mode in e-learning.

EMOTION RECOGNITION AND LEARNERS' LEARNING STATE

Analysis of Learners' Learning State through Emotion Recognition

Learners' learning processes mainly rely on the cognitive process [3]. But, recent research data in behavioural sciences and neurosciences proved that recognition and emotional processes are not only interactive, but are also integrated in the function of neural mechanisms. They formed the basis of behaviours [4]. Emotion influences learners' cognitive drive and motivation, as well as their learning behaviour performance and, then, influences their behavioural state: positive emotions are of great importance to learners' cognitive thinking and learning intelligence, which is helpful to improve their creativity and ability to solve problems, while negative emotions have the opposite effects on individual's thinking [5].

Emotion Recognition and Facial Expressions

Emotion recognition can be figured out from people's facial expressions. For example, when learners are interested in the learning content, they will be in high spirit with their eyebrows raised, eyes open, the distance of upper and lower eyelids enlarged; and conversely, they will be down in spirit with the manifestation of knitted brows and glazed eyes. In view of this, in 2001, researchers at the University of California recognised learners' emotions through facial expressions using emotion recognition technology to forecast the level of difficulty of a video course and students' watching speed [6]. In 2012, American company Affectiva applied Affdex - emotion insights software with the function of facial expression recognition - to an on-line class, which seemed a convenient method for teachers to observe whether students were active and thoughtful during the class [7]. Ekman and Friesen summarised as many as 46 facial expressions after a careful study on people's facial expressions and divided them into six basic types (i.e. happy, sad, surprised, scared, angry and disgusted) systematically establishing an image library with thousands of facial expressions [8].

Emotion Recognition and Intonation and Speed

Learners' emotion can be reflected by the level and speed of the sound they are making. For example, when learners talk about what they are interested in, they will accordingly raise their tone and accelerate their speech speed; otherwise, they will speak in a slow and serious tone. Several projects explored this idea, one of which was MySelf, funded by the European Commission and involving 14 partners from various EU countries [9]. It has been established that learners' emotional state can be identified through comprehensive analysis of physiological signals and speech.

Emotion Recognition, Words and Pictures

Words are the basic form for learners to exchange information. To separate words from sentences and extract emotional words and, then, make an analysis of the emotion is the basic way of using text to work out emotion recognition. Fenske recognises collaborative learning roles in the environment of e-learning through the analysis of words in text judging learners' emotion from the words they have sent [10].

E-learning provided a large number of visual emotional signals and pictures, which can be used as a direct reference for learners when expressing emotions, as shown in Table 1. When learners are interested in the learning content, they will send positive words and pictures, which are called positive word symbols; conversely, they will send negative words and pictures called negative word symbols, if they are not interested.

Table1: Examples of emotion cognition reflected by words and pictures.

Emotional symbols	Emotional meaning	Corresponding picture
;-)	So happy, I am crying.	
:-o	Wow!	
:(Sad	
:-	Angry	
8-O	Oh! my god!	
:-X	A big kiss!	

Emotion Recognition and the Cognitive Evaluation of Learners' Learning State

The process of learning is a cognitive path to process information. The changes of learners' emotion is the result of cognitive influence, which means learners' cognitive and emotional state influence and deduce each other [11]. Lazarus points out that emotion is always the result of a cognitive activity, and a certain meaning produced in a cognitive process [12].

The purpose of cognitive processes is to realise this meaning. Therefore, emotion can evaluate the purpose, valence and attitude of events, objects and media/agency. Among them, the purpose refers to the learners' evaluation of events and it has positive or negative influence on their self-development, valence (or intrinsic attractiveness) refers to whether the evaluation of media/agency's activities meets the standards of behaviour in the individuals' environment, and attitude refers to whether the attributes that are mainly used for evaluation match the learners' attitude.

According to Wu Canghai's study, the learning state judged from a person's facial expression, the movement of eyes and body gesture can be divided into three types: concentrated, quiet and weary [13].

When learners are concentrated, they will be in a state of high excitement, which should be encouraged to be kept for a long time; when learners are quiet, it means that they turn to be in an uninterested or unhappy state, and it is time to lead their emotion, wake up their excitement and encourage them to go on studying; when learners are weary, they will be in sleep or painful state. It is time to make emotional compensation and cheer them up. The cognitive state, emotion recognition and learners' behaviour are interacting and supplement each other, and these relations are shown in Table 2.

