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Simulation of Ancient Technology Works Using Haptic Interaction and Gesture Recognition

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Abstract

The objective of the proposed application is the development of a new interactive application for the simulation of Ancient Greek Technology works, with the use of advanced virtual reality and computer vision technologies. In order to achieve these objectives haptic interaction mechanisms and a gesture recognition system were implemented in a virtual environment platform. A novel collision detection method was developed and virtual reality agents were used in order to achieve the desired results. The developed system was evaluated by real users and conclusions were drawn concerning the potentiality of the proposed application.

Categories and Subject Descriptors (according to ACM CCS): H.5.1 [Information interfaces and presentation]: Artificial, augmented, and virtual realities, I.3.8 [Computer Graphics]: ApplicationsD.2.6 [Software Engineering]: Interactive environments

1. Introduction

A recent trend of museums and exhibitions of Ancient Greek Technology is the use of advanced multimedia and virtual reality technologies for improving the educational potential of their exhibitions [Ili02, Mal78, Mal79].

In [LS03] the authors utilize augmented reality technology to present an archaeological site. They use a scaled model of the Roman "Heindentor" with virtual overlays that provide the visitor with additional information about the exhibit. An attempt to visually enhance archaeological walkthroughs through the use of various visualization techniques is presented in [GPC03]. A collaborative virtual environment system to navigate to a virtual historical city is presented in [BP01]. Authors of [SDP00] present a variety of specialized hardware used in order to create interactive virtual spaces for museums or other cultural exhibitions. These include interfaces for navigation in large scale virtual spaces in museums utilizing new techniques in order to virtually enlarge and augment the exhibit surface.

The aforementioned examples show that museum exhibitions tend to be more and more interactive. Following this direction, the Thessaloniki Science Centre and Technology Museum (http://www.tmth.edu.gr/), has created representations of ancient Greek technology in the form of small-length video films in a PC, so that the visitor can comprehend exactly the operation of specific exhibits and observe their use in their initial operation environment. In a virtual representation enriched with narration, the visitor is provided with a very pleasant educational environment, where he/she can potentially achieve familiarization with the exhibit and in this manner obtain educational benefits.

Even if the acceptance of these applications by the museum visitors is considered to be high, there is a clear need for more realistic presentations that should be able to offer to the user the capability of interacting with the simulation, achieving in this way enhanced educational / pedagogical benefits.

Furthermore, from the technological point of view, interactivity is recently focused on haptic interfaces used in a large variety of applications. Such applications include blind and visually impaired users accessing information presented in 3D [TNF*04], engineers performing assembly planing [NFT03] and students learning geometry [NFTS04] via the use of virtual reality environments (VEs).

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The proposed application aims to contribute to the development of a new perception of the modern era needs, by making reference to the technology evolution, demonstrating Ancient Greek Technology works, presenting their evolution in time and linking this evolution with corresponding individual and social needs. The objective of the proposed application is the development of new techniques for the simulation of Ancient Greek Technology works, with the use of advanced virtual reality technologies and user-simulation interaction. The main goal is to enhance the realistic simulation and demonstration of these technology works and to present the educational/pedagogical use and the continuously development of each technology work.

In order to achieve these objectives haptic interaction mechanisms and a gesture recognition system were implemented in a virtual environment platform. The user is allowed to interact with ancient technology mechanisms in the virtual environment either by constructing or using them via the proposed haptic interface or by selecting options using the gesture recognition system. In order to provide real time haptic feedback to the user a novel collision detection algorithm is used, based on superquadrics, for detecting collision between the hand and scene objects.

The paper is organized as follows. The system architecture is presented in Section 2. The haptic interaction system, the gesture recognition interfaces and the scenario authoring tool are presented in Sections 3 and 4, 7 respectively. Section 5 describes the virtually reality agents created and used to support the application while Section 6 presents the details of the core simulation support unit. Section 8 presents the pilot scenarios used for the evaluation of the system, while Section 9 presents the evaluation methodology and results. Finally the conclusions are drawn in Section 10.

