

New Educational Platform based on Virtual World learning for teaching Renewable Energy

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Abstract. AVARES is a Leonardo da Vinci Transfer of Innovation Project aiming to develop a Virtual Reality environment, to create innovative Virtual Reality learning methodologies and integrate them with traditional learning for teaching more efficiently the challenging field of Renewal Energy Sources (RES). The project aims to establish 3D virtual learning environment and multimedia learning materials providing access to vocational education and training in the field of Renewable Energy Resources (RES), by means of modern information and communication technology for vocational education and training. RES domain is considered a hard domain for students to deeply understand via traditional learning methods. The Innovative Educational Platform to be developed in AVARES project combines traditional learning procedures offered to students via Moodle through Virtual Learning Environment (VLE), with learning procedures delivered to students in a 3D Virtual World. The Virtual World is developed in Open Simulator (OpenSim), an open source platform for creating multi user 3D Virtual Worlds [1]. Moodle VLE focuses on the management of the learning processes, whereas the Virtual World environment offers students the ability to interact with items and constructs in a similar way they would do in real world and to get a deeper understanding of the functionality of special items used in RES domain.

Keywords: Virtual Reality in Education, 3D Virtual Learning Environment, OpenSim, Teaching Renewable Energy Domain.

1. Introduction

The AVARES Project entitled *Enhance Attractiveness of Renewable Energy training by Virtual Reality* is a Leonardo Da Vinci Lifelong Learning Program, which started in October 2012 and will be finalized in September 2014. The main objective of the project is to present new methods of learning and to give the possibility for application the principles of the non-barrier learning in the field of Renewable Energy Sources (RES) and climate protection. In this context the project is going to establish a 3D virtual learning environment and multimedia learning materials for vocational education and training in the field of RES. More specifically, the project's partners are working to develop a Virtual Reality environment, to create innovative Virtual Reality learning methodologies and integrate them with traditional learning for teaching more efficiently the challenging field of RES. The Educational Platform developed in AVARES project for teaching RES domain will combine traditional learning procedures offered to students via Moodle, a very popular Virtual Learning Environment (VLE), with learning procedures delivered to students in a 3D Virtual World. The Virtual World is developed on Open Simulator (OpenSim), an open source platform for creating multi user 3D Virtual Worlds. Moodle VLE focuses on the management of the learning processes and can help students and tutors to get the proper theoretical background on the domain of RES. The Virtual World environment offers a transition from the traditional textbook learning approaches to a more interactive and efficient learning, offering a new, attractive and efficient way of learning through experimenting and interacting scenarios in the virtual world [2]. Thus, students can get a deeper understanding of the functionality of special items such as energy machines, solar collectors, wind turbines etc. The 3D models of

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such items in the virtual world will present in an interactive way the parts they consist of and how they function.

The RES domain has in view all the five online courses: Solar Energy, Water Energy, Wind Energy, Geothermal Energy and Energy of Biomass. The curriculum of each one of the e-courses combines traditional learning approaches with proper learning scenarios in the virtual 3D world.

2. Guide for Virtual Learning Environment and its main features

A Virtual Learning Environment (VLE) has been developed based on the Moodle VLE. Moodle platform was selected because of its popularity and wide-use and also because of its open-source nature. A main advantage is that Moodle is to be an open source environment which can support an international community with more than 1.000.000 members. Moreover, it includes a web service layer that opens it to new technologies and also gives Moodle the ability to be integrated with service oriented architectures.

Moodle VLE focuses on the management of the learning processes and can help the tutors with the course organization and administration and also the supervision of the students' performance. Moreover, it can help students to get the proper theoretical background on the domain of RES[4]. Students can explore and learn about RES domain through the 5 courses devoted to: Solar Energy, Water Energy, Wind Energy, Geothermal Energy and Energy of Biomass. Also, an introductory course on Green Energy is preparing to be offered to the students. In Fig. 1, a first proposal of the main menu presenting students the courses available in VLE is illustrated.

