Proceedings of the 1st WSEAS / IASME Int. Conf. on EDUCATIONAL TECHNOLOGIES, Tenerife, Canary Islands, Spain, December 16-18, 2005 (pp149-153)

A Virtual Lab and e-learning system for renewable energy sources

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Abstract: As the Internet has developed into a reliable channel of tuition, distance-learning programmes have become increasingly popular over the last few years. Technology has a great development rate and it is mandatory for the technicians to be informed about their domains new features. Distance-learning programmes are ideal for professionals, who need to update their knowledge and skills. This paper presents an e-training system for the renewable energy systems in which the visitor can learn, watch and be educated. It gives information in picture-text format and also a virtual lab is available. The implementation of the above system is taking place with the use of new digital techniques, using multimedia content management schemes and Open and Distance Learning (ODL) principles and planning specifications.

Key-Words: e-learning, ODL, ICTs, virtual lab, virtual library, RER

1 Introduction

In the modern world, where everything changes at an extremely fast rate, a constant and everyday updating of knowledge is necessary. Nowadays all energy companies use plenty of the advanced technologies such as renewable energy sources (RER) applications. As those technologies change quickly, and workers do not always have enough time to attend new courses in order to improve their knowledge and keep up with innovative concepts, learning through the Internet seems maybe the only effective and feasible solution.

Information and communication technologies (ICTs) have rapid development. They open up new horizons for progress. Electronic Library (e-library) makes possible to the visitor, to have a real research over a deep database. The database has designed with such a way to support a virtual lab. Virtual lab capabilities enhance the electro technician interaction by deploying data and analysis in real time. The data doesn't mean only text. It is also images, videos or e-mail to exchange information and knowledge [17].

E-learning can be defined as instructional content or learning experiences aiming to learn and increase visitors (here the branch of electro technicians) knowledge and skills in order to be more productive which gives a boost to their careers. E-learning has the potential to attract anyone who is eager to remain close to new products and processes [1,2,3,5,7,8,10].

Open and distance learning (ODL) is one of the most rapidly growing fields of education. ODL is offering flexible learning opportunities and interactive services to the visitors (electro technicians). ODL systems must be always being designed depending of the desired needs, goals and perspectives of the target group that applies to [9].

Because of the extensive material of valuable information the system is using databases organized in the form of virtual libraries (V-Lib). V-lib are directories which administrators modulate them in a logical way. Consequently, they become more user-friendly and offer easy navigation to the visitors. Virtual Lab technology also, is used in the system aiming to replace physical machines with virtual machines on one host server. They eliminate the limitation of physical appearance so that users are able to complete security exercises on the local operating system utilizing the client/server architecture [6,11,12,16].

The name of the system presented is Solwin. It provides Vocational training in the electrical systems technologies for solar and windy renewable energy applications. The system is aiming at life and long distance training of the electro technicians on the

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installation and maintenance of electrical circuits and automations necessary about solar and windy energy systems. For this reason, technologies such as multimedia content management, virtual lab and virtual library are used.

2 Abstract Level Description

In order for the whole system to be more useful and practical, there are some important parameters which have to be taken into consideration. The most important ones are analyzed in the following paragraphs.
An electronic environment is important, which will be constructed with the usage of the advanced teleconference services (e-mail, chat, voice and video) over the internet. This environment will offer a number of facilities and services that will be able to support, via an easy and friendly way, education and training in the form of life long and continuing education and training.

The design and development of the electronic informative material will be based on text sound and video (multimedia) and will be directed towards the aim of training in the field of electrical engineering (science, modern products and technology). The trainees will be the community of industrial electricians and students.

Furthermore, the creation of a human network of scientists, technicians and producers within the scientific domain of electrical engineering, is also one of the main goals of the presented system. This network will undertake the role of the information distributor from and to industry, electricians and students for new products, availability prices e.t.c. Also will bear the feedback and demands from electricians' of industry.

To sum up, the installation and operation of the appropriate internet teleconference services based on chat, voice and video are included on the goals of this system. The teleconference services will support the distributed operation of the human network and will be used to support and interact with the above mentioned "electronic environment".