2. System architecture

The block diagram shown in Figure 1 presents the architecture of the proposed system (APEIRO):

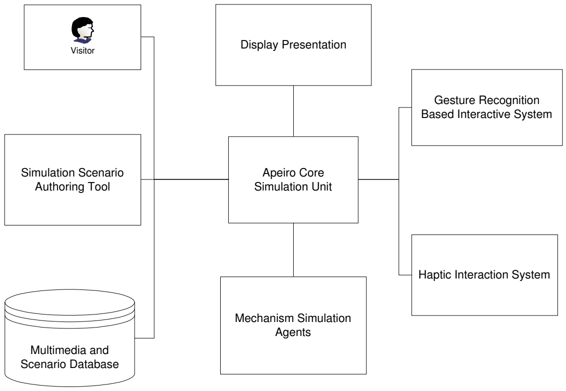

Figure 1: *System Architecture.*

The main components of the system are:

- The **APEIRO core simulation support unit**, which is the main integration environment of the application.
- An integrated technology simulation **scenario authoring tool**, which supports the composition of complex simulation scenarios.
- Adjustable **software agents simulating ancient Greek technology mechanisms**. Intelligent software agents that adapt the simulation response on the input from haptic interaction and gesture recognition modules.
- A **haptic interaction system** which includes subsystems for handling user-simulation interaction via the use of virtual reality devices (wireless trackers, force feedback haptic virtual reality devices, etc.).
- **Gesture recognition** algorithms based on depth information for natural user interaction with the virtual environment. For the development of this particular application an innovative 3-D camera was used to acquire the information corresponding to hand gestures.
- A **multimedia database** supporting the efficient storage of the educational / entertainment scenarios.
- **Educational / entertainment scenarios** for the ancient Greek technologies simulation demonstration.

3. Haptic Interaction System

Haptic interaction is considered as one of the most important new methods for realistic user immersion in virtual environments (especially when interaction with advanced technology simulations is needed). This is due to the fact that in general, the human hands are mostly used for handling, controlling and in general interacting with machines, mechanisms and other technological tools.

The haptic interaction system (HIS) of APEIRO is responsible for the communication with the motion trackers and the haptic devices. It enables connection of the APEIRO core unit with the CyberGlove, CyberGrasp and CyberTouch devices and the wireless Motionstar tracker. The system is responsible for receiving, preprocessing and sending to the core unit the data from the devices. HIS is also responsible to perform the collision detection between the hand and the objects in the Virtual Environment, calculating the force feedback and sending the appropriate data back to the devices.

HIS is integrated into the core simulation support unit of APEIRO and is used in simulations where haptic interaction is requested by the scenario (e.g. scenarios where the user is asked to translate or rotate parts of the simulated technology works, etc.).

The main parts of the proposed system are going to be presented in detail in the following subsections.

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3.1. Haptic VR Devices

The system supports the CyberTouch and CyberGrasp haptic devices for haptic interactivity with the virtual simulation environments [Imm00]. CyberTouch and CyberGrasp are extensions of CyberGlove. CyberGlove is a VR glove that has the possibility to return (to an application) accurately the relative position of the fingers and the palm of the user. CyberGlove does not have the possibility to provide force-feedback though. CyberTouch is an extension of CyberGlove that can provide feedback to the fingers and palm of the user using specially adapted vibrators attached to the CyberGlove. CyberGrasp is an exoskeleton, that can be attached to the CyberGlove and provide force feedback to the fingers of the user (Figure 2). It can be attached easily to hands of various sizes. The position of the mechanical parts of CyberGrasp allows the user to handle even small objects in contrary with all other commercial haptic devices.

Figure 2: *the CyberGrasp device.*

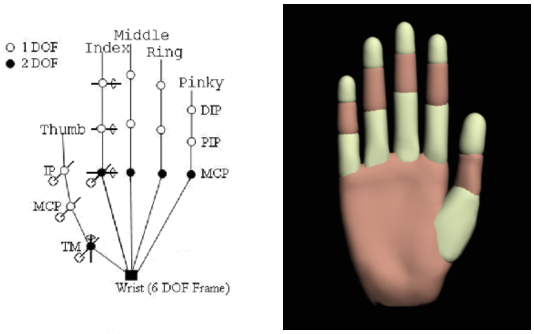
The CyberGrasp haptic device cooperates with a position tracker device for providing information on the accurate position of the hand. Based on the requirements of the proposed application, the MotionStar Wireless Tracker of Ascension Technologies Inc. has been selected as the appropriate device, mainly due to its wireless nature. Combining CyberGrasp with the motion tracker can create a workspace of six meters where the user can move and interact with the virtual model, in contrary with the usual systems that limit the user workspace to be less than half a meter (just in the front of a personal computer).

