ΑΝΩΤΑΤΗ ΣΧΟΛΗ ΠΑΙΔΑΓΩΓΙΚΗΣ
ΚΑΙ ΤΕΧΝΟΛΟΓΙΚΗΣ ΕΚΠΑΙΔΕΥΣΗΣ

(Α.Σ.ΠΑΙ.Τ.Ε.)

«Αρχιμήδης ΙΙΙ – Ενίσχυση Ερευνητικών ομάδων στην Α.Σ.ΠΑΙ.Τ.Ε.»

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Τίτλος: **ΔΗΜΙΟΥΡΓΙΑ ΚΑΙ ΑΞΙΟΛΟΓΗΣΗ ΕΙΚΟΝΙΚΟΥ ΧΩΡΟΥ ΕΡΓΑΣΤΗΡΙΩΝ ΗΛΕΚΤΡΟΝΙΚΗΣ**
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ΠΑΡΑΔΟΤΕΟ

ΕΠΙΣΤΗΜΟΝΙΚΗ ΕΡΓΑΣΙΑ ΣΕ ΔΙΕΘΝΕΣ ΕΠΙΣΤΗΜΟΝΙΚΟ ΣΥΝΕΔΡΙΟ

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Σύνοψη Εργασίας

Οι εφαρμογές εικονικής πραγματικότητας αποτελούνται και συνδυάζουν συσκευές υλικού (hardware), τεχνικές αλληλεπίδρασης και εικονικά αντικείμενα σε διάφορα επίπεδα ανάλυσης. Οι δημιουργοί των εφαρμογών εικονικής πραγματικότητας καλούνται να επιλέξουν τους συνδυασμούς αυτών των συστατικών που θα επιτρέπουν στους χρήστες να περιηγηθούν και να αλληλεπιδρούν με το εικονικό περιβάλλον με επιτυχία. Είναι προφανές ότι υπάρχουν αρκετοί συνδυασμοί των στοιχείων αυτών που επιτρέπουν τη δημιουργία λειτουργικών περιοχών εικονικής πραγματικότητας οι οποίες θα ανταποκρίνονται στις ανάγκες των χρηστών . Στην πραγματικότητα, η επιλογή της κατάλληλης μεθοδολογίας και των κατάλληλων εργαλείων ανάπτυξης επηρεάζεται από το κόστος των διαθέσιμων λύσεων και από τα χαρακτηριστικά (περιορισμούς) της κάθε εφαρμογής. Για την επιλογή του κατάλληλου εργαλείου απαιτείται να εντοπιστούν τα χαρακτηριστικά και οι ιδιομορφίες εκείνες ενός περιβάλλοντος ανάπτυξης εφαρμογών εικονικής πραγματικότητας που θα επηρεάσουν το έργο της δημιουργίας και λειτουργίας του εικονικού χώρου.

Στοιχεία Συνεδρίου

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Η επιστημονική εργασία όπως δημοσιεύτηκε στα πρακτικά του συνεδρίου

Features of Virtual reality development tools

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Abstract
Increased interest in virtual reality technology resulted in an increase in the number of available tools for creating virtual worlds. Some of them are the software libraries, toolboxes, and application development methodologies. Others are integrated work environments that integrate a package with all the tools for creating a virtual reality application, from modelling up and programming the behaviour of space.

The virtual reality applications are composed of an integrated combination of hardware devices, interaction techniques and virtual objects at various levels of analysis and interaction. The creators of virtual reality applications are invited to select combinations of these components allow users to successfully navigate and interact with the virtual environment. So it is understandable that there are several combinations of these elements allow the creation of functional areas of virtual reality and which will meet the needs of users.

Unfortunately, in fact the choice of appropriate methodology and appropriate development tools is affected by the cost of available solutions and features (limitations) of each application. So available for evaluation software development environments, limited to open source software solutions or low cost solutions.

This paper presents the features taken into account when evaluating virtual spaces creating environments. Given the limited resources, efforts will be made to create virtual objects that can be used simultaneously in different development environments regardless of the technology that supports them.

Keywords: *virtual reality, development tools*

1. Introduction

Increased interest in virtual reality technology (Virtual Reality) resulted in an increase in the number of available tools for creating virtual worlds. Since there are no further specifications for virtual reality software, each of these development systems has a unique set of features and interfaces. Each of these system approaches in its own way the interaction of individual parts such as the operating system, the input devices, the

presentation units, the data networks and touch devices. An additional feature is that every virtual reality software has its own development environment for creating graphical objects and for controlling the response of the signals received from the data input modules. Substantial consequence of these differences is that each option has impact on performance and behaviour of virtual reality applications developed.

In short, there are many parameters to be considered by the creator, when choosing a development tool for virtual reality applications. In some cases the differences are subtle, while in others the advantages and disadvantages is very difficult to quantify and compare. The objective of this work is to identify the characteristics and peculiarities of a development environment for virtual reality applications.

