

flock.uc.pt – A Web Platform for Online Educational Modules with Online Experiments

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Abstract—Emerging technologies provide the necessary means to develop online learning programs with online experimental setups through web platforms for educational and training purposes. Combining design techniques with virtual and augmented reality, templates, contents and interfaces can improve users' analytical capabilities of perception and cognition. In addition, it will allow the development of more attractive online courses, while promoting the learning process. This paper briefly describes some relevant features of the platform flock.uc.pt under development at the University of Coimbra, including some application examples. The authors' intension is to demonstrate the main characteristics of this platform presenting some examples of online educational modules.

Index Terms—Online courses, online experimentation, remote and virtual labs, virtual and augmented reality, interface design, haptic devices.

I. INTRODUCTION

In the last few decades there have been significant efforts to develop platforms of tutoring systems, including remote and virtual labs as web-based educational tools [1], for students in different scholar levels and trainees in lifelong learning programs, where the inherent flexibility and adaptability of such systems are greatly valued [2]. Furthermore, the careful design of user's interfaces (UI) and the use of different types of interacting devices, such as haptic devices, represent new and exciting challenges.

This new paradigm of learning and training creates a system rich in educational contents that are practical, flexible and easy to access, contributing to break down spatial and temporal barriers associated with more traditional approaches. In this context, students and trainees can accomplish their own experiments from her/his laptop, just requiring the availability of an Internet connection to have access to different kinds of virtual and real plants and experiments, not only in a b- or e-learning framework, but also enriching the classroom activities [3].

Concerning UI, digital technology and advanced software also expand the creative potential of graphic design by making possible an unprecedented manipulation of color, form, space and imagery [4]. The design process involves the conceptualization of the template for the Learning Management System (LMS), the interface elements necessary for the application's operation, as well as all the elements of the whole platform.

A web platform for online experimentation is under development at Department of Informatics Engineering of the University of Coimbra, with the collaboration of the Faculty of Engineering of the University of Porto.

The platform, <http://flock.uc.pt>, aims to offer to different types of players/users, from secondary to higher education degrees, and also to lifelong training, a framework where tutors and students/trainees can communicate and interact remotely through the internet, in a b- or e-learning context.

The contribution of this paper is to introduce the platform, in particular, some developed educational modules, corresponding mainly to the final work of three master students of Informatics Engineering and Design and Multimedia.

II. STRUCTURE OF THE WEB PLATFORM

The Web platform main objective is to provide and share diverse online educational modules with remote and virtual experiments for learning in collaborative contexts, allowing both tutors and students to interact each other. Like a flock of birds migrating to a promising better future, also the information and services converge together in one single direction, the education and its sharing. Thus, the name **flock** was coined as the acronym for **flexible learning & collaborative knowledge online**.

In order to create an identity for the Web platform, a simple and elegant logo some efforts have been put in its design. The result expressed in Fig. 1 can be regarded as balance of three forms that have the symbolic duality of books and birds overlapping with a transparency of 50% in order to highlight this overlap.

In the following sections, the main aspects of the structure of the web platform flock.uc.pt and some online educational modules are introduced and discussed.



Figure 1. Logotype of the web platform **flock.uc.pt**.

A. LMS templates

The Moodle platform was selected as LMS in order to take advantage of its main dynamic learning environment features for designing a course or module. The templates for educational modules are developed applying design techniques in order to improve the analytical capabilities of perception and cognition. This allows users to perform tasks in online courses that can be too complex and rather confusing, making the interface more attractive, for improving and promoting the learning process.

Finding design solutions that facilitate the human-computer interaction and the information visualization will substantially improve the user's interaction experience with the platform and contribute to enhance the quality of the learning process.

B. Virtual and Augmented Reality

The Virtual and Augmented Reality (VAR) is considered as a tool, which is intended to provide users with an application to be used in the context of learning and exchange of information through simulated environments. Similarly to videogames, the e-learning platforms share an identical objective, namely, to provide users with forms of interaction which will attract and facilitate the learning process [5].

As such, the platform could take advantage of the benefits of Game Design for the development of the three-dimensional environments and interfaces [6], as a Serious Game. In VAR, users see the real world with an additional layer of information allowing the use of tangible interfaces, and giving the user an immersive environment, as well as the ability to interact with virtual objects and to receive physical responses, based on certain attributes of the real objects [6], such as friction, texture or color.

C. Virtual Labs with interface using haptic devices

Nowadays, there is an increasing use of haptic devices in several areas of science, which can be used to provide the execution of complex and remote tasks, or to improve the response to equipment so that the user may have more information on the physical or virtual world.

Virtual experiments are built to give users different and simple perspectives, which reproduce essential aspects of the real laboratory's environment. The user will be able to interact with 2D and 3D simulations and "feel" or has feedback from them by using haptic devices, in a more effective and informative immersive environment.