3.2. Collision Detection Sub-unit

The collision detection algorithm that is used in APEIRO must be very fast in order to respond in real-time and with high accuracy. In order to achieve this, a novel approach is followed in the proposed system, where the virtual hand is modelled using superquadrics [SB90]. Collision detection is performed in real-time, based on the analytical implicit formula of the superquadric, as will be shown in the sequel.

3.2.1. Virtual hand modelling

A typical skeleton model of a 3D virtual hand is illustrated in Figure 3a.



(a) (b)

Figure 3: *Hand skeleton model*

The wrist has six DOFs, three for translation and three for rotation. Every other node has either one or two DOFs depending on whether it can be rotated with respect to one or two axes. Nodes MCP, PIP, DIP, TM and IP represent the metacarpophalangeal, the proximal interphalangeal, the distal interphalangeal, the trapeziometacarpal and the interphalangeal joint respectively. In order to get an accurate superquadric approximation, the virtual hand is segmented into 16 segments as illustrated in Figure 3b. Each of these segments is approximated via a superquadric as described in the following section.

3.2.2. Superquadric modelling of the virtual hand

Superquadrics have been excessively used [SB90, CJB03] to model objects from range images and depth maps. Typically, they are a family of analytical implicit surfaces like superellipsoids, superparaboloids, superhyperboloids and supertoroids. However, in the literature [SB90] the term superquadric is usually used to describe superellipsoids, due to their high applicability. Superquadrics (superellipsoids) are described by the following implicit equation.

$$F(x,y,z) = \left(\left(\frac{x}{a_1} \right)^{\frac{2}{\varepsilon_2}} + \left(\frac{y}{a_2} \right)^{\frac{2}{\varepsilon_2}} \right)^{\frac{\varepsilon_2}{\varepsilon_1}} + \left(\frac{z}{a_3} \right)^{\frac{2}{\varepsilon_1}} = 1 \quad (1)$$

In general, not all objects can be efficiently approximated using superquadrics. Several constraints like convexity and low frequency surface shape reduce the variety of possible

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objects to approximate. However the segments of the virtual hand satisfy these constraints and can be very accurately modelled using superquadrics.

Each finger segment is a superquadric on its own. The approximation of the palm is considered more difficult, because it has a more complex shape and overlaps with the TM segment. However, this fact causes no problem to the present approach, since there is no restriction for non-overlapping segments. Assuming that SQ_i represents the superquadric approximation of the i^{th} element of the virtual hand, the superquadric representation of the whole virtual hand (VH) can be described as the union of all superquadrics.

$$VH = \bigcup_{i=1}^{16} SQ_i \tag{2}$$

Figure 4 illustrates the resulting superquadric approximation for the virtual hand.

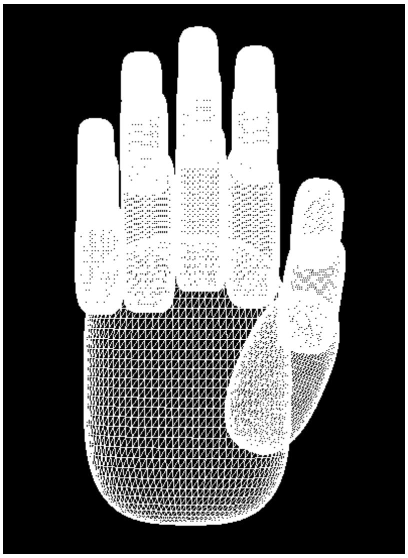

Figure 4: *Superquadric approximation for the virtual hand.*

3.2.3. Collision detection

There are two collision detection algorithms used in the proposed application. One is used to detect collisions between objects in the virtual scene and the other to detect collisions between the virtual hand and objects in the virtual scene.