2. Development Environment Features for Virtual Reality Application

The first step in developing a virtual reality application is the determination of those characteristics that are important for the type of application to be developed. In this section we present a number of characteristics that must have a virtual reality environment.

2.1 General features. There are three basic requirements of a virtual reality applications development system:

- **Performance**. To emulate a virtual space with the corresponding actual space, a frame rate of at least 15 Hz, with the least possible delay, is required. The poor performance in this feature is not only a nuisance for the end user but can cause unpleasant side effects.
- **Adaptability and versatility (flexibility).** The development environment must be able to adapt to various operating systems and software configurations. If the environment is not able to adapt, the applications to be developed will be limited use.
- **Ease of use.** The development environment should be easy to configure and his learning. A negative point of an easy to use development environment is the many options that make it difficult to optimize its operation. There is therefore a limit between convenience and optimization, which is to be assessed according to the needs of the project

An ideal development environment should achieve the best result in each feature. In fact, however, the various features often come into conflict with each other, resulting in excellent results in one of them can have negative effects on one another. For example, the ease of use is achieved often at the expense of flexibility, while a very adaptive system has a negative impact on performance due to multiple options that will offer to the user.

2.2 Features of the software development of virtual reality applications

The general characteristics mentioned above can be classified in more detail as follows:

- **Compatibility.** In fact, all customers / users of a virtual reality application does not necessarily use the same computer systems (hardware, software). Even if we confine to the most popular applications such as those based on the UNIX operating systems and Windows NT, the differences are particularly large as to require special effort to develop an application for each. A well designed tool should be compatible with the widest range of operating systems, so that the transfer of an application from one to another can be done quickly and at less cost. This is done using a common programming language and common data format.
- **Support Specialized Hardware for Virtual Reality.** The virtual reality applications are particularly demanding on the amount of data processed. To speed up data processing the computing platforms use special electronic devices (graphics cards). Using such devices with large capacity and processing speed is essential to create reliable virtual reality applications.
- **Hardware Independence from software (hardware abstraction).** In a virtual reality application is vital the function of the automated customization of code in each hardware. The existence of corresponding software interfaces (API) that automatically undertake the adaptation of code depending on the available hardware helps to use an application from users with different computer systems. A well designed development environment for virtual reality applications is an ideal tool for the programmer and creator of virtual spaces. This environment should provide a balance between a uniform development environment with a specialized development environment. The first offers ease and speed of programming while the second allows for maximum utilization of the connected devices.
- **Locally Distributed Applications.** In order to increase the execution speed and consequently the performance of a virtual reality application, we spread the load to other networked computers with to the computer running the application. There are two ways to do this, either the development environment of the application will automatically include in the application the load distribution software, either the programmer will integrate with writing the corresponding code.It is obvious that each of these options has its pros and cons but the distribution of the processing load accelerates the frame rate.
- **Online Distributed Applications.** The distribution processing is the distribution of an application in computers that are distributed locally. In reality, and given the high speeds the WWW can now share the application load in computers located in different places around the world. Development environments that have such capabilities can now enable interactivity and simultaneous participation in virtual spaces of people from different parts of the Earth. Such environments are typically embedded or can incorporate external toolkits that enable such capabilities.
- **Fast Development of Prototype.** Since most groups of developers will have access to only one or two Integrate Development Environments for virtual

reality applications (due to the high cost of such workstations) it is important that everyone can have access to the expensive equipment will be available. But because this is practically impossible, many working environments enable execution of applications on simulators. These are built-in software that simulates the behavior and response of external devices used in the actual execution environment of the final application. Such possibilities are very important because they allow monitoring the application and correcting errors from the early stages of development, before their effects cause any problem in integrity and in development time. A specific factor that can affect the speed of development of a virtual reality application is the existence of specific and concise programming language (scripting language) for the control and behaviour of objects in virtual space. This feature is useful because it enables faster development of such an application.

- **Flexibility.** Sometimes the user must be able to change hardware configurations while the application is running, without the need to restart it. Moreover many times the initial mode settings of a device may not be ideal for running application which required new setting or restart the device until you achieve optimum operation. This feature is further useful in cases where we want to be transferred from the simulator of a device in real device without stopping and restarting the running application. In this case the interface should replace the APA simulator as in the real device without conscious awareness of the application running.

2.3 Interfaces, Tool, Programming Languages

- **High Level and Low lever Iinterfaces.** Each of the existing Development Environment virtual reality applications gives the programmer a different user interface for creating applications. In some of them applications can be created with graphical tools and scripting languages, while others allow low-level programming. The first category enables quick learning of the environment and faster application development at the expense of the ideal and broad performance (in terms of the various types of hardware) while the second offers an ideal execution speed but requires specialized knowledge from the programmer.
- **Graphical Interfaces.** Existing application development environments are fundamentally different in the way of graphics processing. While some environments emphasize the use of models created by specialized software packages (such as CAD), others incorporates specific API for creating them. Some allow the user to control a model at the level of individual polygons representing the surface, whereas others permit only the loading and display them. Still, others allow the handling of the whole scene in virtual space, while others require planning and more individual features and functions of the site as a) the movement and collisions of objects b) display of texture and color of various surfaces. The choice of such benefits from a development environment is valuable, otherwise the developer should develop the corresponding software.

