Radiowave propagation e-learning

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Abstract: - This work describes an application for the learning and the self-evaluation of the contents of the subject of radio wave propagation. We have developed this application with Macromedia Director MX. The program is organized by means of a menu according to the different radio wave propagation media (troposphere, surface wave and ionosphere). The design of this learning tool pursuits a user friendly interface. The application is oriented to undergraduate engineering students with a mainly practical approach.

Key-Words: - E-learning, radio wave propagation, distance teaching.

1 Introduction

E-learning lets the student to adequate his own learning process by integrating the contents of a subject with the information and communication technologies. The use of these technologies in learning also lets a faster and continuous actualization of the contents and the methodology.

This kind of learning process lets the student to follow the whole contents in a remote way (it is not necessary to go to the classroom in a regular way) or to improve his knowledge on a particular concept.

The planning of a subject for its study in a remote way is not a simply matter. It is not enough to create a kind of web site with all the information. It is necessary to follow a systematic and structured way, starting with the previous analysis of the following topics: design of the web site and available tools, management of the subject, communication, monitoring and finally evaluation. The definition of these topics must be previous to the creation of the contents and, of course, to the beginning of the lessons [1-4].

The application that we have created is a tool that lets the remote learning of the subject of radio wave propagation. This tool has been developed with Macromedia Director in order to achieve a user friendly tool [5].

The communication that we are presenting is organized in three parts. First, we analyze the educational objectives and contents planned for the subject. Second we describe the tool and its use, both in learning and self evaluation ways. Finally we present some conclusions of the work.

2 Subject organization

The radio wave propagation study is traditionally very important for the communication engineering curriculum. The scope of this subject varies from basic concepts to complex radio system planning. The aims of this tool do not concern with system planning but they do with the comprehension of radiowave propagation phenomena according to the working frequency and terrain profile. We assume that the student is familiarized with electromagnetic fields concepts (at least the plane wave propagation ones) and circuit theory concepts. We have employed for the tool classical text books [6-16] and, in order to achieve a practical approach, we have adapted the calculi and bibliography to ITU-R recommendations [17].

The subject is structured in six chapters. The first one is an introduction to radio electric systems. The physical model and fundamental antenna parameters (impedance, radiation pattern, gain, and reference antennas) are defined. We also include a definition of the most common logarithmic units. Finally free space propagation and Friis formulation is analyzed. Second chapter is dedicated to surface wave propagation. Here we study the propagation in an homogeneous path as well as in a mixed one using the Millintong method. Chapter three deals with ionosphere wave propagation. The problem of plane wave propagation in plasma is settled. The ionosphere is modelled as a multilayer medium with temporal variations. Finally the skip distance, MUF and OWF are studied. The last three chapters are devoted to troposphere propagation in the range of VHF and higher frequencies. Initially, a two ray model in line of sight and an homogeneous atmosphere model is presented to explain the reflection phenomena on the earth as well as interference and Fresnel Zones. After this, we analyze the obstacle obstruction and the effects of a stratified atmosphere. This six described chapters have been

divided into 30 lessons which are equivalent to a traditional lecture. The chapter menu is shown in figure 1.

3 Application description

The developed application has been optimized for a 800 x 600 pixel resolution.

For a better use of this tool, the student must do the following:

Step 1. Chapter selection.

Step 2. Lesson selection.

Step 3. Self evaluation test.

Fig. 1 Initial Screen.

3.1 Step one: Chapter selection

All the chapter which comprises the subject are shown at the beginning.

By placing the mouse on every menu item, they change their colour as shown in fig. 2.

Before been able to go to a chapter, it is necessary to pass the evaluation of the previous ones. This is noted because there is not color change when placing the mouse on those non accessible items.

Fig. 2 Chapter one selection.

The purpose of blocking the other chapters is to avoid the student going on his learning process without a correct understanding of the previous lessons.

3.2 Step 2: Selecting a lesson

Every chapter has been divided into lessons. Each one is equivalent to a classic one hour lesson. As an example, the main screen of chapter one is presented in figure 3.