In the first case, object to object collision detection, the Rapid [GLM96] algorithm is used. Rapid utilizes Oriented Bounding Boxes (OBBs) in order to split the 3D geometry and finally perform triangle-to-triangle collision detection. Although the algorithm is accurate and fast, it might cause delays to haptic feedback when large objects with many triangles (such as the hand) are used. For this reason a superquadric based algorithm is proposed for collision detection between the virtual hand and objects in the virtual scene.

The proposed collision detection scheme does not need to handle triangle-triangle intersections on contrary to most typical methods presented in the past [GLM96, Zac98]. The proposed method utilizes bounding volumes [Hub95] of to model the hand. In particular, it checks if a vertex of an object lies inside the virtual hand. Thus, in order to avoid collision, the vertices of the scene objects have to be left outside the virtual hand. The collision detection test is performed by evaluating equation (1) for each vertex of the objects and for each superquadric composing the virtual hand. Thus, for a 3D point (x,y,z) of an object:

If $F_i(x,y,z) \geq 1 \quad \forall i,$ the point (x,y,z) lies outside the hand.
else the point (x,y,z) lies inside the hand.

The proposed collision detection procedure executes the calculations about 20 times faster than the collision detection algorithms used for collisions between objects in the scene, while retaining the necessary accuracy.

4. Interaction using Gesture Recognition

Although the last two decades we have witnessed a rapid evolution of computing, communication and display technology, the physical human-computer interface remains unchanged since the first workstations - keyboard and mice. Such devices are inadequate for modern applications such as interacting with complex three-dimensional environments. Recently several innovative controllers and sensors have been investigated towards a more "natural" interaction with the machine. Several of these new systems, such as glove-based devices, compromise convenience by requiring the user to be instrumented with encumbering devices, in order to achieve high expressiveness.

The use of gesture recognition provides an attractive alternative to cumbersome interface devices for human-computer interaction that are typical of present industrial control and supervision systems [MS01, MTM*01]. Vision-based recognition of hand gestures in particular promises natural, unobtrusive, human-computer interaction. This is based on analysing signals - acquired by imaging sensors such as video, infrared or ultrasonic - inferring the geometry and motion of the hand and finally mapping to a set of predefined gestures. A large potential interest of this technology comes from the possibility to develop advanced interfaces for the interaction with virtual objects. These objects can be images on a computer screen. The user can "manipulate" the objects by moving his hand and performing actions like "grasping" and "releasing". The computer uses gesture recognition to reproduce the user actions on the virtual object and the result of the operation is shown in the graphical interface so

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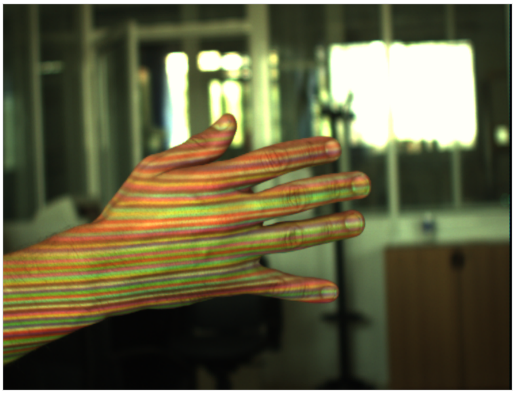

Figure 5: *Color-encoded light pattern.*

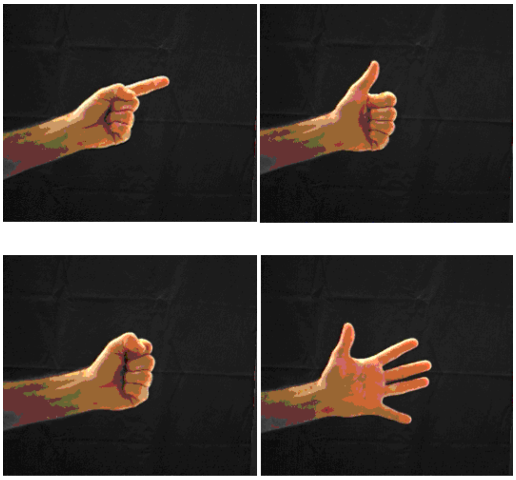

Figure 6: *Some of the supported gestures.*

that the user can have a feedback. Application is in simulation, robot teaching, graphical interface control, device control and Virtual Reality.