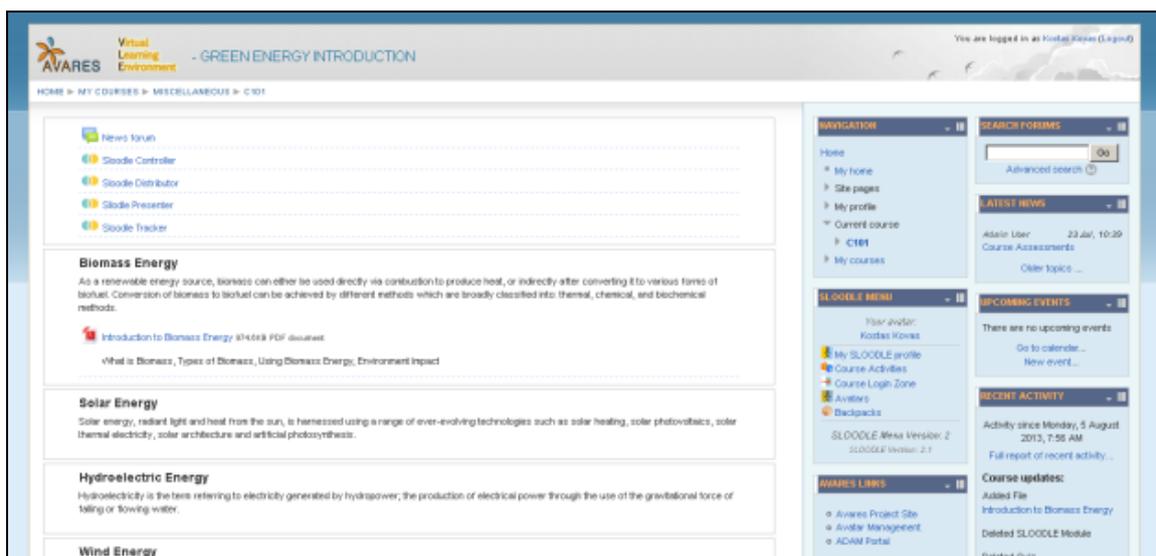


Fig. 1: The Moodle VLE and the courses offered.

A short description of the proposed course follows.

- **Solar Energy Course:** Introduces students to the basic theoretical concepts regarding solar energy production. The students learn how solar energy can be generated and used through ever-evolving technologies such as solar heating, solar photovoltaic, solar thermal electricity, solar architecture and artificial photosynthesis.
- **Water Energy Course:** The Water Energy course provides students the proper theoretical background of how hydropower generation systems operate and how hydropower energy is produced.
- **Wind Energy Course:** During this course the students learn how the wind is converted into a useful form of energy, and also the way this is made by using, for example, wind turbines to make electrical power, windmills for mechanical power and wind pumps for water pumping or drainage.
- **Geothermal Energy Course:** Geothermal energy explains how is thermal energy generated and stored in the Earth. The course presents the geothermal bearings (Hot Springs, Fumarols, Mud volcanoes, Geysers) and some of the advantages and disadvantages in using geothermal energy.

- **Energy of Biomass Course:** As a renewable energy source, biomass can be used directly via combustion to produce heat, or indirectly after converting it to various forms of bio-fuel. Conversion of biomass to bio-fuel can be achieved by different methods (thermal, chemical, and biochemical methods).

In Fig. 2, is illustrated a proposed example presentation during the course of biomass.

A student registered on VLE platform is requested to fulfill different assignments consisting in exercises such as fill-in-the-blank exercises, multiple choice exercises and open answer ones. After having answered, the student can submit the answers for grading. Finally, the VLE platform offers various ways of communication between trainers and trainees including: News and Announcements, Discussion Forum, Instant Messaging / Chat, Files Sharing.