D. Environment Simulation Tool

The platform will include an Environment Simulation Tool (EST), named **carbono** (Fig. 2), where the tutor may design his/her own experiments or adapt available experiments with contents and structural elements according to students/trainees level, and taking into account the requirements of a given educational subject.

The application includes an editor, responsible for the design phase, where the tutor may choose the objects to include on the scene, its position, behavior and features like surface texture, weight or height. This environment is being developed using the Unity 3D IDE.

With the purpose of controlling the designed environments with greater virtualization of reality, not possible to mimic with standard I/O devices, e.g. a keyboard or a

mouse, the EST will be developed to give the possibility of interaction using different types of haptic devices.

III. ONLINE EDUCATIONAL MODULES

Some online educational modules with online experiments are in development using the referred web platform **flock.uc.pt**. These modules include mainly virtual experiments to illustrate basic concepts of physics with applications including, for example, pulleys, springs, pendulum or inclined planes.

A. Basic concepts of physics using inclined planes

This module introduces some basic physics concepts using inclined planes. An object placed on an inclined plane may slide down the surface due to an unbalanced force with an acceleration that depends on several factors. To understand this type of motion, it is important to analyze, for example, the forces acting upon an object on an inclined plane. Figure 3 depicts a draft of a virtual scenario for this application example.

This module was tested by classes of a secondary school in two different stages: Firstly, to prepare the laboratorial experiment with an inclined plane (Fig. 4), and, in a second phase, to repeat virtually the experiment, obtaining new data and consolidating the knowledge about the involved physics principles.

The tests results were very positive and of great importance to pursue the development of this and other educational tools.

B. Other example

Other examples of educational modules include a diversity of experiments to introduce hydrostatic concepts in fluid mechanics. A virtual representation of the three-tank benchmark system (Fig. 5) could be used to support some of these application examples.



Figure 2. Logotype of the Environment Simulation Tool - **carbono**.

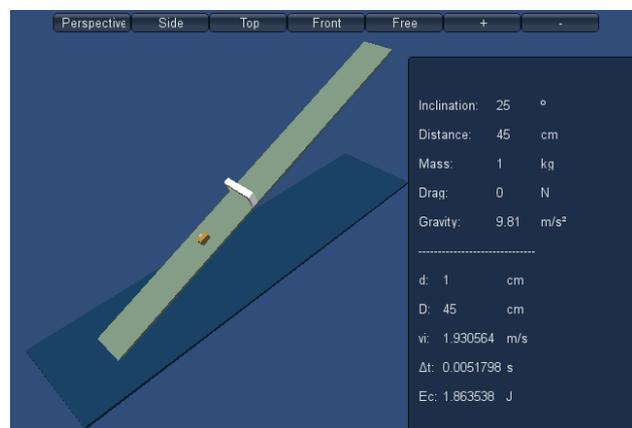


Figure 3. Virtual scenario with an inclined plane.

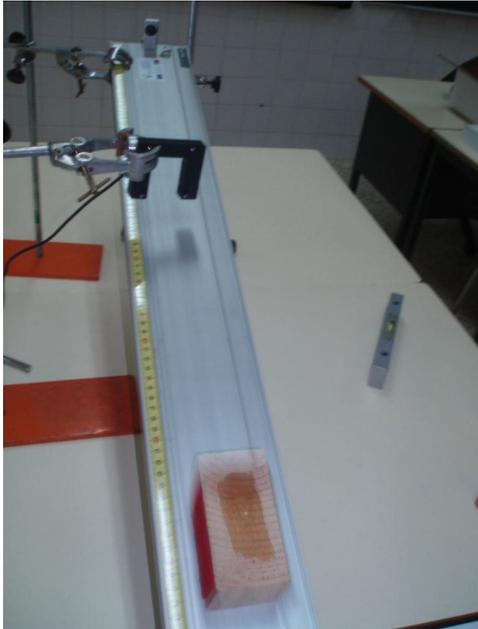


Figure 4. Real scenario with an inclined plane experiment.

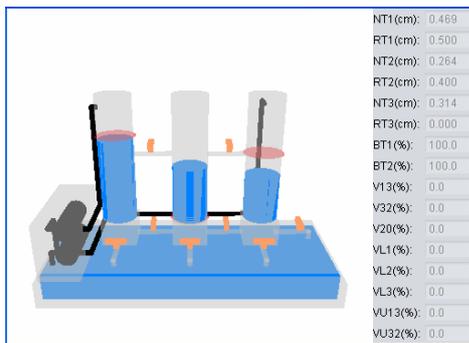


Figure 5. A virtual experiment with the three-tank system.

IV. CONCLUSIONS

Some aspects of the **flock.uc.pt** Web platform for the development of online educational modules using online experimentation were briefly described. The design project, the multimedia contents and the interaction using haptic devices were discussed.

The evaluation of the module through the experiment with an inclined plane was carried out by classes of a secondary school with very positive outcomes, being of great importance for further developments of the educational modules.

During the Exhibition Session @ REV2012 some illustrative modules with online experiments have been demonstrated.

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