Our aim in this work is the development of novel hand gesture recognition system. The system relies on a novel 3D sensor that generates a dense range image of the scene. The proposed approach does not rely on colour information, and guarantees robust segmentation of the hand under various illumination conditions and content of the scene.

4.1. Description of 3D camera

A camera acquiring 3D images is used in the APEIRO application [FMB01]. The 3D camera was developed by SIEMENS during the HISCORE IST project. This is based on an active triangulation principle, making use of an improved and extended version of the well-known Coded Light Approach (CLA) for 3D-data acquisition [MAS02]. The CLA is extended to a Color Coded Light Approach (CCLA). The basic principle lying behind this device is the projection of color-encoded light pattern on the scene and measuring its deformation on the object surfaces. The 3D camera achieves real-time image acquisition of range images (12 images per second). It is based on low cost devices, an off-the-shelf CCTV-color camera and a standard slide projector (Figure 5). The average depth accuracy achieved, for an object located about one meter from the camera, is less than 1mm.

4.2. Gesture Recognition System

A system for the real-time recognition of hand gestures from 3D data was developed. The system is robust against orientation of the user body, background and illumination. Several 3D image analysis algorithms were developed: segmentation of the body from the background, segmentation of the arm from the body, segmentation of the hand from the arm, measurement of 3D position, volume and orientation of the hand. The sequence of 3D measurements was subsequently used as input to a tracking system capable of mapping these measurements to application specific actions.

The segmentation of the subject's arms is achieved by means of a hierarchical un-supervised clustering procedure [MAS02]. This is based on the observation that the various parts of the body, such as the arms, torso and head, form compact 3D clusters in space. Classification algorithms are prone to rigid transformations of the input pattern. In our case all input patterns are transformed to a canonical frame. Availability of 3D information leads to efficient estimation of the orientation of the hand, making the second approach more appropriate.

Our aim is real-time recognition of complicated deictic, mimetic and symbolic gestures that may be subsequently mapped to application specific actions. Examples of such gestures useful for our target application are:

- Movement of the thumb.
- Rotation of the palm.
- Grasping or "clicking".
- Wide open palm.
- Fast swinging motion of the hand.

Several such gestures are defined and used to perform specific actions in the application scenarios (Figure 6). The gestures can be programmed to perform specific actions for each scenario using the APEIRO authoring tool, to be described in detail in the sequel.

5. VR Simulation Agents

Another important part of the proposed application are the mechanism simulation agents The agents are used in order to enable the usage of the ancient technological works in a

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more realistic way. There are five types of agents created in order to support the scenarios: the 'Move agent', the 'Rotate agent', the 'Scale agent', the 'Trigger agent' and the 'Snap agent'.

The first three agents apply constrains to the movement of the objects while the trigger agent enables or disables specific actions and the snap agent enables assembling components in order to construct a mechanism. Each of the agents gets a transformation matrix as input (which includes positioning rotation and scaling information), a speed vector, an angular speed and the maximum and minimum allowed values.

Each object in the scenario can be associated to one or more of these agents and also to other objects. When the user grasps an object (A) the agent associated to this object is activated using data from the virtual hand as input. Thus object (A) acts according to the constraints provided by its associated agent. If object (A) is associated to another object (B) then the agent associated to object (B) is called using data from object (A) as input. This procedure continues until no further associations are reported for each object. The parameters that each agent uses in order to calculate the new transformation of each object are defined in the scenario file. The following pseudo-code describes the usage of the agents during the execution of each scenario:

for *each graspable object* O_i *in the scenario*
  if O_i *is grasped*
    O_i*.Agent(handTransorm)*
    While O_i *is associated to an object*
      inputTransform = O_i*.Transform*
      O_i = O_i*.AssociatedObject*
      O_i*.Agent(inputTransform)*
    end While
  end if
end for

An exception to this is the trigger agent. The trigger agent does not follow the procedure described above. A trigger agent receives the same input as the rest of the agents and enables or disables a number of parameterized predefined actions like turning on and off a fire, showing and hiding objects, or moving to the another step of the scenario.