Table 2: Recognition of emotion and learning.

Learning state	Recognition of emotional state	Recognition of learning behaviour	Emotional countermeasures
Concentrated	Happy, pleasant and surprised	Concentrated	Not to interrupt, proper encouragement
Quiet	Sad or scared	Wake up, begin to be distracted	Encourage and guide
Weary	Disgusted or angry	Neglect. Make mistakes	Persuade and compensate

MODEL DESIGN

The Evaluation and Selection of Emotional Index

The Method of Obtaining Data

In order to get the right emotional information, one has to realise that not all cameras will track the information from facial expressions and body gestures as; for example, hidden cameras make the subjects feel psychological pressure, thus, inhibiting their expressions and actions [14].

However, the current smart terminals have high-performance cameras inside, and software control can obtain more efficient and more natural data (see the method of obtaining data in Figure 1). Learners study using smart terminals and their facial expressions, eye movement and the change of body gestures can be obtained through the cameras in the smart terminals, and those installed in front of the smart terminals or behaviour capture tools (like Kinect); the words, pictures and sound generated by learners in learning activities, comprise collected information and are sent to an emotion database through wired or wireless communication.

When making analysis, the workstation extracts this information from the emotion database, codes and recognises the learners' emotional and cognitive state and, then, provides the results for emotional support or countermeasures to learners through the smart agent.

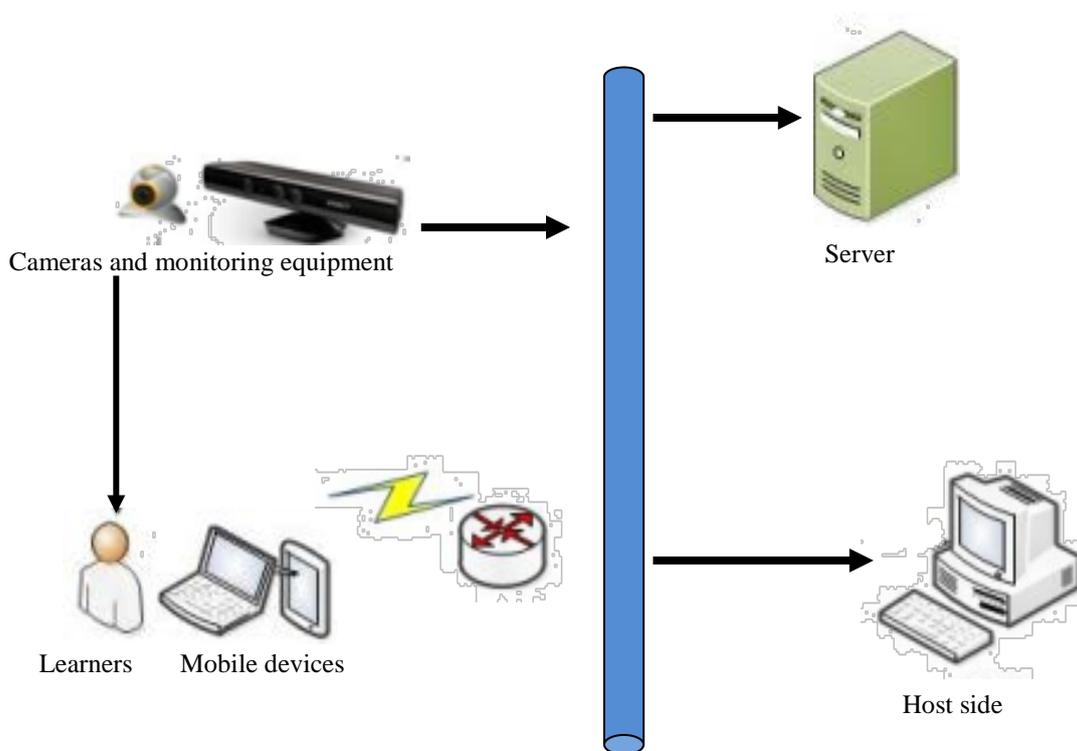


Figure 1: Method of obtaining emotional data.

