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Problems of Working With Computer Graphics Applications in The Educational Process

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Abstract

This paper describes the use of Real Time graphic applications as educational tools, specifically oriented to working with people who have certain learning difficulties. We first focus on identifying the most relevant traits (from a psychological point of view) of those disorders, then we continue by analyzing the advantages of graphics in Real Time in this context, and how they can be used to complement the conventional teaching methods.

Keywords: *creating graphics; teaching graphics; graphics applications; alearning difficulties; virtual reality; computer graphics*

1. Introduction

An image that is presented on the computer screen is made up of pixels. The screen consists of a rectangular grid of pixels, arranged in rows and columns. The pixels are small enough that they are not easy to see individually. In fact, for many very high-resolution displays, they become essentially invisible. At a given time, each pixel can show only one color. Most screens these days use 24-bit color, where a color can be specified by three 8-bit numbers, giving the levels of red, green, and blue in the color. Any color that can be shown on the screen is made up of some combination of these three "primary" colors. Other formats are possible, such as grayscale, where each pixel is some shade of gray and the pixel color is given by one number that specifies the level of gray on a black-to-white scale. Typically, 256 shades of gray are used. Early computer screens used indexed color, where only a small set of colors, usually 16 or 256, could be displayed. For an indexed color display, there is a numbered list of possible colors, and the color of a pixel is specified by an integer giving the position of the color in the list.

In any case, the color values for all the pixels on the screen are stored in a large block of memory known as a frame buffer. Changing the image on the screen requires changing color values that are stored in the frame buffer. The screen is redrawn many times per second, so that almost immediately after the color values are changed in the frame buffer, the colors of the pixels on the screen will be changed to match, and the displayed image will change. A computer screen used in this way is the basic model of raster graphics. The term "raster" technically refers to the mechanism used on older vacuum tube computer monitors: An electron beam would move along the rows of pixels, making them glow. The beam was moved across the screen by powerful magnets that would deflect the path of the electrons. The stronger the beam, the brighter the glow of the pixel, so the brightness of the pixels could be controlled by modulating the intensity of the electron beam. The color values stored in the frame buffer were used to determine the intensity of the electron beam. (For a color screen, each pixel had a red dot, a green dot, and a blue dot, which were separately illuminated by the beam.)

A modern flat-screen computer monitor is not a raster in the same sense. There is no moving electron beam. The mechanism that controls the colors of the pixels is different for different types of screen. But the screen is still made up of pixels, and the color values for all the pixels are still stored in a frame buffer. The idea of an image consisting of a grid of pixels, with numerical color values for each pixel, defines raster graphics. Computer graphics classes in the past revolved around the mathematics and programming for making tools that can be used to produce graphics and even had students write parts or components of software tools that make graphics. Today, the need has shifted to be good producers of the graphics content rather than the tools. Many graphics tools either require a sense of

computer programming (Adobe Flash, for example), or scripts and small programs can be combined with graphics to create interactions in movies and games.

Nowadays, the area of computer graphics is widely used in a variety of applications for specific purposes. We can find information about virtual simulators for training in driving vehicles, like cars, buses or trains; 3D representations of future buildings or houses most of the times only with the objective of visualization; computer and console games with high-quality graphics, where the player can live a different experience inside the virtual world; or film scenes and characters that are generated using computer graphics. Simulation, training, visualization and entertainment are environments where the use of computer graphics is very popular. In this context, the possibilities of using computer graphics applications for education are opening an important research area. The technology is every day nearer to children, not only at home but also at school.

Classes on computer graphics at high schools and community colleges usually emphasize how to make computer graphics, while four-year and graduate programs tend to include or even focus on the theory of how computer graphics software programs work. Most of the computer graphics classes at the university level are offered from a computer science department and require a background in computer programming. University classes tend to include these topics in 2D and 3D graphics, as well as the mathematics behind some of these areas:

- history of computer graphics
- transformations
- clipping
- factorizations
- aliasing and anti-aliasing
- projections
- light, color, shading
- texturing
- ray tracing
- animation

Assignments in the classes range from mathematical problems within the graphics concepts to developing computer graphics products, usually from existing graphics tools. The tools most commonly used include Open GL and the Adobe Creative Suite of tools such as Photoshop, Illustrator and Flash.

There are scholarly subjects only related to technology and there is a common interest in all schools to introduce new computer-based programs and applications, for teaching specific concepts included in the school curriculum.

In the area of people with special needs, the application of new technologies is starting to produce good results in the education and intervention process. The idea of creating useful applications for teaching and training specific concepts (such as academic, social or communicative skills) seems to be of interest to all associations and special schools. There are efforts to describe the characteristics and possibilities of the use of new technologies (TIC) in the education of students with especial needs [7]. The idea of TIC is defined as ‘‘technological instruments for the compensation and help in the intervention of students with special needs’’

Computer graphics is a very wide discipline, so we want to focus our attention on one type of these kinds of applications, the Real Time ones. Their main characteristics are, the use of 3D graphics, a very important degree of interaction, a realistic answer to the user actions and immersive possibilities, depending on the equipment used. [6].

