



A New E-Learning System Design Focusing on Emotional Aspect Using Biological Signals

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Abstract

E-learning is content and instructional methods delivered on a computer, and designed to build knowledge and skills related to individual or organizational goals. It is commonly thought that new technologies can make a big difference in education. Though e-learning is being debated to have some advantages over person to person teaching, the latter is considered to be superior with respect to the effectiveness of teaching. One of the reasons for this advantage of human expert tutors is their ability to deal with the emotional aspects of the learner. In e-learning system, emotions are important in the classroom, we proposed a new e-learning system that focuses on affective aspects. Our system also integrates biological sensors to measure, detect, and analyze user emotions and also designed this would complement the effectiveness of e-learning.

1. Introduction

E-learning is content and instructional methods delivered on a computer (whether on CD-ROM, the internet or an intranet), and designed to build knowledge and skills related to individual or organizational goals [1]. The definition of e-learning is broader than, but includes, "online learning," "Web-based training," and "computer-based training." Most importantly, it signals the paradigm shift in education and training that is in progress. Thus, many universities have applied electronic communication for e-learning systems to enable people to learning anytime and anywhere, to deliver content, and methods that build new knowledge, and skills linked to individual learning goals, or to improve performance.

In e-learning systems, emotions are important approach to foster, and develop positive emotion of students. The emotional education can help students to form a right attitude to requirement, motivation, and interest. E-learning is different from traditional education has become a new learning way. It is characterized by the separate location of teachers and students. Students who study with mouse, keyboard, screen don't see any teachers' expression of encouraging or criticizing in the learning environment and are easy to lose learning interest [2]. For these reasons, it is important for teachers to create a positive, emotionally safe classroom environment to provide for optimal learning. Learning how to manage feelings and relationships constitutes a kind of "emotional intelligence" that enables people to be successful [3].

A biosensor is an integrated receptor-transducer device, which is capable of providing selective quantitative or semi-quantitative analytical information using a biological recognition element [4]. We used three biological sensors, are electrocardiography (ECG), electroencephalography (EEG), and eye tracking for measurement of emotion of learner.

In this study, we focused on the emotional aspect of the e-learning system using biological signals. The purpose of this study is to design learning environments and tools that avoid inappropriate affective states such as boredom, anxious, anger etc.

2. Literature review

Kittanakere et al. introduced the design of an emotion sensitive e-learning system that gives emphasis to the complete learning process and is very cost effective [5]. The system categorizes a learner's emotional state as follows: Happy, Neutral, and Sad. This motivates to think about incorporating emotional aspects of teaching in e-learning systems to make it more intelligent. An intelligent e-learning system should be able to adapt to the knowledge, learning abilities and needs of each learner. This would give them a feel of individual care which would help them in the learning process. Khan developed a framework for e-learning, which contained eight dimensions [6]. It consists of the following eight dimensions:



- The pedagogical dimension of e-learning refers to teaching and learning. This dimension addresses issues concerning content analysis, audience analysis, goal analysis, media analysis, design approach, organization, methods and strategies of e-learning environments.
- The technological dimension of the e-learning Framework examines issues of technology infrastructure in e-learning environments.
- The interface design refers to the overall look and feel of e-learning programs. Interface design dimension encompasses page and site design, content design, navigation, and usability testing.
- The evaluation for e-learning includes both assessment of learners and evaluation of the instruction and learning environment.
- The management of e-learning refers to the maintenance of learning environment and distribution of information.
- The resource support dimension of the e-learning Framework examines the online support and resources required to foster meaningful learning environments.
- The ethical considerations of e-learning relate to social and political influence, cultural diversity, bias, geographical diversity, learner diversity, information accessibility, etiquette, and the legal issues.
- The institutional dimension is concerned with issues of administrative affairs, academic affairs, and student services related to e-learning.

This framework also applied and provides a new e-learning system.

Huiqin et al. also provided in e-learning, the emotional teaching design consists of six parts based on virtual reality [7] as follows:

- learning goal: The emotional goal should be determined supported by students' individuality and subjects' characteristics, which is helpful to developing students' emotion in the process of studying.
- learning content: The learning content, especially emotional content should be selected according to the attribute and content of course. It should enrich students' emotional experience, arouse students' learning interest.
- learning strategy: The proper strategies, such as collaborative learning and group learning provide more emotional interaction between teachers and students.
- learning manner: It is a good way to combine visual thinking and logic thinking for emotional education in e-learning.
- learning environment: The learning environment should be designed according to the learning content to help students understand easily.
- teaching evaluation: Evaluation that comes from teachers, students and fellows can enhance communicate each other, and students may feel the loving care of teachers.

