AUGMENTED REALITY AND THREE-DIMENSIONAL MODELS OF TECHNICAL DRAWING AND GEOMATIC TECHNIQUES LEARNING

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Abstract

Based on the acquired experience on teaching and learning the subjects of Graphic Expression and Geomatic Techniques in different study plans of engineering degrees, a group of lecturers is working on the generation of new resources and documented materials based on the 3D Models and Augmented Reality application.

In this paper we present an advance of results of the Educational Innovation Project IE1617-2007 "Augmented Reality and 3D in Graphic Expression and Geomatics ".

Project objectives are designed to help the student to develop a better spatial vision in the 2D-3D process. Finally, by means of these tools, we propose to increase the efficiency in the use and application of tools and geomatic techniques.

The resources thus obtained are adapted and implemented in 2.0 type methodologies. They are based on collaboration, sharing and team work, with the permanent revision of the teaching-learning environment in the field of Geo-Spatial Information Technologies. It is imperative that students identify themselves with a graduation profile and the specific competences they must achieve, in this case in relation to graphical expression and geomatic techniques.

Keywords: Augmented Reality, 3D, Technical Drawing, Geomatics.

1. INTRODUCTION

The work develops a tool by augmented reality (AR) so the student can experience, learn and interpret a faster spatial vision. It will be one accessible resource in both format classroom face-to-face format and outside the classroom, distance and easy to use, both for teachers and for students.

The main objective is to implement AR in a learning environment, in this case, it is to overlap the perception of useful information that engineering students have of some geometric elements and real spaces. Such information is typically encoded in the form of computer-generated images and they can enrich the user's experience in a real environment [1].

The study of the comprehension and development of spatial capabilities in students using AR tools, have been used by Martín-Gutiérrez [2].

Spatial intelligence encompasses concepts of spatial perception, spatial visualization, rotations, spatial relationships and spatial orientation, all of these features are in the field of geometry, an educational field that is responsible for improving these spatial abilities [3].

Thus, the use of AR in University education, in our case in graphic expression (Fig. 1), can be essential due to the development of spatial ability and adaptation to the learning rhythm of each student. There are several developments in research work for the teaching of abstract geometry concepts applying AR techniques [1].

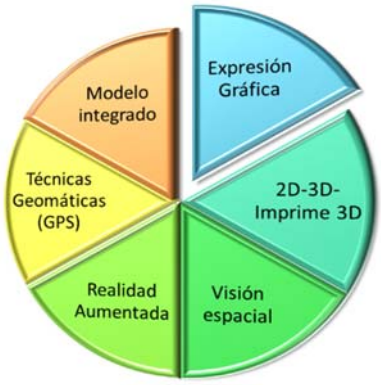

Figure 1. Process followed in the matter of Graphic Expression.

For the creation of AR systems, the process of combining the virtual image with the real image is fundamental. The different current mobile devices, tablets, mobiles, etc., they are of daily use and will be used in the present work. The accessibility to these mobile devices by students makes them the most adequate to be able to work and develop AR tools in the learning process, as well as the acquisition of spatial skills (Fig. 2).

Figure 2. Development of spatial vision by AR.

To carry out the process and follow-up of AR applications we will use the following types of markers:

- ID Markers. They are rectangular and used for AR applications. They are easily detected and tracked.
- Bar codes or rapid response codes (QR). Bar codes are 2D representations with computer readable information. QR codes are similar to ID markers and are the best known. From its recognition by a specific reader will take us to an application on the internet.

For the QR case, we start from the position of any piece (Figure 2) in the context of traditional geometry (projection system of the first dihedral). Later, its design and three-dimensional insertion with a simple software, SketchUP type, hosting in Gallery or Online repository in an AR portal (type Augment or Aurasma). Finally, it is shared in a specific learning environment. It is operated in the same way in the case of the matter that we call Geomatics techniques (Fig. 3) and its application to a real case (Fig. 4).

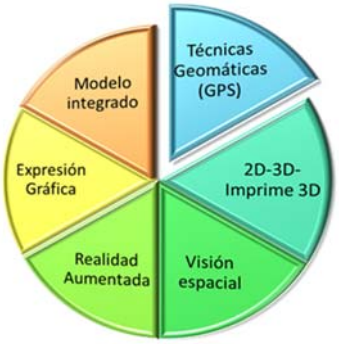

Figure 3. Process followed in the matter of Geomatics Techniques.