6. Core simulation support unit

The APEIRO core simulation support unit, supports data input and output, controls the simulation agents and opens and saves scenario files. This unit does not implement the connection to the peripheral devices but receives the input data through the Haptic Interaction System. Thus, changing the virtual reality hardware components used in the application does not affect the core simulation support unit. The core simulation support unit controls the data flow between the software components and is actually used to integrate all the components that constitute the APEIRO platform.

7. Ancient Greek Technology Scenarios Authoring Tool

In order to support the extensibility of the proposed system an authoring tool was created that provides a user friendly environment to the expert user in order to manipulate all the necessary data in order to create an educational scenario.

This is a very powerful and extensible authoring tool for the creation of ancient Greek technology presentation scenarios to be simulated by the application. The tool provides: a) functionalities for the composition of 3D simulations, b) capability of connecting with the interactivity support applications (using either VR devices or gesture recognition), c) capability of parameterising the intelligent software agents that simulate the functionality of parts (or the whole) of Ancient Greek mechanisms, d) capability of composing, processing and storing scenarios, e) integration of various scenarios and the possibility to save in a new scenario and f) capability of modifying haptic parameters of the objects.

The authoring tool allows the user to create and modify educational scenarios that can be imported in the APEIRO platform. The expected complexity of the scenario files, lead to the adoption of X3D standard as the scenario format, in order to be able to create more realistic applications. Information that cannot be supported directly from the X3D format is stored as a meta tag of the X3D scenario file. The tool allows the user to select virtual reality agents, associate them with objects in the scene, insert and modify their parameters and provide constrains to them. Each scenario may contain one or more steps. The objects may have different characteristics and associations in each step according to the scenario needs. The author can control the flow of a scenario using simple arithmetic rules (i.e. $<, >, =$) in order to trigger the next step in the scenario depending on the actions of the user.

8. Pilot Applications - Demonstration Scenarios

There are three pilot application scenarios developed in order to evaluate the APEIRO system. These scenarios were selected in order to test the usability of the system in terms of interacting with Ancient Greek technology.

The users were asked to perform the tests described in the following subsections and evaluate their performance using both technological and pedagogical criteria.

8.1. Interactive use of technology using haptic feedback interfaces

The user interacts with an Ancient Greek Technological work in the virtual environment. Initially he/she wears the haptic glove and the tracker sensor. Then the APEIRO application provides the user with information about the technological work presented in the virtual world and then asks the user to try and use it. There are two scenarios implemented to

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Figure 7: *Archimedes screw pump.*

evaluate the APEIRO platform's usability using haptic feedback: a) the Archimedes screw pump and b) a single -pulley crane.

The Archimedes screw pump is shown in Figure 7. In this scenario the user has to grasp the handle of the pump and rotate it along the axis in order to pump water from the river. The level of the water in the pump depends on the angular speed of the handle. When the speed exceeds an upper limit water flows of the pump.

In the single-pulley crane scenario (Figure 8) the user has to pull a rope by rolling it around a wheel. While the user pulls the rope, a rock that is attached to the other side of the rope, is being lifted. The user in this scenario has to grasp the handle of the wheel and rotate it in order to lift the rock.

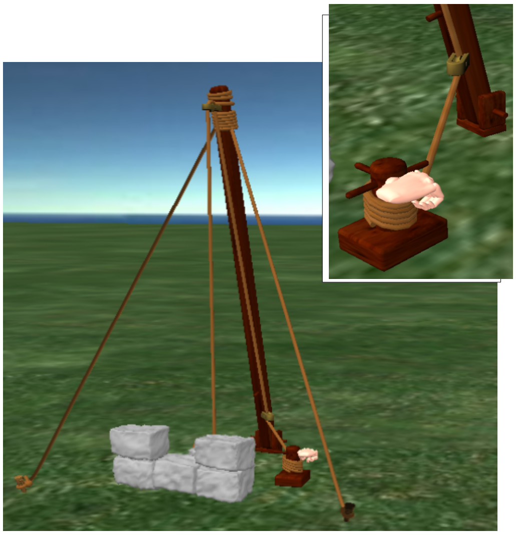

Figure 8: *Single-pulley crane.*

8.2. Interactive use of technology using a gesture recognition interface

In order to practice the "Message Fires" communication mechanism used in ancient Greece, the use of fires to formulate a message is first presented to the users (Figure 9). In order to spell a letter using the "Message Fires", the users have to raise light torches. Specifically the user controls two sets of five torches each. The first set represents the column and the other the raw of a matrix. Each position in the matrix represents a letter. The matrix with the letters is given to the user. The experiment includes two phases. In the first phase, the user is asked to create the appropriate combination of fires in order to represent a letter. In the second phase, a set of light fires is presented to the user and he/she is asked to decide the correct one by choosing from a set of 5 possible letters.