Fig. 3 Lessons in chapter one.

When placing the mouse on every item, they change their colour as same as the previous screens. They show in this way that it is possible to access to the following screens.

Every chapter screen is organized as it is shown in figure 4. It is divided in two areas. On the left side, it is present at every moment the index of the lesson, allowing the student to select any item by simply clicking on it. The normal mode of operation is to follow the "Next" and "Back" arrows to proceed in a suggested sequence.
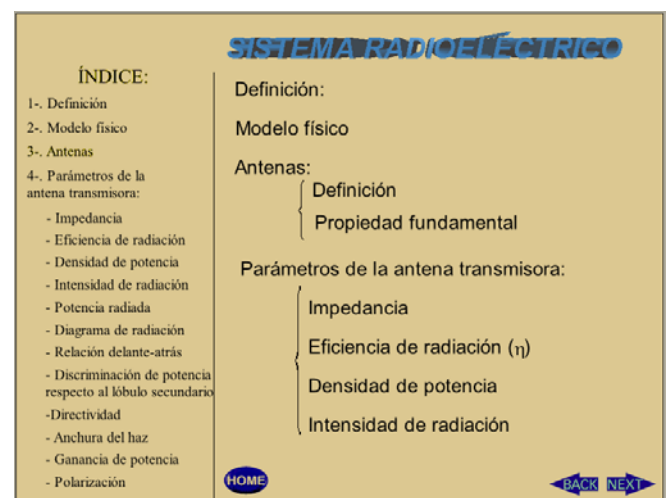

Fig. 4 Summary of lesson one in chapter one.

The student may return to the main screen as easily as click in the "Home" button. This button can be seen in figure 4.

A complete copy of every chapter is available in a high quality pdf format for the student by clicking on the corresponding icon of the screen shown in figure 3. This is a very convenient feature because the pdf can be printed for a more comfortable reading. The printed copies can be conveniently used an annotated in a traditional way by the students.
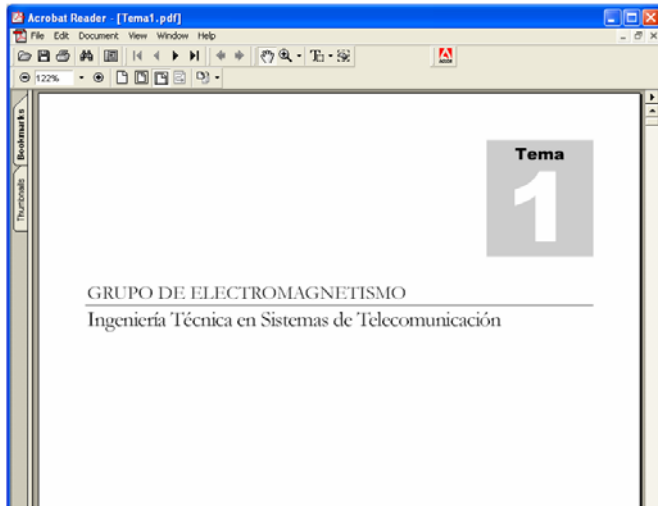

Fig. 5 Pdf copy of chapter one.

On figure 3, another icon allows to access to the corresponding bibliography for the lesson. The pdf are written from the references cited in this bibliography. In this way, the student may complete get further information about the subject. A practical point of view has been pursuit in selecting the contents and bibliography as mentioned before. ITU-R Recommendations have been included as a firm basis for the definition of radio electric link parameters and related calculi.
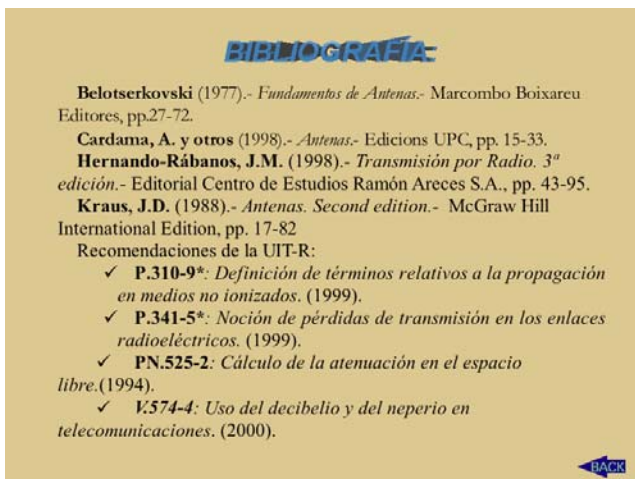

Fig. 6. Bibliographic screen.

