virtual_control_room

a new learning environment

July 2002

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Learn about space and astronomy

The virtual_control_room is an electronic learning environment resembling a real space control centre. The virtual_control_room makes use of Virtual Reality technology to enhance the experience of learning.

Edutainment in an electronic classroom

The virtual_control_room targets high-school students (16-18 years old), but will fascinate people of all ages.

It is great fun for students and teachers.

Hands-on and role playing

By planning and performing a simulated space mission, the students learn about astronomy, space science, physics, chemistry, etc.

A unique experience

The virtual_control_room allows planetariums and science centres to offer a unique experience to their visitors. The virtual_control_room is modular, scalable and flexible, satisfying the individual needs and requirements of planetariums and science centres.

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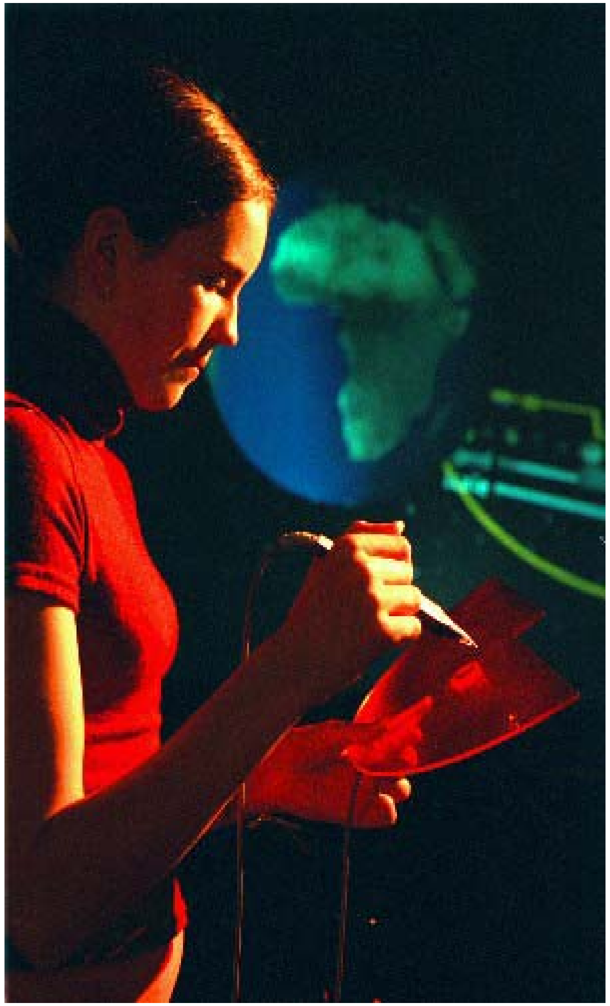

A new learning environment

The virtual_control_room represents a new concept of learning. It supports collaboration, provides multimedia content and makes use of Virtual Reality technology to enhance the experience of learning. The concept is known as edutainment, the pedagogical valuable cross-over between education and entertainment.

The virtual_control_room provides children and adults with access to knowledge about space science and astronomy in a manner that they can all benefit from and enjoy. The difficulty in understanding space and astronomy inhibits many persons from appreciating new achievements in this area. Furthermore, this also impedes them to pursue a further interest in the subject.

The virtual_control_room is a means for achieving a much better appreciation and understanding of astronomy and space. The virtual_control_room exhibits a high quality user interface experience. It applies digital models, simulations, 3D visualisations, video, and current events in the familiar and yet stimulating setting.

Users of the virtual_control_room experience shared access to scientific information about astronomy and space. The concept is based on interconnected multimedia devices and material, allowing groups to explore and learn about astronomy and space. The system mediates this information while engaging users in realistic simulations and shared virtual environments.

The virtual_control_room allows planetariums and science centres to offer a unique experience to their visitors.