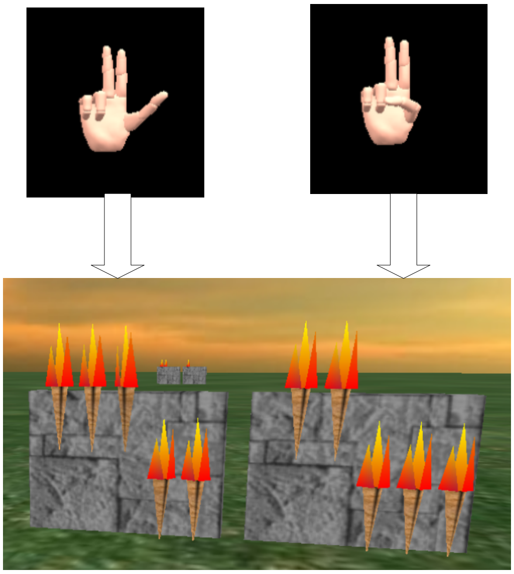

Figure 9: *Message fires scenario.*

8.3. Construction of technology works using haptic feedback interfaces

Construction scenarios consist of two main parts; the introduction part and the assembly part. In the introduction part, the user can see and examine the construction.

In the assembly part, the user has to construct an ancient mechanism. The first part of the mechanism is automatically placed in the scene and the user has to select another part and connect it to the base part. The procedure continues until the user constructs the mechanism successfully or fails to construct the it. In that case the system guides the user and lets him/her try again in order to really perform the assembly on his/her own. The proposed assembly mechanism is an extension of the assembly environment described in [NFT03].

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There are two scenarios implemented in this case: the Archimedes screw pump and the Hydraulic telegraph:

- Archimides screw pump: This is a very simple scenario where the users can grasp the inner part of the pump and place it inside the outer cylinder in order to complete the task. This is used as a first step to get the user acquired with the application.
- Hydraulic telegraph: In the case of the Hydraulic telegraph the user has to assembly the telegraph presented in Figure 10. The telegraph is initially split at four pieces. The user has to decide the order of assembly of the Hydraulic telegraph components. If the user proceeds in the correct order, the assembly is completed successfully. If the user makes an error, then the assembly is not finished successfully. The user is informed about it, and is allowed to try one more time.

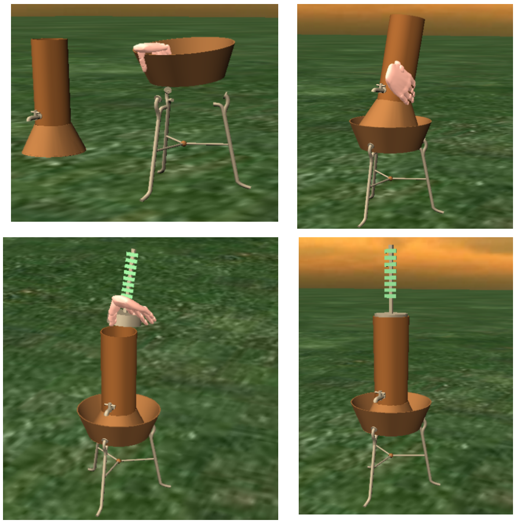

Figure 10: *Steps for the assembly of the hydraulic telegraph.*

9. System Evaluation

The evaluation was designed in order to help the qualitative / quantitative estimation of:

- The overall usability of the proposed technologies to non-specialized individuals.
- The extensibility and expendability of the use of the proposed technologies into other application fields.
- The acceptance of the tools, the user-friendliness and the points where improvement is needed.
- The easy understanding of hardware.
- The added value produced by the introduction of new interaction techniques in the educational/entertainment procedure of Ancient Technologies simulation.
- The acceptance of the demonstration of the novel interaction technologies by the users.
- The educational value of the applications.

