Augmented Reality Application for Telecommunications Concepts Learning

Patricia Madrinan
i2t Research group–CENIT Research Center
Universidad Icesi
Cali, Colombia
e-mail: patri@elsitiomio.com

Domiciano Rincon
i2t Research group
Universidad Icesi
Cali, Colombia
e-mail:
domiciano.rincon@correounivalle.edu.co

Andres Navarro
i2t Research group–CENIT Research Center
Universidad Icesi
Cali, Colombia
e-mail:anavarro@icesi.e.,du.co

***Abstract*—Learning concepts is difficult using only a traditional chalkboard approach; practical experience to develop enigineering abilities, however, can be expensive and complex. In this setting, a gamification approach is useful and can improve the learning process. The objective of this paper is to present an educational experience based on a technological development that is implemented on a smartphone using augmented reality. The purpose of this approach is to facilitate learning by maintaining the attention and interest of users/learners through game techniques, and to develop soft skills, such as teamwork and lifelong learning.**

Keywords-games; serious games; engineering education; gamification.

I. INTRODUCTION

Soft skills, such as teamwork, communication, and lifelong learning are essential for today's engineers but are fairly difficult to employ and evaluate. In addition, some concepts in radio engineering are traditionally taught in the classroom using a mathematical and theoretical approach. In this study, we propose a new approach for learning a traditional concept: radio localization, or direction finding (DF). Radio localization using line of bearing is a well known concept that has been described in the literature. However, our field experience has demonstrated that although many engineers understand the concept theoretically, they are unable to use DF equipment to locate an emitter. The use of portable DF equipment and illegal emitters is expensive, and there are regulations that prohibit the use of real test scenarios for training engineering students.

As a consequence of these limitations, we have developed an application called Hunting, with the aim of developing not only technical skills pertaining to DF concepts, but also soft skills, such as teamwork. Hunting refers to a task in telecommunications that involves using the line of bearing technique to locate a radio transmitter with a portable device. It should be noted that commercial devices for this purpose are sold by main test equipment manufacturers.

Telecommunications, within the context of engineering, encompasses a wide range of specific areas. It is a multidisciplinary field whose specific language must be decipherable by teams having different levels of abilities. Presenting an application in this field in a friendly and effective manner has been an incentive and challenge for our work.

Engineers, and more specifically engineering students, require skills that allow them to experiment proactively to acquire long-term learning abilities; simply acquiring knowledge that expires in a short time does not suffice. Each educational experience can be an opportunity to ask questions, make decisions, and dare to challenge previous assumptions.

The Hunting application serves to teach the basic concepts of DF. It is a serious multiplayer educational game that is developed as an application for Android cell phones using augmented reality. It integrates hardware capabilities to enable interaction with the application in the cloud, which can be remotely controlled by an instructor from a server, locating users in real time and adjusting the location of the goal.

The cognitive objective is very specific: to locate a source of interference. To accomplish this task, the apprentices must leave the classroom, or the enclosure, to find the source, aided by sounds, animations, and a dynamic map in the application. A clear goal, sense of achievement, deciphering an enigma, and conquering an objective are the essential components for maintaining motivation within the game, all while discovering and learning concepts in a pleasant and satisfying way.

With respect to technological devices, different levels of intimacy exist. The cell phone has become an extension of the body and is perceived as part of the individual, a prosthesis without which life seems unthinkable. This phenomenon occurs mainly among young people, who appear as true cybernetic organisms, or "cyborgs" [1]. A new category of educational mediation based on modern information and communication technologies has emerged, taking advantage of widespread smartphone use. Combining gameplay, usability, interactivity, and empathy, these afore-mentioned educational technologies can provide a friendlier learning environment than has so far been available.

Removing students from the classroom and including physical movement within a learning activity involves new challenges. The main objective of the proposed learning activity is to use a technological tool to help break the habits of passive learning and to force students to be active participants in the learning process.

Hardware limitations present several development challenges, however, such as the lack of standardization in the technical specifications of various commercial smartphone

 ISBN: 978-1-61208-689-7

models. The link between mobile devices, which are increasingly affordable for the vast majority of the population, and new technologies gives rise to opportunities that transcend geographical distance and digital gaps. In this work, these opportunities are applied to education in the realm of engineering.

