ARBlocks: A Projective Augmented Reality Platform for Educational Activities

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ABSTRACT

This demonstration will allow visitors to use different applications builded for the ARBlocks, a dynamic blocks platform based on projective augmented reality and tangible user interfaces aiming early childhood educational activities. Those applications, along with the platform itself, were designed to be useful tools for educators to teach general subjects for children, such as mathematical and language skills, as well as develop important abilities, like motor coordination and collaboration.

Keywords: augmented reality; education; tangible user interface

Index Terms: K.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems—Artificial, augmented, and virtual realities; K.3 [Computing Milieux]: Computers and Education

1 ARBLOCKS

The ARBlocks is a dynamic blocks platform for educational activities based on projective augmented reality and tangible user interfaces. It explores a strong educational concept called playfulness activities, in which a subject is taught without the child to realize that he/she is learning [4]. The platform uses the enormous potential of augmented reality to improve information visualization for education, which is very important, especially when it comes to children [1]. Since the ARBlocks is based on tangible users interface, it have have all the advantages of using tangible objects in education [6], among them are sensory engagement, accessibility and group learning.

1.1 Demonstration

During the demonstration the visitors will have the opportunity to use the ARBlocks with at least three different applications. One of them is to develop the language ability, in which the child will manipulate the blocks to combine the letters and form a word according to an image. Depending on the teach needs, they can also put together all the images with its correspondent word. In another application, the students can improve their mathematical skills, since the child is able to count the number of bees inside a block and, through the manipulation of them, learn basic operations, such as sum and subtraction. And finally, there is an application to improve the child motor coordination, in which the students have to move the blocks with specific movements. All the applications displays feedback to the student, so they can know if the activities were executed correctly, as shown on Figure 1.

During the demonstration, the visitor will notice that all the activities are done using only the blocks, showed on Figure 2. Thus, all the interaction performed by the children are done through this tangible user interface. Only the teachers will need to use keyboard and mouse to initialize the system and choose the application. Other feature the visitors will have the opportunity to see is that the camera-projector system is calibrated automatically, so the only concern of the educator is to ensure that the camera is capturing all the projector area.

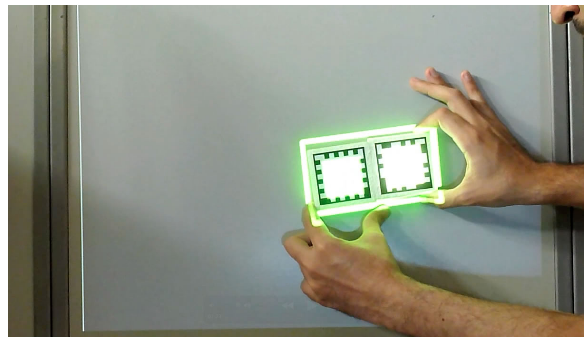

Figure 1: Positive feedback displayed when the blocks with an image is put together with its correspondent word.

Figure 2: Close up of one block with an image projected on it.

1.2 Set Up

The set up for the ARBlocks consists of a simple projector facing a table or any planar surface where the visitor can manipulate the blocks. In order to fulfil this condition, it can be attached to the roof or a tripod. This projector, along with a webcam, will be connected to a computer or notebook. The blocks are made with ethylene-vinyl acetate, or EVA, cut with the size of 6 x 6 x 2 centimeters (approximately 2.36 x 2.36 x 0.78 inches).

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2 VOXAR LABS

The Voxar Labs is a research group developing and transferring technology related to visualization, tracking and interaction techniques focusing augmented reality in multi-disciplinary application domains. The laboratory is located at the Informatics Center building, CIn, at the Recife campus of the Federal University of Pernambuco, UFPE.

Since 2005, a group of researchers with common interests has been investigating virtual reality and augmented reality technologies at CIn, leading recently to the creation of the Voxar Labs. This team, headed by Professor Veronica Teichrieb, is composed by multi-disciplinary researchers, from professors to PhD, master and undergraduate students, nowadays numbering seventeen. Figure 3 shows part of this team on a meeting. They work in diverse knowledge domains like computer science and computer engineering, design and mathematics, as well as application driven areas like physiotherapy.

Figure 3: Part of Voxar Labs team on a meeting.

Developing people by augmenting experiences is what the Voxar Labs team does, being the laboratory mission. The values representing the core priorities in its culture are creativity, cooperation, reliability, responsibility, flexibility, and enjoyment. Detailed information about the Voxar Labs can be found at http://www.cin.ufpe.br/voxarlabs.

2.1 Research Areas

Voxar Labs performs research on three major subjects, which are visualization, tracking and interaction, focusing augmented reality, as illustrated in Figure 4. The laboratory team has been involved with augmented reality research for almost six years.

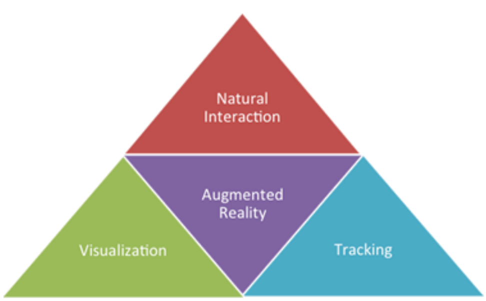

Figure 4: Voxar Labs focus on augmented reality as result from research on visualization, tracking and interaction.

2.1.1 Visualization

Ideally, augmented reality proposes that the user must not be able to distinguish between real and virtual information, demanding that the virtual elements show both geometric (correct placement, correct size, occlusions identification) and photometric (shadowing, mutual reflections, chromatic adaptation to scene illumination) consistency. To accomplish this task, the Voxar Labs works with great efforts in real time computer graphics algorithms [2] for massive data visualization and photorealistic rendering. Other projects regarding this subject aims to build tools for 3D reconstruction from images and for aiding the hydrodynamics design of submerged ships advancing and maneuvering with physics simulation in collaboration with the Brazilian Navy.

2.1.2 Tracking

The problem related to correctly positioning virtual information relative to the real environment is solved by tracking the environment so that the synthetic elements can be adequately registered with the real scene. There are diverse tracking technologies available and the optical tracking is often used due its cost, accuracy and robustness. Two types of optical tracking can be cited: marker based and markerless. The Voxar Labs conducts research on both of them. For the ARBlocks, a frame marker was proposed and its tracker was developed. Markerless augmented reality has received more attention from researchers in the latest years and presents important challenges to be overcome. Two examples of works with markerless tracking inside the laboratory are a hand and face tracking technique and an interest point based 3D tracking algorithm integrated with a particle filter, which is part of a markerless augmented reality framework developed at Voxar Labs.

2.1.3 Natural Interaction

Natural interaction is a powerful tool to achieve intuitiveness and usability for human-computer interfaces. In fact, interfaces are constantly evolving to provide users an easier way to interact with machines. Inside this field, Voxar Labs are conducting research focused on natural interactions applied in diverse application domains. One of them is education, with a dynamic blocks platform using tangible user interfaces [5]. Another one is physiotherapy, with an environment for rehabilitation and accessibility purposes based on virtual and augmented reality techniques using Microsofts Kinect. In the field of entertainment, the Voxar Labs has a musical game following consolidated platforms such as Rock Band [3].

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