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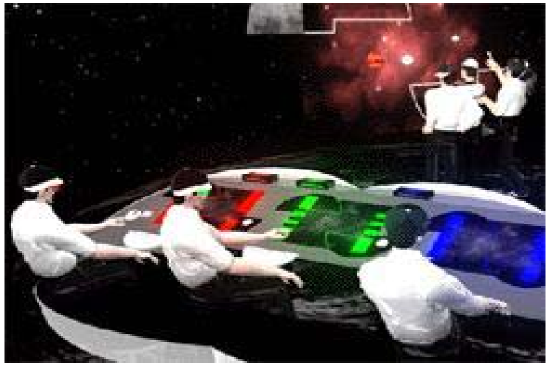

Edutainment in an electronic classroom

The virtual_control_room makes it possible for school classes to plan and carry out a virtual mission to the comet Wirtanen to look for traces of life. The students will play the roles of scientists, engineers, mission control managers etc., and they will experience the excitement of making new discoveries.

The virtual_control_room setup

The virtual_control_room is a new vision of a learning environment. It creates a unique setup that fascinates and motivates students, thereby increasing the learning effect.

The virtual_control_room has a look and feel like a real space mission control centre with a big screen and a number of work places. The students are seated at these work places. For pedagogical reasons work places are grouped in islands. An island has three work places each equipped with a touch sensitive screen. Two students can share a work place. This means that an island can accommodate between 3 and 6 students. Furthermore, each island has a big screen (island screen) used to provide additional common information. The islands are grouped around the big screen. A standard virtual_control_room configuration includes four islands in order to accommodate a school class with up to 24 students. However, the number of islands can vary according to specific needs and physical constraints. This makes the virtual_control_room concept flexible.

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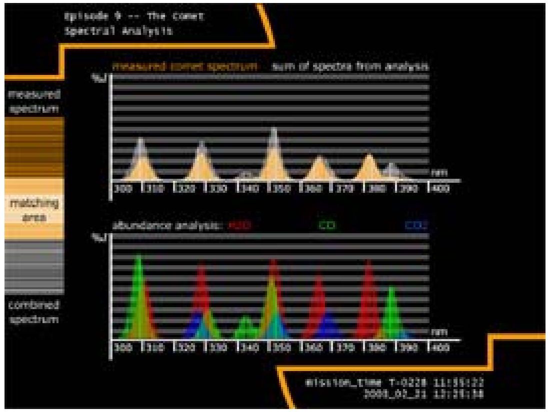
Hands on experience

By planning and performing a simulated space mission, the students learn about astronomy, space science, physics, chemistry, and more. Learning by doing is more efficient than the classic unidirectional and passive style of lecturing and thus an optimal supplement. Students are more excited and motivated, hence the mediated knowledge is better memorized.

Currently, the virtual_control_room provides a scenario of a mission to a comet based on ESA's Rosetta mission to the comet Wirtanen. Many other missions can be supported, such as a mission to land on a planet or a visit to the International Space Station. The virtual_control_room also supports learning in scientific and technical domains other than space.



Learn about science

The space mission not only covers information about the solar system. It also presents topics from physics, chemistry, mathematics, biology, geology etc. The missions are carefully planned from a pedagogical point of view, in order to maximize the outcome for the participants.

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Performing tasks in a team

The virtual_control_room encourages co-operation between students in order to give the experience of both the necessity and the strength of working together when exploring complex physical phenomena. The different episodes of the mission are designed with collaboration in mind.

Pedagogical presentation of science and assistance by the virtual character Dr. Ashley

The virtual_control_room provides access to knowledge about natural sciences and astronomy through simulated space missions, presented and narrated in a pedagogical fashion, by the virtual Dr. Ashley.

The students will experience the laws of physics and will be introduced to the concepts of space travel.