Shen et al. also integrated the heart rate (HR), skin conductance (SC), blood volume pressure (BVP), and EEG brainwaves EEG detect an emotion of learner [8]. The results about emotion recognition from physiological signals achieved a best-case accuracy (86.3%) for four types of learning emotions. The system affective e-learning model that included only a subset of the factors that could be taken into account to assess learner's emotional reactions in e-learning.

From the literature reviews, designing a system that focuses on user emotions using some biological signal is very promising. Therefore, we propose a new e-learning system design that avoids inappropriate affective states such as boredom, anxious, anger etc.

3. Design of e-learning system

E-learning are becoming an increasingly important part of higher education. This type of education can take place over the Internet, through which the instruction and educational content are delivered [9].

We applied four learning goals using the following criteria as a process and goal, content, learning tasks, and development time. and applied three important design aspects of instruction for create the new e-learning design as below:

- instructional design is provides an overview of strategy, tactics and activities of instruction.
- Interactive design is provides an introduction to interactive engagement, and modes of interactivity.
- Testing & evaluation is provides a discussion of the essential role of testing and evaluation.



We proposed a new design of an e-learning system using biological signal that are affective to the learner that closer to learn in the classroom. Our system also integrates biological sensors to measure, detect, and analyze user emotions. In this section we discuss the overall designed of the e-learning system "Fig. 1". This system uses an LMS (learning management system) for delivering, tracking, and managing education and a web server that provides the user with easy access by web browser on a personal computer. While they using our system, biological sensors measure user biological signals as EEG, ECG and eye tracking as sensors to analyze and detect their emotions. The learners can express the positive or negative emotions which have significant influence on learning by the system.

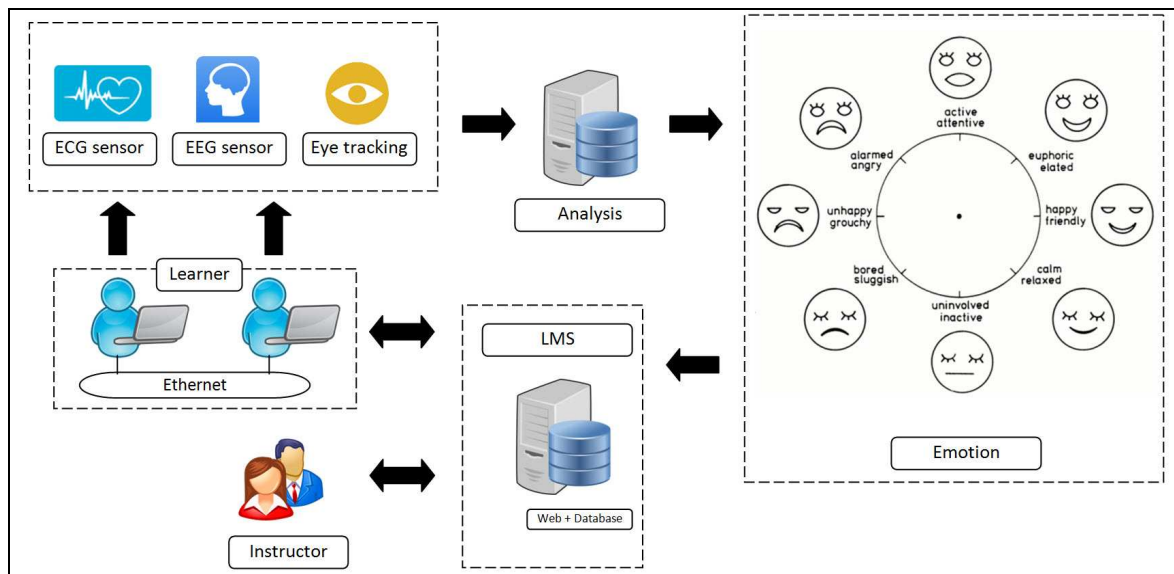


Fig.1. The proposed e-learning system

We used a framework for e-learning [6], which contained eight dimensions "Fig. 2". These factors can encompass various online learning issues, including: pedagogical, technological, interface design, evaluation, management, resource support, ethical, and institutional.