3 System Analysis

The core of the system design is the offered technical training courses (Figure 1). These courses are divided into two major parts: Photovoltaic cells and Solar Power Integrated Installations. Although they seem similar in content, the above courses have different case studies, so this division aims at conveying as much spherical knowledge as possible. These sub-courses are organized in the form of virtual laboratory. They contain practical training by applying a simulation process in various installations, and theoretical training as well in the form of a virtual library.

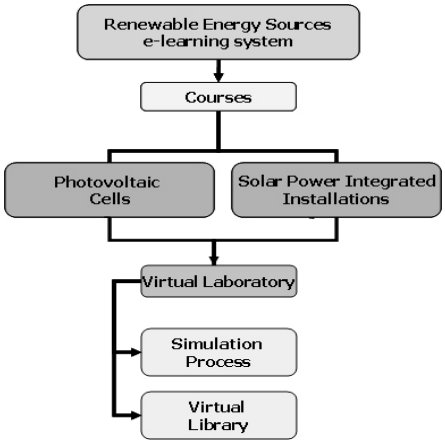

Fig.1 – System structure

The opening page of the system is depicted in Figure 2 where the user/visitor has the following options to choose:

- About Project
- State of the art
- Courses

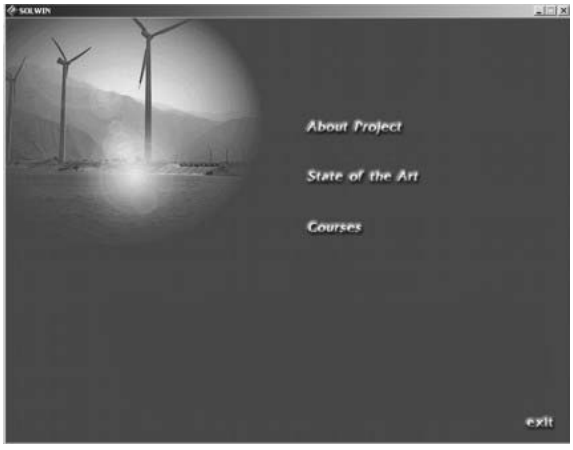

Fig.2 – System's opening page

By choosing the first option, a thorough description of the energy current situation and perspectives is presented, concerning Renewable Energy Sources (RER). Here the role of the European Union is essential as it is funding a numerous number of projects paving the way to the future. Besides, the main goals of this system are being mentioned focusing on the combination of web-based features

and the specialization of RER technicians implementing long life learning schemes.

Getting back to main menu and by choosing the second option (State of the Art), the visitor can be informed about a market research held across four different countries, about training needs in the electrical and RER engineering sector. These countries -indicated by their flags- are Greece, Cyprus, Germany and United Kingdom.

The third option (Courses) is the most important part of this system and can be shown by clicking on the last option from the main page. In this phase, the electro technician can select in which kind of energy he is interested in. Photovoltaic (PV) and solar systems are available for each visitor to exam and to be informed (Figure 3).

Fig.3 – Photovoltaic Library main page

In this section the use of renewable energy is analyzed with a lot of examples, figures and texts by using virtual library techniques. A power system, consisting of a wind turbine, an array of photovoltaic panels, a battery bank and a diesel generator supplies electricity to a single household and a small workshop on an island (Figure 4) is described in detail.

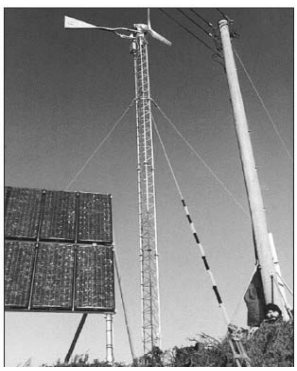

Fig. 4 – Power system

Here, someone can learn the multiple stages and conversions of solar power, in order to become suitable finally, for domestic use.

Also power generation systems which use photovoltaic cells (PV) can contribute in the energy balance via the electrical grid. Innovative solutions have been discovered, with solar houses built with photovoltaic systems, where the solar thermal panel was integrated into the roof structure (Figure 5).

