E-Learning Applications through Space Observations

Ioannis Chochliouros
OTE S.A., General Directorate for Technology, Greece

Anastasia S. Spiliopoulou
OTE S.A., General Directorate for Regulatory Affairs, Greece

Tilemachos D. Doukoglou
Hellenic Telecommunications Organization S.A. (OTE), Greece

Stergios P. Chochliouros
Independent Consultant, Greece

George Heliotis
Hellenic Telecommunications Organization S.A. (OTE), Greece

INTRODUCTION: THE ROLE OF THE D-SPACE PROJECT

In the context of the present work, we discuss several fundamental issues originating from the work already performed in the scope of the Discovery Space (D-Space) Research Project, founded by the European eTEN Work Program. The Project has been awarded as the "Project of the Month - November, 2006" and the "second best European research activity" in the scope of e-learning thematic activities (http://www.discoveryspace.net/).

The prime purpose of the work was the development of a virtual science center, able to integrate robotic telescopes from all over the world into one "virtual observatory" through a proper Web-based interface, to provide an automated scheduling of the telescopes to end-users (i.e., students, teachers, and researchers) and access to a library of data and resources for lifelong learners. Potential users can benefit from professional-quality data from their local sites, using modern broadband (Internet-based) facilities (European Commission, 2002).

Following the echo from the market request for more cost-effective and compelling applications to be delivered over the currently-launched broadband networks supporting the expansion of the global information society (The European Survey of National Priorities in Astronomy, 2004), the relevant service application aimed to take advantage of the convenience of the high-speed Internet access to involve its various users (originating from distinct thematic categories) in extended episodes of playful learning. The basic issue was the creation and presentation, to the market, of an entirely interoperable worldwide service, able to support options for further enhancement of e-learning facilities for teachers, students, researchers, and other practitioners. The approach has been considered the existing Internet-based facilities as the basis to "transform the today's classroom to a research laboratory" and to develop further the European e-learning market (Chochliouros & Spiliopoulou, 2004; Danish Technological Institute, 2004).

BACKGROUND: ROBOTIC TELESCOPES FOR EDUCATIONAL PURPOSES

A Broadband (Internet-Based) Virtual Network

The primary target of the entire research effort of the "D-Space" Project was to investigate the technical feasibility and the business case of the online use of a specific thematic set of applications, mainly developed for educational (and informative) purposes with the aim of providing users with the possibility to remotely utilize controlled robotic telescopes (in "almost-real-time" application), accessible *"at all times from everybody*

from everywhere" (Solomos, Polykalas, Arageorgis, Fanourakis, Makroyannaki, Hatzilau, Koukos, Mavrogonatos, 2001).

The corresponding approach has thus suggested the "creation" of a "virtual science thematic park" comprising several distributed robotic telescopes, together with an interactive, constrain-based scheduling service, extended databases of scientific data and other variable resource archives. Consequently, the proposed service takes advantage of the tremendous synergistic potential of an international "virtual network" consisting of professional-grade, remotely-accessible observatories, adequately interconnected via modern infrastructures and related facilities (Chochliouros & Spiliopoulou, 2005).

The suggested application is already cooperating with five telescopes located in various European countries and Israel. During the current stage, the two telescopes of the Skinakas Observatory (located on the Ida mountain in Central Crete, Greece), the Liverpool Telescope (the largest robotic telescope in the world located on the island of La Palma in the Canaries), the Ellinogermaniki Agogi Telescope (located in the area of Attica-Athens, in Greece) and the Sea of Galilee Observatory (located in Israel), can be remotely operated by educators, students, researchers, visitors of science museums and science thematic parks, as well as the wider, interested public, according to their scheduled availability. In the near future, more telescopes will enter the "network" to extend the opportunities that are offered. A prerequisite for the proper functioning is the assurance of continuous Internet access, available at a speed of at least 1.5Mbit/s. The entire system has to possess enough computing power to handle Web interfaces, File Transfer Protocol servers, and storage space for images and logs (Sotiriou & Vagenas, 2004).

DEFINING A MODERN USER INTERFACE

The communication of the related telescopes is achieved through a proper system's interface (Fischer, 1993). In particular, a common user interface, on the basis of an "open" and transparent architecture, is the main portal to the services being offered, thus allowing for easy adaptations and/or other modifications.

Each telescope communicates with the "D-Space interface" through the common File Transfer Protocol (FTP) server-client. The Master Control System (MCS) of each robotic telescope (i.e., a set of hardware, software, and communication units, responsible for the management and operation of the telescope) considers the interface as a remote user. The service requests a series of observations from the MCS using a text file (files). Then, the following day, the system asks for the results from the FTP server of the MCS.

Since the corresponding communication protocols are widely known, the addition of a robotic telescope to the current "network" is not a complex task. The whole system sees a new telescope as a "black box", so any potential new candidate can use any internal platform (software and hardware) to control its own instruments. The only requirement is that the MCS is connected to the Internet, and the transfer protocols are properly observed. This freedom of underlying platforms makes the effort an attractive service for educational and scientific purposes.

The user requests observations through a proper Web interface. This contains a list of telescopes, targets, weather conditions in the remote sites, and other useful information that can help performing observations. User interface has been developed to be an adding tool that bridges science teaching and technology. The educational software can support teachers/students in an innovative learning environment while, at the same time, is compatible with graphics and analysis software components, to further investigate trends and patterns of data collected by the telescope usage (Sotiriou & Vagenas, 2004).

The user has to select the astronomical object to be observed from an object list (properly updated by the involved team partners), together with helpful information to perform valid observations. Then the user fills in a submission form with the details of the observations (like date, time, filters, duration, etc.) and the request is stored in the local database of the D-Space Web server. Every night, an automated program sends all requests to the telescopes, for the necessary scheduling purposes.

If the request is realized in the desirable night, then the image taken by the telescope is introduced in the system's library the next morning (where it can then be downloaded by the user). If there is a technical or any other problem (i.e., a big queue of requests, improper weather conditions, etc.) on the desirable date so the request cannot be realized, the user is then informed about the realization delay of the request. In this case,