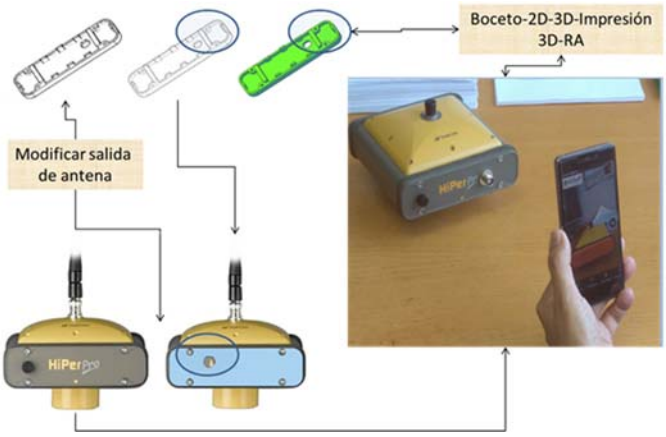

Figure 4. Use of AR in Geomatics instrumentation. (Adaptation of housing in GPS receiver).

2. METHODOLOGY

We start with a selection of figures, given in the orthogonal cylindrical projection (Dihedral System) and analyze its complexity in the passage from 2D figures to 3D models. Subsequently, the figures are designed using the SketchUp software, and we conveniently examine the different views of the model.

The 3D model will be used to implement a database in the cloud or shared Gallery. The AR developed tool will use these 3D models as an aid in the understanding and development of the space capabilities to convenience of each student.

Each student will be assigned the views corresponding to a 3D model and will have to develop their spatial visualization. The teacher will guide in the necessary exercises, to develop these capabilities and will use the AR implemented tools as an aid to achieve those objectives [3].

The last proposal stage is directly associated to the acquisition of skills, both in the previous case and in its application. The action is aimed at students of 1st and 2nd year in engineering degrees.

The matter of graphic expression in engineering degree programs is to provide the student with some skills and allows him to express with precision in technically graphic language in the development of his future profession. We start with a basic figure and its representation in the Dihedral System (2D-3D), is assigned a QR code that will serve as a link to visualize the referred figure and implement it in any virtual or real context.

The subject of Geomatics Techniques, in several engineering degree programs, has as aims to provide the student with specific skills and knowledge that allow them to use instruments and technical related, as it is, in the case here treated, the use of GPS receivers. We need to attach a new antenna output to a GPS receiver housing, for this we follow the referral process (Fig. 3) and (Fig. 4). From the measurements of the casing we design the new model, then we print on a 3D printer, we test the new format and it is validated. Finally, we add the necessary information for the correct use of the GPS system.

3. RESULTS

As has been discussed in the previous paragraphs, the final results will be directly related to the overall development of the project, however, in this advance it includes series of geometric elements elaborated and integrated according to the process described. The results are forming an open resource for possible improvements, but now meets the mission to accelerate and improve the learning process of the students.

On the other hand, this research work is an initial reference to deep and improve the methodology previously described. On one hand, we have a database with 2D elements and its 3D correspondence, on the other hand, we have the key-markers (QR codes and images) for its implementation on a portal such as Augment and / or Aurasma. Finally, it should be noted that the materials or tracking templates have been previously generated in a video guide format.

4. CONCLUSIONS

In this work we present some of the experiences obtained in the framework of the Educational Innovation Project IE1617-2007 called: "Augmented Reality and 3D in Graphic Expression and Geomatics". We need to emphasize that, in the experimental use made with students with little spatial vision, the validity of this proposal has been confirmed, since it has improved to reduce the time spent by the student to acquire these capabilities.

The fact of relating the acquisition of abilities and specific competences of two upcoming subjects such as Graphic Expression and Geomatics Techniques, will allow us to implement active methodologies in a short time, as in the case of Learning Based in Project (LBP).

The experience and the results that we are obtaining improve the students yields in a very significant way. On the other hand, the almost massive use of mobile devices with wide compatibility and with connections to the network increasingly robust and fast, influences positively in this methodology to increase visibility, as well as the possibility of sharing learning in real time by opening new slots that each student adapts to their availability.

5. ACKNOWLEDGEMENTS

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