4th International Conference on New Horizons in Education

Towards Smart Education: Ambient Intelligence in the Mexican Classrooms

Pedro C. Santana-Mancilla [a,*], Martha Alicia Magaña Echeverría [b], Juan Carlos Rojas Santos[a], José Alejandro Nieblas Castellanos[a], Alma Patricia Salazar Díaz[c]

[a] *IHCLab, School of Telematics, University of Colima, Mexico*
[b] *School of Pedagogy, University of Colima, Mexico*
[c] *School of Tourism, University of Colima, Mexico*

Abstract

The rapid adoption of portable devices, like tablets and smart phones, has allowed students to have access to information directly in the classroom. However, this is not enough. Due to the new trends of interaction with computers and wireless interconnection networks between heterogeneous devices and the growing interest in improving the teaching-learning process, has led to the educational field the application of a discipline known as Ambient Intelligence (AmI) with the purpose of provide intelligence to the ordinary classroom. AmI is a new information paradigm, in which people are immersed in a digital environment that is aware of their presence and context, which also suits their needs. In this research work, we describe a smart classroom, which aims to realize the AmI vision in education. This vision applied in Mexican schools can significantly enhance the educational domain, through personalizing and adapting of the learning environment to enable natural interactions and context aware education in the technologically augmented classroom of the future.

Keywords: Ambient Intelligence; Smart Classroom, Smart Education, Learning Technology.

1. Introduction

The rapid adoption of smart mobile devices and the predominance of laptops used by students, have enabled that school classrooms (especially in advanced degrees) have access to information much faster than previous generations. However, this is not enough.

Some difficulties that face students while studying with computer-supported media are: the resources do not facilitate communication between students, or the exchange of information between them and the professor, the information gathered by students is not always relevant or appropriate to the subject of study presented in class, computers are not able to help with specific exercises made on physical media, such as textbooks, copies and other print materials (Margetis, Zabulis, Koutlemanis, Antona, & Stephanidis, 2012).

With the new trends in natural interaction between the computer and the human, wireless networks between heterogeneous devices and a genuine interest in research to improve learning, has led

* Corresponding author. Tel.: +52-312-316-1059; fax: +52-312-316-1059.
E-mail address: psantana@ucol.mx.

to the application of new technologies in this area to improve the situations described above, as in the case of ambient intelligence (AmI).

The work presented in this paper aims to develop an intelligent classroom, which will use the AmI paradigm to transform the conventional classroom into a context aware environment.

2. Background

For years, the computers miniaturization has allowed their incorporation in our daily lives, a few decades ago it was impossible to think that we would have devices that fit in the palm of a hand with the processing power of a desktop computer, it was not feasible to think in wireless networks of low-power consumption and high-speed, embedded devices that perform thousands of non-invasively functions into our lifes. The use of smart mobile devices is so entrenched that there is a new generation of user called digital natives (Bennett, Maton, & Kervin, 2008). Digital natives are used to work with electronic devices and information technologies, most connected to the internet and, in general, for these users are a big part of their daily life. Therefore, new research paradigms as the AmI are growing rapidly (Shadbolt, 2003).

Today, it is difficult to find an area of study that has not been permeated by AmI and do not feel its influence. The systems are being designed so that people do not need prior computer knowledge to be benefited by its use (Augusto & McCullagh, 2007). For example, the graphical interfaces have been augmented with speech recognition, video games have been adapted for use with wireless full-body interaction, wireless communication protocols such as Bluetooth and Zigbee have removed the need for a wired connection.

These devices must be used in conjunction with highly intelligent software to understand the events and the relevant context occurring around the device and from that make rational decisions (Augusto, Nakashima, & Aghajan, 2010), in a digital environment that proactively, but reasoned, supports people in their daily lives (Augusto, 2007).

This set of technologies is aligned to the term "the disappearing computer" (Weiser, 1993):

"*The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.*"

These technological advances bring enormous potential for improving education through more efficient ways, different and innovative (Kinshunk, Sutinen, & Goh, 2003). In addition, academic institutions can use technology to monitor the progress of their students' learning (Cook, Augusto, & Jakkula, 2007).

3. Related work

Next we describe research works that make use of AmI in support of education.