3.3 Step 3: self-evaluation

Finally, a last icon is places on the lower right side of the screen as can be seen in fig. 3. This icon lets the access to a self evaluating test which must be passed by the student before been able to continue his learning process.
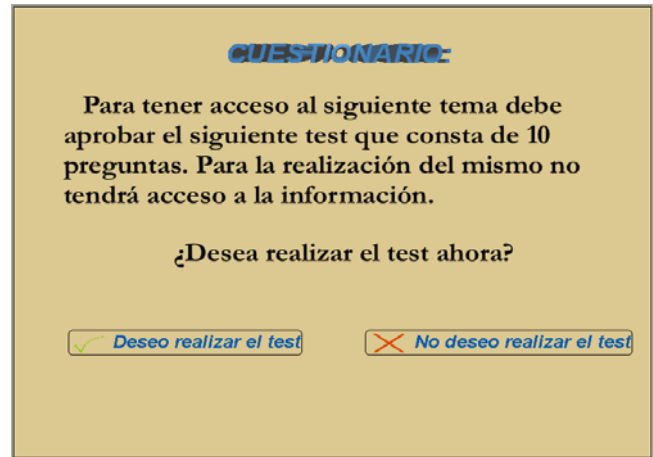

Fig. 7 Self evaluation access screen.

When selecting the self evaluating test, the tool shows figure 7. It is possible to avoid the test clicking on the convenient option if this screen has been selected by mistake. On the contrary, if the student really wants to perform the evaluation, the first question, with multiple choice answers, will be shown. The test comprises ten questions and he student must answer correctly at least five of them (Figure 8).
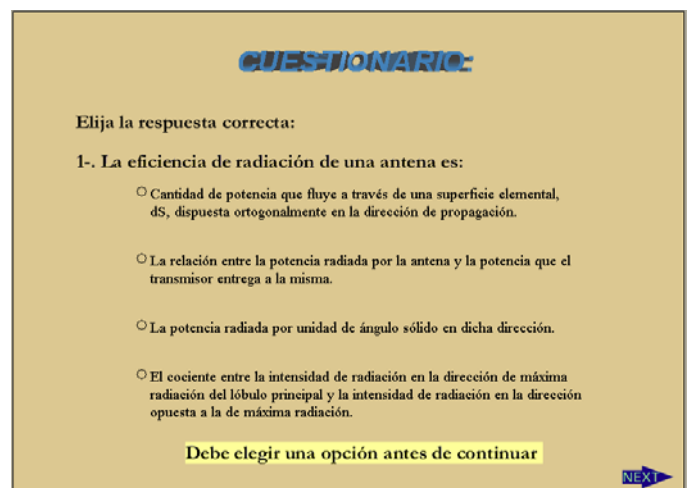

Fig. 9 Chapter one self test.

When the test is completed, the marks are shown. If the test is passed, the application backs to a screen similar to figure 2, but in this case, the student can progress next chapter as well as review the previous ones. If the test has not been passed, the application

will back to the menu screen and the following chapters will not be accessible.

3   Conclusion

In this paper we describe a learning tool oriented to support the teaching of the radio wave propagation subject. This is a complement, but not a replacement of the traditional class. New information and communication technologies allows for a much faster actualization of the contents and a better monitoring of the learning process.

The application also includes all the stuff related with the subject, especially the text of every chapter in pdf format which is a standard and high quality format.

A representative feature of this application is to avoid the student to progress into next chapters before mastering the previous ones.

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