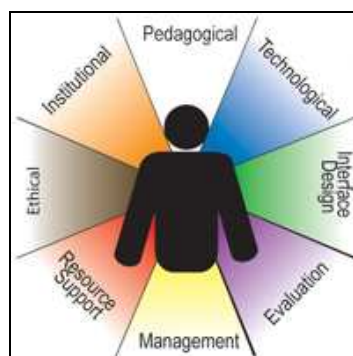


Fig.2. Badrul Khan's E-Learning Framework

The framework design of e-learning system using biological signals consist of five modules as shown in "Fig. 3". The content will be described as below:

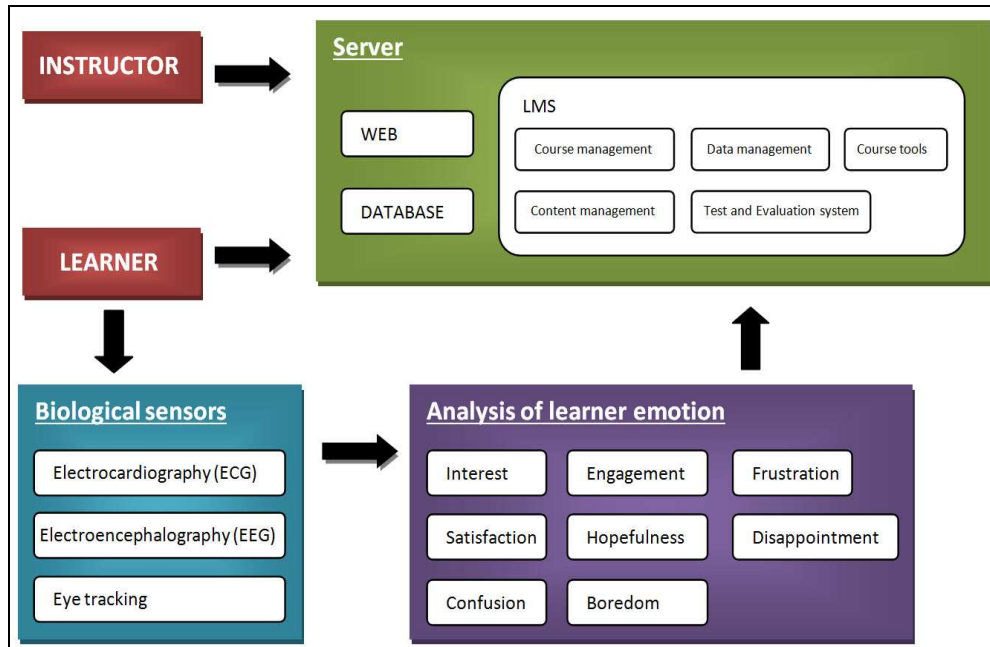


Fig.3. Freamwork design

- **Learner**: is the individual who takes up the e-learning by registering themselves to the e-learning system. The learner can choose any of the courses provided by the system and using five I/O devices such as speaker, monitor, touch screen, keyboard, and mouse.
- **Instructor**: The instructor is an important in this system who creates and designs courses, contents, tests, quizzes, and evaluation.
- **Server**: Servers are web server, database server, and LMS that provide services to other computer programs (and their users) in the same or other computers. A web server is simply a computer program that dispenses web pages as they are requested. Our design uses an internet information server as a web application server. A database server is a computer program that provides database services to other computer programs or computers. LMS is a software application or Web-based technology used to plan, implement, and assess a specific learning process. Typically, a learning management system provides an instructor with a way to create and deliver content, monitor student participation, and assess student performance. LMS consist of 5 parts as a course management, content management, test and evaluation, course tools, and data management system.
- **Biological sensors**: Biological sensors are ECG, EEG, and eye tracking for measurement of emotion of learner. An EEG sensor measures voltage fluctuations from electric ions within the brain's neurons. An 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 (BMP). Eye tracking is a device for measuring eye positions and eye movement.
- **Analyze emotion of learner**: This design system is to understand how learners' emotions evolve

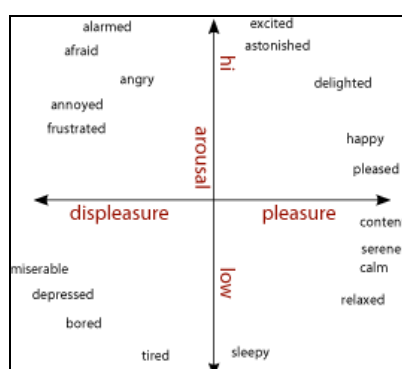


Fig.4. Russell's 'circumplex model'



during learning process, so as to develop learning systems that recognize and respond appropriately to their emotional change. We used Russell's 'circumplex model' to describe user's emotion space [10] as shown in "Fig. 4". The basic set includes the most important and frequently occurred emotions during learning, namely, interest, engagement, confusion, frustration, boredom, hopefulness, satisfaction, and disappointment.

4. Conclusion

We have described our approach to designing a new e-learning system that focused on emotional aspects. The learners can express the positive and negative emotions which have significant influence on learning by themselves. Therefore, the e-learning system aim is to avoid inappropriate and affective states such as boredom, anxious, anger etc. In future work, we will take experiments our system. Comparing with e-learning design based on contents such as multimedia, text video, etc that affect with emotion's learner and improve our system. In addition, we can do further research on more complexes and find out what is the most effective in students' learning.

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