A smart classroom at Northwestern University (Franklin, 1998) use microphones and with the captured information infer the speaker's intentions and thus control the lighting, play videos, flip slides, etc.. The interesting part is that no explicit programming is required to interact with the system; natural actions of users enable appropriate responses in the environment.

The iClass architecture (Ramadan, Hagras, Nawito, Faham, & Eldesouky, 2010) is a classroom with multiple sensors, actuators, processors, and a heterogeneous network. This allows controlling various aspects of the classroom as the air temperature, the opening of shutters, and the intensity of the light in the lamps. All these sensors are hidden from students and teachers so that the user is not aware of the class intelligent infrastructure.

4. Contextual study

Our field work was designed to know the opinions of the actual students of our school, we focus on the services required on a smart classroom on their opinion.

4.1 Methods

We interview 20 randomly-chosen students from different grades from the School of Telematics at the University of Colima.

4.2 Results

Fig. 1 show that 70% of interviewed students unknown what a smart environment is. So we had to explain what is it before continue with the interview.

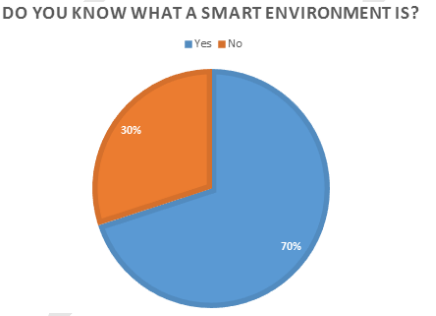

Fig. 1. Answers to question: Do you know what a smart environment is?

Fig. 2 shows that the 20 students interviewed are interested on a smart classroom.

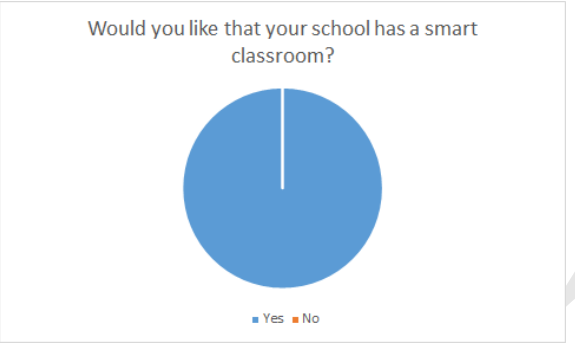

Fig. 2. Answers to question: Would you like that your school has a smart classroom?

Fig. 3 shows the students preference on putting intelligence on the following services of a classroom.

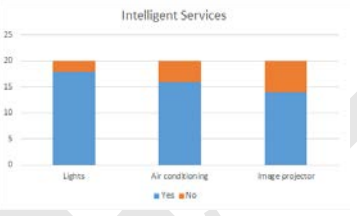

Fig. 3. Answers to question: Desired intelligent services

Finally we ask is they think that a smart classroom will be helpful on their studies, 99% said yes (see Fig. 4).

Fig. 4. Answers to question: Do you think a smart classroom will help you in the study?

5. Envisioned system

In order to achieve these issues, we envision that our system needs to address the following aspects:

Support heterogeneous devices. The system must be able to be used in as many devices as possible because there are a very large number of different devices. The idea is that the scope gets to be as broad as possible.

Interface easy to use. The smart environment must have a very small learning curve and be as easy to use as possible.

6. System design

Based on our envisioned system we engaged in the design and development of a prototype of the project, which is described next.

The project consist on two boards (master and slaves) in order to gather and process all the information in the sensor network at the classroom.

The master board is responsible for interacting with the smart classroom, monitoring the temperature, the amount of indoor light and the teacher's presence to turn on the projector, as well a graphic LCD display for monitoring all the components. This card works with a microcontroller Pic18f4550.

The temperature module works with a DHT22 sensor with a temperature range from -40 °C to 80 °C with a resolution of 0.1. The lighting module has a LDR sensor with high index of lumens and the proximity module uses an ultrasonic sensor.

All modules communicate with the slave boards via the XBee communication module.

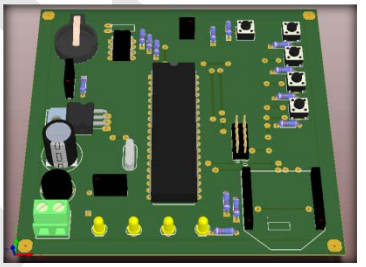

Fig. 5. Master board.