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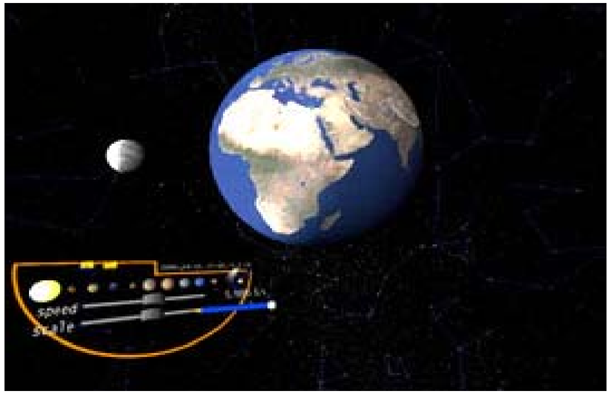
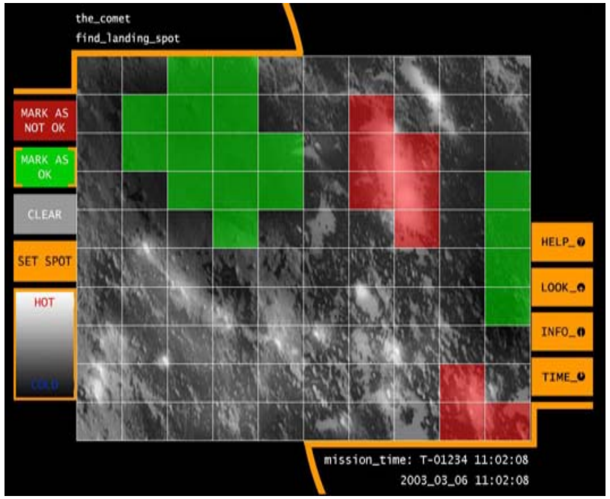


Intuitive user interfaces and Virtual Reality technology

The virtual_control_room provides an intuitive 3D virtual reality based user interface. The user interfaces to the system are touch sensitive screens and a special Personal Interaction Panel (PIP). The PIP allows students to manipulate 3D objects in a very intuitive and user-friendly way. The user interfaces and collaborative pedagogical approach of the virtual_control_room provide a learning environment with qualities beyond current state of the art. The illusion of being in a control room and working together is an important part of the concept.



Example of a task

One example of a task for the students is finding a suitable landing spot for the Rosetta lander module. This is to be done after a successful orbit-insertion manoeuvre.

Each student is presented with a map of the same area of the comet, but with different geographical and/or geological properties displayed. For instance, one student sees an infrared map, showing seismic activity, and another student is presented with a map showing where the surface is icy or rocky.

Each student then has to figure out where on his or her particular map it would be advisable to land. The students now have to work, first individually and then together, in order to find a suitable landing spot where all the criteria from the combined set of maps are met.

The mission

Students plan and carry out a space mission in the virtual_control_room.

The inspiration for the mission comes from the ESA mission Rosetta. The Rosetta mission will be launched on 13 January 2003. The spacecraft will make a nearly ten years journey through the solar system before it reaches its target. On its way it will pass the asteroids Otawara and Siwa in 2006 and 2008, respectively. It will pass Mars in August 2005, make a swing-around back to Earth in 2005 and 2007, and finally reach the comet Wirtanen in 2011.

This complicated orbit takes advantage of the gravity of Earth and Mars to give the spacecraft the necessary energy to reach the comet. When the spacecraft approaches the comet scientists will use the onboard scientific instruments to get detailed information about the comet, including a map for selecting a suitable landing spot. Eventually the spacecraft will be inserted into orbit around the comet. The climax of the mission will be in 2012 when a lander is released and put down on the comet's surface. This will be the first landing on a comet.

The main theme of the mission is searching for traces of life in the universe. Our understanding of life on Earth is increasing rapidly. However, there are still some very fundamental open questions:

- How did life come to Earth?
- Did Earth provide the right conditions for life to start spontaneously?
- Or did life come to Earth from somewhere else in universe?

We don't know, but today most scientists believe that Earth is not the only planet in the universe where life exists. Scientists also think that there are links between the different 'civilizations'. In other words, life is able to travel through the universe. A possible explanation is that comets could be the carriers of the building blocks of life. If we are looking for traces of life outside the Earth the comets are therefore good places to look. Comets spend most of their time far away from the Sun and are as such representing the most pristine material in the solar system

The tasks

A number of tasks will guide the students through the mission:

- Identification of a suitable comet (in this case Wirtanen) and calculation of its orbit.
- Selection of a set of experiments suitable for the mission.
- Calculation of the optimal orbit of the spacecraft, applying Newtons and Keplers laws.
- Launch of the mission.
- Travelling through the solar system to reach the comet, making observations of planets and asteroids when they are passed.
- Conducting detailed studies of the comet, including finding a good landing spot.
- Landing on the comet and carrying out the planned experiments.
- Drawing the conclusions from the experiments and trying to answer the main question:

Are there any traces of life on the comet?