Due to the kind of people who are going to use our tools, all of them are non-immersive Real Time applications, which only need a computer (with screen, keyboard, mouse and joystick) to use and interact with the tool easily. This option was selected in front of other more immersive versions (like using head mounted displays, cyber globes or caves installations) because it is cheaper and accessible for all the schools, associations and special centers, it is less invasive than other elements, the user can interact with the application easily almost without previous training and it allows for collaborative work between the teacher and the child. Some tests were done with the same version of the tool but

one using immersive equipment (head mounted display and cyber globes) and another using tactile screen and joystick. The answer of the participants (all of them with learning difficulties) suggested higher levels of acceptance and interaction in the non-immersive version, easier adaptability to the interfaces used with less previous training and better interaction between the child and the teacher.

When the type of application to be used is clear, it is necessary, during the design process of any tool, to specify the characteristics of the final group of people who are going to use it. In our case, it is important to know the specific profile of individuals with learning difficulties and to determine the content that the application may have to satisfy in the areas of knowledge that are necessary for their intervention and educational process. For that reason, before defining the possibilities of using this kind of software to help people with learning difficulties, we want to define in more detail the group of people to whom these tools are addressed.

The characteristics of the applications presented before made it necessary to make a decision on the software to use for their development. We decided to use a Real Time Graphic Library (OpenGL Performer) integrated in an Object Oriented Language (C++) because of the potential of this kind of libraries for the creation of customized tools and the possibilities of achieving better quality and results than any other methodology. This library provides us with the basic scene graph and graphical control needed to structure and interact with the application in real time. The modularity of all the elements involved in the system allows the reusability for other new environments and the flexibility to integrate all the desired functions. The design and models creation as well as the animations integrated in the environments were developed using well-known graphic tools such as 3D Studio Max and Photoshop. All these components, integrated in a well defined and structured system, results in computer graphics applications used for a special group of people, trying to help them in their knowledge development and quality of life. Use Real Example Graphics.

As part of the class, real graphics are shown that the professor made or had made for specific purposes. One of the main messages is to have a purpose for the graphics that are produced. For example, the International Space Development Conference of the National Space Society (www.NSS.org) in 1991 was chaired by the author. She worked with a graphic artist to develop an image that was used on posters, shirts and brochures where the idea was to depict the

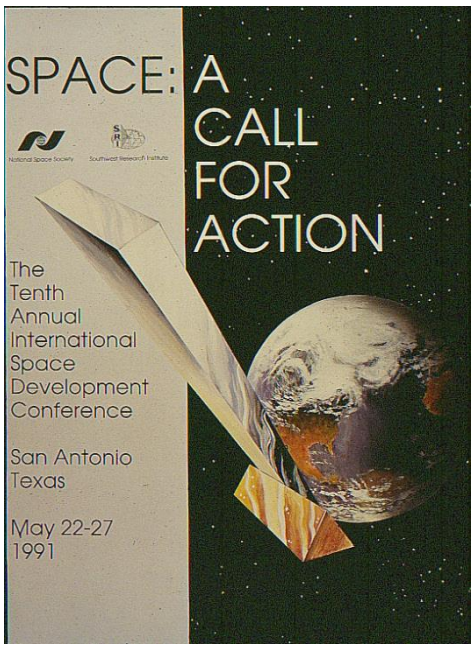

Figure 1: Poster for ISDC 1991

Archimedes statement to give him a lever long enough and a place to stand and he could move the Earth. The conference theme was Space: A Call for Action. The conference was presented as the place to come find out about the actions large enough to get us moving and living off of the Earth. Figure 1 shows the resulting poster.

Many software development projects that included the development of graphics are presented such as an educational game called Dr Phsio that taught middle school children better health behaviors included graphics for baboons, a lab, a savanna, basketball, food, scientists, a locker, a couch, exercise equipment, and a magazine. A recent example is from the San Antonio Ultimate Frisbee Leagues where a design is put on discs, bags and shirts. That league is put on by a group of volunteers and the graphics are typically made by them. Figure 2 shows a design for a league from 2014 that had the theme of lost in space. The team names and colors were planets.

Figure 2: Ultimate Frisbee League design for Lost in Space

The development of graphic applications in Real Time, specifically addressed to people with special needs, constitutes an emerging field of work inside the area of computer graphics applied to educational processes, being of special interest due to the learning difficulties inherent in these individuals.

2. Conclusion

This kind of applications offers a wide set of advantages over conventional pedagogical methods. On the user's side, people with learning difficulties show a special affinity towards computers; regarding the technology, Real Time graphics offer a complete control over the environment presented, and facilitate abstract concepts, very difficult to represent in real world, to be explained to the user in a visual and intuitive way. The tools presented in this paper are good examples of this kind of applications, where technology meets education to improve the learning experience and, at the end, the quality of life of final users. Students who later complete a computer graphics course come from different walks of life and from many cultures, particularly America, Europe, and Asia. Students of different backgrounds and cultures can learn to create computer graphics in a meaningful way to express their values in the brand they create

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