7. Usage scenario

To illustrate the functionality of the system, we present the following scenario of use that describes how the students would interact with the smart classroom:

Sun is shining in all its splendor and it's just a bit too warm to feel comfortable, but as soon as someone walks in the classroom, the fans start spinning and you feel a welcoming breeze. A few minutes later, all that heat leads to storm clouds forming and leaving you in the dark, but suddenly lights go on, automatically, and you start to take notes soon again. Then, your teacher remembers he has a few slides prepared to help you understand that equation you can't master just yet, he approaches the video

projector and connects his laptop. The projector starts doing it's job and lights dim, again, in an automatic way. After this, you can't help but to think "There's no other classroom I'd rather be."

8. Applications

Working on the smart classroom project we realized that creating physical infrastructure was not enough, so we started creating apps to coexist at the intelligent environment.

Augmented reality for secondary education students

We are using mobile augmented reality to allow Mexican secondary education students to access additional educational contents related to their textbooks (see Fig. 6).

Fig. 6. Student with the AR app.

Mexican history through a serious game with physical activation

We are working to create a serious game for children's physical activation. The interaction will be provided through the Kinect.

This game will allow them to learn from the history of Mexico in addition to increasing their physical activity (see Fig. 7).

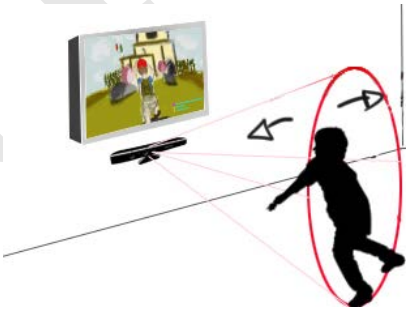

Fig. 8. Serious game.

Natural interactions for learning mathematical concepts

Now we are engaged on developing an app for learning mathematical concepts through the use of natural user interactions. You can find a couple of screenshots of our first prototype.

Fig. 8. MathNUI.

9. Conclusions

This work proposes to improve the learning process by the design of a smart classroom with ambient intelligence. The design process was informed on a contextual study with actual student.

As a general conclusion we can say that the use of smart classroom for education is adequate for the students and the learning process.

Acknowledgements

This project was sponsored by the IBM Students for a Smarter Planet Initiative trough the project “Smart classroom through ambient intelligence and natural interactions”.

References

Augusto, J. (2007). *Ambient Intelligence: the Confluence of Ubiqui- tous/Pervasive Computing and Artificial Intelligence.* Londres, Reino Unido: Springer.

Augusto, J., & McCullagh, P. (2007). Ambient Intelligence: Concepts and Applications. *Computer Science and Information Systems*, *4*(1), 1-28.

Augusto, J., Nakashima, H., & Aghajan, H. (2010). *Handbook of Ambient Intelligence and Smart Environments.* Nueva York: Springer.

Bennett, S., Maton, K., & Kervin, L. (2008, Sep). The ‘digital natives’ debate: a critical review of the evidence. *British Journal of Educational Technology*, *39*(3), 775-786.

Cook, D., Augusto, J., & Jakkula, V. (2007). *Ambient Intelligence: Technologies, Applications, and Opportunities.*

Franklin, D. (1998). Cooperating with people: The intelligent classroom. *Proceedings of the Fifteenth National Conference on Artifical Intelligence,* (pp. 555-560).

Kinshunk, S., Sutinen, E., & Goh, T. (2003). Mobile technologies in support of distance learning . *Asian Journal of Distace Education, 1*(1), 60-68.

Margetis, G., Zabulis, X., Koutlemanis, P., Antona, M., & Stephanidis, C. (2012). Augmented interaction with physical books in an Ambient Intelligence learning environment. *Springer Science+Business Media*.

Ramadan, R., Hagras, H., Nawito, M., Faham, A., & Eldesouky, B. (2010). The Intelligent Classroom: Towards an Educational Ambient Intelligence Testbed. *2010 Sixth International Conference on Intelligent Environments,* (pp. 344-349). Cairo.

Shadbolt, N. (2003). IEEE Intell. (18), 2-3.

Weiser, M. (1993). Hot topics: Ubiquitous computing. *IEEE Computer*, 71-72.