The remainder of this paper is organized as follows. In Section II, we describe the application and related concepts. In Section III, we present several technical matters and preliminary results obtained from a small group of students and individuals of different ages. In Section IV, we present conclusions and proposals for future work.

II. EXAMPLE OF "LIES" MEDIATED BY A TECHNOLOGICAL APPLICATION

With our hunting application, we introduce the concept of a learning immersive experience significant (LIES)**,** a proposal for an educational methodology that takes into account the experience of the individual and uses an application as a technological mediator. We play with the word *lies* (from the verb *lie*) to express that a virtual, or unreal world, using augmented reality (immersive experience) is used to enhance the learning experience (significant experience).

We propose a blended immersive approach, attempting to make use of traditional online virtual courses. However, our approach is neither a typical face-to-face course nor a virtual or traditional blended concept. Instead, it falls between both of these teaching methods, supposing a pedagogical mediator. On the one hand, there is mobile technology, which offers, similarly to tattoos or prostheses [2], an ever-present companion that accompanies individuals everywhere. On the other hand, there is the instructor, who provides a pedagogical experience by guiding a group in an adventure. The pedagogical figure has a great significance in all types of "disciplines" (which is received from another individual), in contrast to "invention" (which is discovered by oneself) [3].

Technology acts as the pedagogical mediator [4] between the cognitive content of the course and the interpersonal relationship between different participants of the same experience. It facilitates situations, triggers emotional responses, and generates circumstances that extend the boundaries of traditional education [5].

Fear is a barrier that can stop the immersion that enables the empowerment of knowledge [6]. However, the playfulness conspires to deal with the initial fear and overcome it. Through the game, we can appreciate the way in which the intangible becomes visible through a mediating device (augmented reality) when paying attention to signals and directions that guide us toward an objective. The relationship between the digital map and the terrain that we tread and the encounter with physical experiences related to a mental process generates an educational atmosphere that increases the level of consciousness and, therefore, the ability and autonomy to solve problems. A LIES search aims to make the apprentice, gamer, or user desire to learn and experience the following: "Instead of resisting or being scared when facing a task, we softly accomplish it, alive and fulfilled with new knowledge, and avid to see what comes next" [7].

The Hunting application is not a competitive game. All students must decipher the enigma (the location of the emitter), and collaboration is promoted when a team of two or more students share a device. The goal is clear: the students must locate the pirate (illegal emitter), which is the interference source responsible for generating problems (represented by a parrot as a figurative image of the target to be located). Hunting tasks involve DF issues, in which engineers must discover the precise location of the source on a map and travel to that location to retrieve it. With the Hunting application, students are immersed in the combination of the real world and the virtual world (as the information is generated in the application), and they must physically travel around the campus to find the emitter.

III. TECHNICAL FINDINGS AND PRELIMINARY RESULTS

The Hunting application requires an Internet connection, a cell phone with a global positioning system, and at least one of the following three sensors to be able to operate: digital compass; magnetic field sensor; and/or orientation sensor. The application uses an accelerometer to determine the position of the cell phone with respect to its center, and it uses the orientation sensor to determine the position of the cell phone with respect to the earth's north (and in this way, determine the direction in which the device points). Initially, we expected that most mid- to high-end devices would incorporate the required sensors, as they are used in many popular navigation applications.

The application was tested with various devices, including Huawei P8, Lenovo Vibe K5, Motorola Moto G2, Motorola Moto G3, Motorola Moto G4 plus, Motorola Moto X, Motorola Moto Z, Samsung Galaxy S6 Edge, and Samsung Galaxy Alpha. Of these cell phones, all the high-end phones were compatible with the application; that is, they possessed the required sensors. However, game performance in all cases was not identical. Samsung phones were expected to have superior performance, but their orientation sensor offered lower resolution by launching as few angles as possible when making a loop with the cell phone. Motorola Moto G2 and G4, Moto X, Huawei P8, and Lenovo Vibe K5 offered superior resolution in their orientation sensors, achieving improved performance by improving fluidity when making a sweeping motion looking for the "pirate." In contrast, to our surprise, Motorola Moto G3 and G4 Plus were not compatible with the application because they lacked an orientation sensor. We expected them to possess the sensor, as they were newer versions of the Moto G2 that did possess the orientation sensor. Finally, it should be noted that for correct operation of the orientation sensor, the mobile device must be shaken in all directions before starting the game.