The Selection of Emotion and Learning Behaviour Index

According to the corresponding relation between the emotion recognition and learning cognition, based on the definition of the pleasure-arousal-dominance (PAD) model used in affective computing in psychology [15], sociology and computer science, as well as a learning 3D state model in learning cognition, and other sources, the author of this article constructed a conceptual framework of emotional state and learning recognition state.

It is more accurate to work out the emotion recognition and make a judgment on the cognition state, when learners' facial expressions, action, words and image information that they sent are recognised at the same time, and the results are verified against each other.

Typically, an emotional state can be reflected by learners' facial expressions, eyes and body gestures, which is further verified by the words and pictures that they send. Then, in relation to the corresponding emotional support and feedback, the emotional state is divided into three dimensions: pleasure refers to the learners' attraction and acceptance in the process of completing a learning topic or task; arousal refers to the level of fatigue; dominance refers to the learners' satisfaction with the learning environment.

The framework of learners’ cognition state and behaviour state is shown in Table 3. The learners’ cognition state should be judged comprehensively and considered with their emotional data and behaviour data [16].

Table 3: Judgment of cognitive state and behaviour state.

Learning cognitive state	Classification	Description	State	Behaviour state	Ask for help
Learning phases	Task-based learning	Learning the relevant knowledge in line with the assigned tasks/ topics	Judge learners’ state in this process of learning: They are in concentrated, quiet or weary state	According to learners’ current learning phases and learning whether their main learning behaviour is: communicating, inquiring, moving, solving problems, testing, doing nothing	Feedback selections made by the system: whether you need help, whether you accept the recommendation, whether you have grasped the learning task, whether to enter the next learning task, etc. Learners choose in line with their learning state and, then, the system will deduce whether they need emotional encouragement, compensation or not to interrupt approach
	Task problem-solving	Using the knowledge you have learned to solve problems			
	Task test	Test the mastery of completed tasks and topics			
	Task space	Did not enter the task or did nothing in the task/topic			
Learning content	Theme/ question model	Judging the on-going learning topic or learning model according to the context	Judge the completion of a task: go back, stop or go forward		
	Content type	Including learning content, title, test and others			
	Presentation ways	How the present the learning topic and mode: text, picture, video, courseware, and others			

When the learners’ learning state is in the negative pole and they have difficulty in learning, it is time to give positive emotional support, like encouragement and compensation; when learners have already completed a learning task or learn in a happy and relax state, it is better not to interrupt them.

The Design of Emotional Interaction Model in E-learning

The emotional interaction model in e-learning can be seen in Figure 2. This model can be divided into three levels: emotional state recognition, learning state recognition and behaviour inference.

Among the three levels, the data of emotional state recognition come from the learners’ expression data, and the text and pictures they sent. The specific process is: first, coding, matching and selecting the collected data and, then, classifying in line with the three dimensions of emotional state; second, acquiring learners’ emotional state; finally, sending to the agent and deciding whether it is necessary to give emotional support to the learners.

According to the data of learners’ behaviour, the learners’ cognitive state is inferred. The learners need to click the time data of a certain task; for example, the time spent in communicating with others, viewing content, entering and exiting a topic, sending and delivering text and pictures; learners’ learning behaviour will be captured when undertaking a learning task; for example, seeking solutions to some questions, completing a task test, asking for help, etc. All these can deduce the learners’ initial learning cognition state as concentrated, quiet or weary, and whether they have completed the task or met some difficulties.

Sending the learners’ coded cognitive state to the agent and comparing it with the former emotional cognition state to deduce whether it is necessary to give emotional encouragement or compensation to the learners. This can be realised by the agent through language, text, expression or action. For example, providing relaxed words, warm smile, and passionate action etc, which may help to cheer the learners up and release any tension and stress. In the meantime, according to learners’ learning behaviour and learning cognitive state, the agent can also get to know the current learning topic or the progress of task providing targeted help and suggestions.