The latter procedure is generally tedious and time consuming, even for skilled programmers.

Equally important is the kind of API supports the graphics library used. It has its own library or supports known libraries such as OpenGL and Direct3D that can be used in other applications than those of virtual reality? Popular libraries as mentioned have the advantage that there is plenty of support material for use and developer training and further allow easy integration of the various interfaces.

- **Interaction.** In many work environments, the programmer can create event handlers software in virtual space. In this way the virtual space sends messages when there is interaction between user and objects, in order to perform the necessary movements and changes of objects and scene. Alternatively, the programmer can have complete control of the virtual spaces and making the signals sent by external devices decides if there is a stimulus that requires renewal of the scene.
- **APIs and Scripting Languages.** A virtual reality application can be created either by using specific graphical user interfaces (GUI), or by using specialized programming languages (scripting languages), or even by using standard programming languages like C ++ and Java. Specialized programming languages have characteristics and structures that are designed for this purpose that allow them to respond quickly to virtual reality applications requirements. These languages have the advantage of rapid manufacturing applications but require experienced developers.

2.3 Other Factors

- **Expandability.** A virtual software library should be easy to expand into new devices, new platforms and new virtual interfaces since the scope of virtual reality is constantly changing. Software libraries should be able to easily adapt to change, not to become obsolete and limit the functionality of virtual spaces created with them on old computer systems.
- **Minimum Requirements.** While simplicity is valuable, the software should not restrict power users from doing what they want. The environment should not require excessive restrictions on the structure of the program, nor should it prevent the programmer in direct communication with the computer operating system.
- **Monitoring Performance.** A virtual reality software system should be able to collect and present data about the performance of the applications developed with it. Such information is necessary in order to optimize the software and configure the graphics hardware to perform better.
- **Commercial and Open Source Software.** Development systems for virtual reality applications are commercial products or academic / research institutions products. Both product types have advantages and disadvantages. Most of the systems are academic research products are available at no cost, which is a great advantage. Moreover, the groups that created them are usually open to

partnerships for expansion and adding further capabilities. In many of these cases have freely around the environment code, offering any user the ability to adapt it and extends it according to his needs. A key disadvantage of these solutions is that they require special knowledge to implement them.

The commercial packages are extremely friendly to use and easy to learn them, and are designed for the average user and the typical computing environment. The disadvantage faces when the application to be developed goes beyond the needs of the typical user. In such cases, commercial packages may offer extensions that will increase the cost of the solution.

3. Conclusion

The use of virtual environments is the result of the rapid evolution of technology and the growth of user requirements. Their development can be carried out easily, utilizing both the hardware and the software of the computer system. The fact that the design and implementation of a virtual space can be performed on each operating system, gives the designer freedom to create from the simplest to the most complex virtual environment.

This report summarized the characteristics of virtual spaces development tools available to the developer for creating interactive spaces. Because of their variety, these features were selected from different categories such as programming languages, ready virtual spaces, three-dimensional objects construction tools and combinations of all these.

It is obvious that there is no perfect solution and each tool has a specific purpose and provides specific solutions. All tools have disadvantages and advantages which the individual creator of virtual spaces have to assess theoretical and practical.

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Διαφάνειες παρουσίασης

Features of Virtual reality development tools

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General features

- **Performance,** frame rate at least 15 Hz.
- **Adaptability and versatility (flexibility)** able to adapt to various operating systems and software configurations.
- **Ease of use** easy to configure and learn.

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Software Development Features

- **Compatibility** with the widest range of operating systems .
- **Support Specialized Hardware** (graphics cards).
- **Hardware Independence from software (hardware abstraction)** automated customization of code in each hardware.
- **Locally Distributed Applications** spread the load to other networked computers .

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Software Development Features

- **Online Distributed Applications** distribution of an application in computers that are distributed locally.
- **Fast Development of Prototype** allow monitoring the application and correcting errors.
- **Flexibility** change hardware configurations while the application is running.

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Interfaces, Tool, Programming Languages

- **High Level and Low lever Iinterfaces** different user interface for creating applications.
- **Graphical Interfaces** use specialized software packages (such as CAD) or specific API.
- **Interaction** messages when there is interaction between user and objects.
- **APIs and Scripting Languages,** specific graphical user interfaces (GUI), specialized programming languages, standard programming languages **.**

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Other Factors

- **Expandability** easy to expand into new devices, new platforms and new virtual interfaces.
- **Minimum Requirements** should not require excessive restrictions on the structure of the program.
- **Monitoring Performance** able to collect and present data about the performance.
- **Commercial and Open Source Software.**

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THANK YOU

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