The Rosetta mission is very interesting from a teaching perspective. It is an exciting mission searching for traces of life, it includes many facets of space exploration and astronomy, and it can illustrate topics from mathematics, physics, biology, geology and so on. The concepts of time and space are covered and an understanding of life and its building blocks is fundamental.

The Rosetta mission was selected for demonstrating the concept of the virtual_control_room. It is the intention to develop other missions in the future.

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About the ASH project

The European Commission funded project IST-1999-10859 ASH (Access to Scientific Space Heritage) has developed the virtual_control_room concept. The ASH project started on January 1st 2000 and lasted for 2½ years. Here school classes can plan and carry out virtual space missions. Students get involved by playing the roles of scientists, engineers, and mission control managers. The virtual_control_room emphasises the importance of collaboration between students for achieving results. New Virtual Reality technologies and simulation tools provide a powerful user interface, which enhances the learning experience. The virtual_control_room groups students on 'islands' placed around a large central screen. This concept provides a modular, scalable and flexible learning environment offering new pedagogical opportunities.

About the project partners

The partners together provided the knowledge and research capabilities necessary to carry out the project. Each partner had a clearly defined role in the project that reflected their expertise.
The planetarium partners, Europlanetarium, Royal Observatory, and Tycho Brahe Planetarium , provided knowledge about user groups, information mediation and creation of accessible content. The three technical partners - DELTA, Space Applications Services, and Technical University Vienna - each provided different expertise and technologies necessary to implement the system and mission.

DELTA Danish Electronics, Light & Acoustics (Denmark) www.delta.dk
Role: (CO) Project management; Overall system implementation and integration; CSCW tools. Experience: Management experience from European Projects; System Analysis; Virtual Classroom; Computer Supported Collaborative Work tools.

Space Applications Services (Belgium) www.sas.be
Role: (CR) System requirements; Simulation of physical models; Procedure execution system (script based). Experience: Space system engineering; Command and control Systems; Computer Assisted Learning.

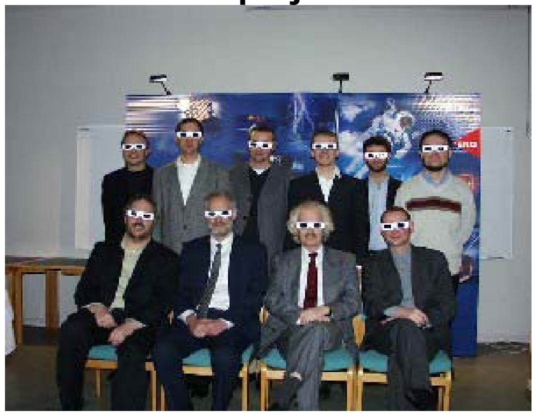
Technical University Vienna, Institute of Computer Graphics/Imagination Computer Services (Austria) www.imagination.at
Role: (CR) System specification; VR presentation and manipulation system for interactive collaboration (Open Inventor from SGI); Models and animations. Experience: VR systems; Models.

Europlanetarium Genk (Belgium) www.europlanetarium.com
Role: (CR) User trial and evaluation; Experience: Dissemination of Astronomy.

Royal Observatory of Belgium (Belgium) www.astro.oma.be
Role: (CR) Specification and development of scenarios; Evaluation of scenario's. Experience: Astronomy research; Dissemination of Astronomy.

Tycho Brahe Planetarium Copenhagen (Denmark) www.tycho.dk
Role: (CR) Requirements identification; Evaluation of scenario's. Experience: Dissemination of Astronomy; Control Centre trials.

The ASH project team



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