Until now, we had only tested the application in a small group of undergraduate students to obtain an initial impression of the user experience. For the majority of the students, the use was intuitive, and all teams found the emitter. Some students had comments about the initial instructions; however,

 ISBN: 978-1-61208-689-7

the application purposely lacks instructions. Because the game is intended not only for engineering students, but also for individuals from different telecommunications disciplines, the friendliness of the interface is important for facilitation of usability. Figure 1 demonstrates the initial screen of the application, and Figuress. 2 and 3 display students playing the game. In both figures, it is possible to see the various lines of bearing that are generated by the simulated direction finder in the application.

Figure 1. Welcome image of the application

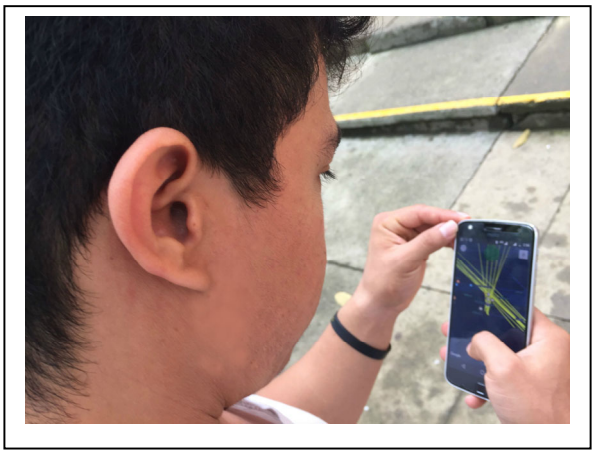

Figure 2. Student testing the application

Figure 3. Searching for the target.

IV. Conclusions

The educational experience process is the pedagogical objective itself, where the goal of the game is the excuse and learning is an additional gain. The important issue is the involvement of the skills necessary to achieve the goal and the manner in which this goal is achieved.

For the first time we propose and apply in this work the LIES concept using the Hunting application. This application of the LIES method, as a pedagogical mediation exercise using a technological development, is an example of a user-centered activity that offers a simple way of active learning, bypassing usual procedures by breaking away from the boundaries of the classroom.

Although technology serves as a mediator of the pedagogical process, it is not the center of the experience, but rather a tool. Requiring the application of knowledge, and transcending traditional classroom borders, the application allows for the integration of cognitive abilities and active learning. The LIES approach promotes the active role of the student, as students are eager to receive feedback that clarifies their experience. The Hunting application opens the door to learning, offering an autonomous exploratory activity.

One implementation problem of the Hunting application involves the differences in the performances of device sensors, as well as the lack of standardization in the technical specifications of different smartphone models. This issue results in different yields and accuracy of location data, and should be addressed in future work.

References

[1] M. M. Kusnagi, "Dispositivos, prótesis y artefactos de la subjetividad cíborg," *Jóvenes Tecnofilosofía Arte Digit.*, p. 41, 2013.

[2] H. Belting, *Cruce de miradas con las imágenes. La pregunta por la imagen como pregunta por el cuerpo*. Universidad de Salamanca, 2011.

[3] E. D. Dussel, *La pedagógica latinoamericana*. Nueva América, 1980.

[4] F. G. Pérez and D. P. Castillo, *Mediación Pedagogica: apuntes para una educación a distância alternativa*. Instituto de Investigaciones y Mejoramiento Educativo, 1996.

[5] M. McLuhan, B. R. Powers, and C. Ferrari, *La aldea global*. Gedisa, 1995.

[6] J. A. Marina, *Anatomía del miedo*. Anagrama, 2010.

[7] C. Pinkola, *Mujeres que corren con los lobos*. Barcelona: Ediciones B, S.A., 1998

 ISBN: 978-1-61208-689-7