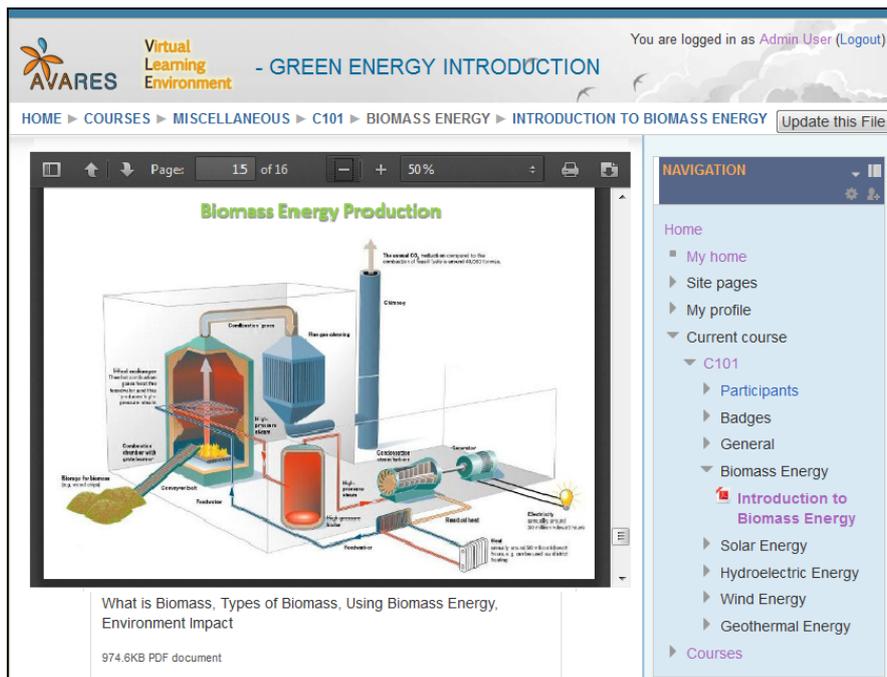


Fig. 2: A presentation during the Biomass course in the VLE

As mentioned above the aim of the courses offered by the Moodle VLE is to help the students get the proper theoretical background on course's concepts. After a student has covered the basic theoretical topics, he/ can access the Virtual World and to get the proper practical training thought different learning scenarios.

3. The AVARES Virtual World

Over the past decades technology has changed the education domain as well. Recent approaches for more efficient and intensive learning are via digital, 3D Virtual Reality environments. A Virtual World environment offers to the student the ability to communicate between them and with the teacher and collaborate in the learning experience, to interact with items and constructions in a similar way he would do in the real world. A very popular platform is the Open Simulator (OpenSim) platform. This is a multi-user virtual world platform and is being used very successfully in many domains and especially in education. The Virtual World developed empowers the students to move around the areas of the virtual word, to talk with other students, to gesture, to manipulate items and constructions in a very natural way. In Fig. 3, a part of the proposed Virtual Word developed is presented.

The main objective of the Virtual World is to present the learning material for each learning topic stored in the VLE, in corresponding areas inside the world. It offers 3D models of the presented devices that will help students understand the way they function. The 3-D virtual worlds provide immersive learning delivery platform that can be adapted to different training scenarios such as: discovery learning by clicking on objects with associated information; reinforcement learning by offering a knowledge tools associated with objects in 3-D; collaborative workspaces, such as 3-D classrooms and informal sites for discussion, encouraging

school-style study and research; traditional instructor-led learning through a distance delivery method; simulated learning by modeling a process or interaction that closely resembles the real world in terms of fidelity and outcomes.

3-D virtual environments possess several significant advantages and offer more assessment possibilities, by tracking the avatar interactions in the Virtual World and also more ways for communication of trainers and trainees.

As an example, next to the landing point in the Virtual World, the user is presented with boards that indicate the basic controls for navigating the avatar and controlling the camera.