The system has been evaluated in tests with students of two secondary schools in Thessaloniki, Greece. The test procedure consisted of two phases: In the first phase, the users were introduced to the system and they were asked to use it. During this phase, the users were asked questions that focused on usability issues and on their interest in participating to each test. The questionnaire used contained also questions to the test observers, e.g. if the user performed the task correctly, how long did it take him/her to perform the task, etc. The second phase was carried out immediately after the tests, using an after tests questionnaire. Specifically, the users where questioned after finishing all the tests about general issues such as: (a) the benefits and limitations that they foresee on this technology, (b) the usability of the system in a museum environment, (c) other tests and applications or technologies that they would like to experiment with the APEIRO application, if any, etc.

The system evaluation results have shown that users consider it very innovative and satisfactory in terms of providing a presentation environment in a real museum. The percentage of the satisfied students was reported to be more than 90%.

The Analysis Of Variance (ANOVA) [Sch59] test is used to test differences in means for statistical significance. The ANOVA method was used to compare the performance between male and female students, students familiar to computers and 3D graphics and those that were not familiar, and students that were already familiar on the ancient technology to the rest that were not. The time needed to complete each test was used in order to compare the performance of the groups. The result of the ANOVA test are based on the F Distribution [Wei]. A critical value for the F value is used in order to decide whether the two groups are statistically different or not. The critical value for the parameter $F_{critical}$ of the ANOVA method was calculated to be equal to 4.04 (assuming probability equal to 0.05 and degrees of freedom between groups equal to 1 and within groups equal to 49). When the F result for a pair of groups is grater than the critical value the difference between the mean values for the groups is considered significant and the two groups different from each other. Two groups and 51 measurements were assumed in each case and thus parameters DFS and DFG were computed to be DFS=2-1=1 and DFG=51-2=49.

The gender of the users did not seem to affect the performance results. According to the ANOVA method the F value was 3.33, and the average time was 3.7 min for female users and 4.0 min for male users.

The use of computers affected the performance of the users. The average time for the students that where familiar to 3D computer graphics was 3.9 min, while for those that were not familiar the average time was 4.2 min. The F value of the ANOVA test was 4.5 min which confirms the initial

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hypothesis that users familiar with computers performed better in the environment.

Knowledge of the ancient technologies did not affect the performance of the users. Average time for the students that where familiar to ancient technologies was 3.9 min while for those that were not familiar the average time was 4.2min. In this case the F value of the ANOVA test was 3.02 which does not confirm the initial hypothesis that users familiar to the ancient technologies would perform better in the APEIRO platform.

10. Conclusions

The described application focuses on the presentation and dissemination of Ancient Greek Technologies in order to produce awareness to the major part of the young population of the country. Specifically, the analysis of the basic characteristics of Ancient Greek Technologies are presented using virtual reality environments, so that they can become easy perceptible even to those that are not familiar with the technology. In this way, the platform contributes substantially in the general effort to promote the knowledge on Ancient Technologies. This research work is expected to contribute significantly in the general effort of sensitization and briefing of the public, regarding the Ancient Greek Population.

The system architecture provides a platform that enables the system to achieve a number of technological and pedagogical targets.

The main technological targets achieved are:

- The presentation using interactive virtual environments of Ancient Greek Technology achievements, as well as the demonstration of the evolution of the same construction / technology in time.
- The use of virtual reality techniques for simulating interaction between the user and the virtual exhibits.
- The use of gesture recognition algorithms for supporting natural interactivity.

The main educational / pedagogical targets achieved are:

- The development of a simulation system where the curiosity and the imagination will be encouraged and where all the human senses will be involved in the learning process of the fascinating world of Ancient Greek Technology.
- The exploration of the Ancient Greek Technology issues using advanced methods requiring active participation of the visitor in explicit applications presenting the role of the technology in any field of ancient and modern life.
- The comparison between the basic skills that modern people should possess with the corresponding skills required from the ancient Greeks.
- The comparison of the knowledge level that was considered acceptable in Ancient Greece with the corresponding current knowledge level.

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