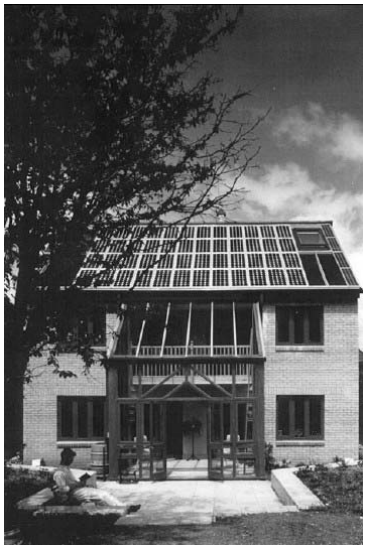

Fig.5 – Solar houses

In addition, to be used as a working example of a domestic photovoltaic installation, a house example is used as a teaching and research facility and constitutes a virtual lab. In other words, it consists of an integrated case study.

Firstly, the skeleton of the system is provided (Figure 6) with a detailed scheme of array support structures, fitting them to the roof of a residence.

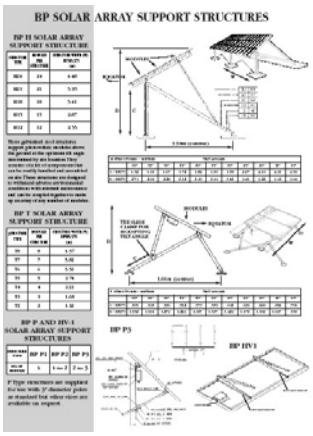

Fig.6 – Solar array support structures

In addition, special care should be taken about the type of connections among the batteries which compose the battery array which is the whole systems energy repository (Figure 7), optimizing the total performance and increasing the availability even when the weather is not sunny.

Fig.7 – Connections of batteries arrays

Of course, the case study cannot be integrated without having the technical specifications table (Figure 8). These specifications include vital components such as wind turbine, solar cells, batteries, inverter and generator. Now all the necessary elements are gathered in order to plan the PV/Wind system.

Table: Details of the System

Wind turbine	Rating:	3 kW
	Rotor diameter:	5 m
	Number of blades:	3
	Power control:	Tilt
	Generator:	Synchronous with field control
	Manufacturer/Model	North Wind HR3
Solar cells	Type:	Polycrystalline
	Peak power per panel:	64 W
	Number of panels:	8
	Manufacturer/Model	Solarex MSX 64
Batteries	Type:	Lead acid stationary
	Nominal voltage:	24 V
	Capacity:	900 Ah (24 hours)
	Manufacturer/Model	Varta Bloc 428
Inverter	Type:	Sinusoidal, solid state
	Manufacturer/Model	AP-Tech
Generator	Type:	Diesel 5.5 kW
	Manufacturer/Model	Lister TS2

Fig.8 – Technical specifications table [4]

4 Benefits

The described e-training system has a various benefits, especially for the electro technicians.

On the one hand, Virtual library and its usage is giving to the user better access and flexibility in the extensive material of valuable information. In this way the system is giving him/her the potential to have higher quality of learning and an increased level of interactivity with the provided services. The user/visitor can be educated without time, place or schedule limitations because the technicians are workers and their training takes part in parallel with their job or they maybe have other obligations (eg family) [9,13,14,15,17].

On the other hand, the goal of this system is to give a further support for the renewable energy systems developed by scientists and engineers. With the forum and the chat areas the technicians can communicate and exchange knowledge. This way the electro technicians can be informed for the last updates of the systems and apply them to their installations. Moreover, designers and engineers of this kind can get a clearer picture of the practical side of RER installations, leading to a better collaboration with the technicians and connecting theoretical and applied knowledge. Finally, the electro technicians do not face the threat of unemployment because they update their position by upgrading their skills taking a supervising role [18].

5 Conclusions

Alternative energy technologies proved to be more cost-effective in different situations. In general, it is the calculation of the average amount of energy required per day which dictates the choice of the system.

In the described system it was proved that e-training is dynamic and creative fiend and Virtual laboratories are centers for creativity fulfilling every thought even a phenomenally not reachable one. Such systems should be reliable both in educational and technical aspects. They must be designed with careful planning and thorough case studies.

Giving equal opportunities to all technicians satisfies their need to adapt to the new status of renewable energy sources technology. Thus, these opportunities lead to a healthy and balanced society with ‘equal rights and access to information for all’.

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