Fig. 3: An overview of an area in the Virtual World

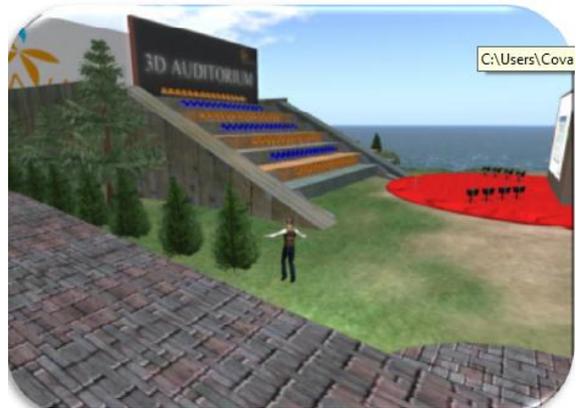


Fig. 4: 3D auditorium in the Virtual World

The speaker-avatar can import/upload images-slides of his presentation. FreeSwitch server is installed to allow voice communication.

It is possible for teachers to create groups and invite their students to create working groups. OpenSim can also embed suitable communication software, such as the FreeSwitch server, to allow voice communication.

3.1. The Virtual World Facilities/Constructions in AVARES project

The AVARES Virtual World is proposed to consist of:

- **The 3D Auditorium:** Trainers giving lectures in the 3D Auditorium will be able to load specific presentations from the VLE or even upload their own slides.
- **Learning areas:** Specific areas in the world will be associated with each learning topic, containing theory (presentations etc) and practice (3d models, animations etc). Example for Biomass Energy in adjacent image
- **Sub-Areas dedicated to each course:** For each one of the five main learning topics (Solar, Water, Wind, Geothermal, and Biomass) there will be a designated area inside the world. Each area will host the corresponding training material along with interactive 3D models that will help them comprehend the presented topics.



Fig. 5: Specific learning areas.

- **Classrooms/ Meeting Rooms:** These rooms can serve both as meeting areas for project partners and as classrooms for small groups of students.

The learning material stored in the VLE will be also available in the Virtual World. By visiting the 3D Library, users will have access to the textbooks and will have the option of opening them in browser windows inside the Virtual World or following external links to the VLE. Specific textbooks and presentations will be visible as posters or boards, at various areas of the Virtual World. For example inside the 3D Virtual Park, adjacent to 3D models representing RES systems, users will be able to read the corresponding learning material from the VLE. Trainers giving lectures in the 3D Auditorium will be able to load specific presentations from the VLE or even upload their own slides.

SLOODLE [4] is a Moodle plug-in that has been developed to facilitate the integration of Moodle with SecondLife or Opensim. Using SLOODLE avatars will be able to participate in the exercises stored in the VLE by sitting on corresponding “test chairs”. Their answers will be stored and automatically evaluated by the VLE. A Scoreboard connected with the VLE can present their assessment in the 3D world. Communication of users inside the virtual world will be stored inside the VLE as well. It will also be possible to use “enrolment booths” in the Virtual World to automatically register and enroll users in the VLE. This will also be necessary to connect a student account in the VLE with the corresponding avatar. OpenSim can embed suitable software such as WIFI for offering an avatar account management system. This allows users to create and manage an avatar account for the virtual world. The administrator of the system can also use this tool to remotely manage avatar accounts and groups of avatars, to assign specific roles and grant permissions. It also allows using a number of default avatars (e.g male, female) for users to select during the avatar creation. This system can finally be used in parallel with the Moodle registration module to allow the automatic creation of the avatar during the registration of the user in the VLE.

4. Conclusions

In this paper is presented a *new educational platform* that is being developed in order to assist in teaching the domain of Renewable Energy Sources. The authors propose two main components: a traditional Virtual Learning Environment and a 3D Virtual World as well as an efficient way to combine these two together. The 3D Virtual World can support traditional learning environments by offering new ways of communicating and delivering learning material. The platform is expected to be available by September 2014 and the authors hope that AVARES Project Platform it will provide a useful supporting activity for RES classes.

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