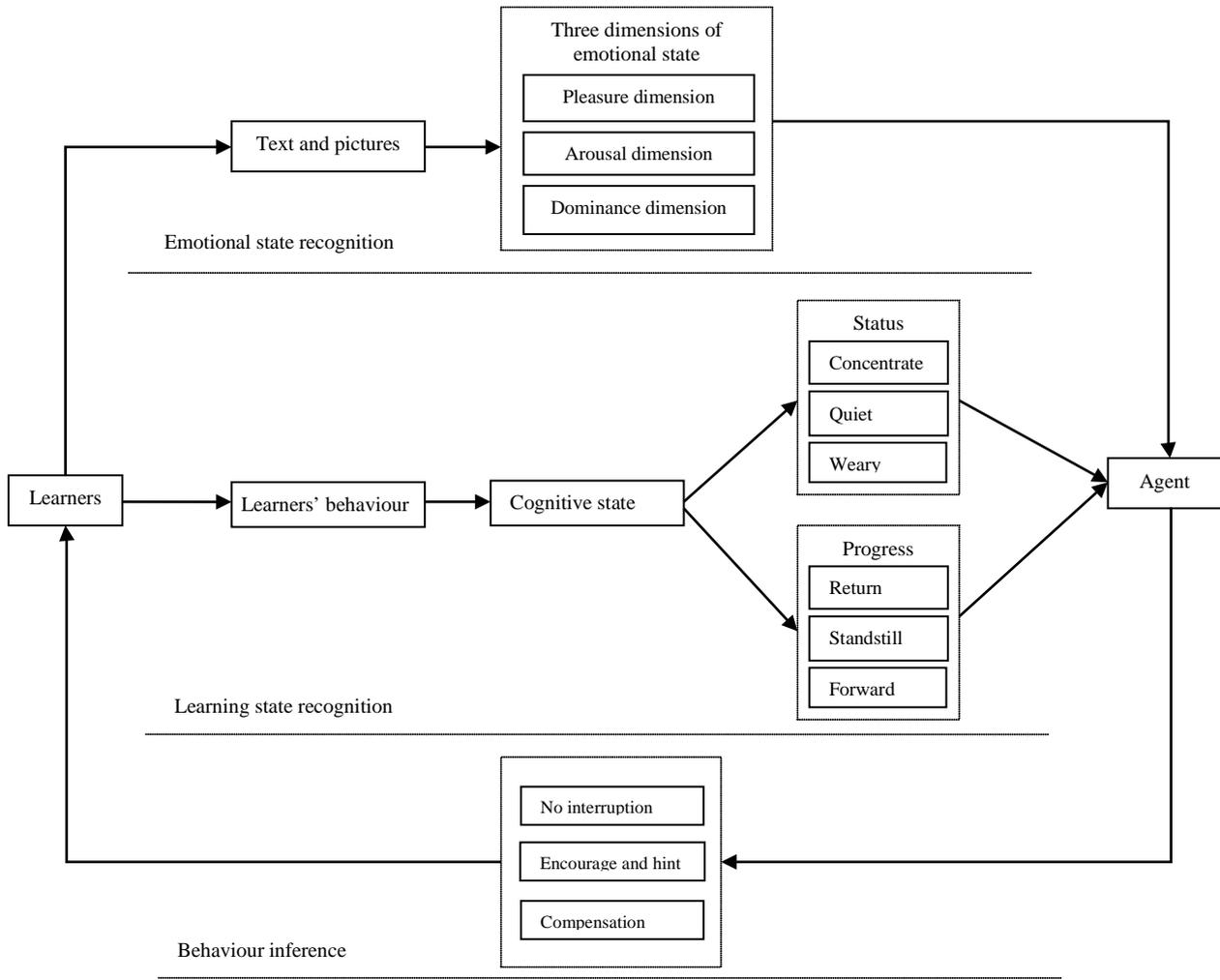


Figure 2: Emotional interaction model in e-learning.

CONCLUSIONS

This study constructed an emotional interaction model in e-learning by virtue of emotional recognition technology, which is integrated with facial expression, eyes movement, body gestures and emotional text and pictures. The main innovations lie in giving appropriate emotional adjustment or compensation to learners, with a more accurate model recognition, and keeping learners' interest in a learning topic or task, so as to optimise learning effects. This model can improve the degree of learners' emotional recognition in the environment of e-learning, which is helpful when judging the learners' learning cognition state.

E-learning with an emotional interaction function is a combination of cognitive science, emotional computing, machine learning and pattern recognition techniques. It can be both an effective auxiliary means in teaching, and it can also promote the learners' cognitive and emotional development.

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