

TELEMATIC TRAINING VIA A WEBSITE OF TECHNICIANS IN WORK-RELATED RISK PREVENTION

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Abstract: This work presents a web portal for telematic training in work-related risk prevention: noise at work and machine vibrations. Training in Work-related Risk Prevention, especially in the area of Industrial Hygiene, has a practical laboratory component, which is fundamental for a correct preparation of prevention technicians so that they can become acquainted with the field equipment that they have to use in risk evaluation, its configuration, principal parts and handling; everything from its calibration to its application in measuring as a function of the job's conditions, always within the correct methodological application dictated by the national and international norms which regulate these field applications. This signifies important time expenditure for specialist teachers and in field equipment for the users being trained. With virtual laboratories containing the web application developed it is aimed to complement experimental laboratory training, with simulative tools which provide the knowledge and the practical handling of the equipment under the most real conditions possible, thus considerably reducing the number of laboratory hours necessary. It is a matter of having a catalogue of virtual laboratories with a free and easy access, the one in the first stage being specifically that corresponding to noise at work.

1 INTRODUCTION

At present, the main objective of many software systems developed is teaching and the transmission of knowledge. The use of a computer for this purpose accelerates the learning process of the notions provided by the system since interacting with it helps the contents to be assimilated more quickly and placidly.

The creation of a virtual laboratory permits the dissemination of that information to its final users and the teaching of theoretical-practical concepts by experimentation making use of the new technologies. In addition, the expansion of the software through Internet makes it easy for any professional or student interested in the theme developed to use the laboratory and benefit from its contents, thus obtaining a didactic complement to the traditional theory classes. Although there is abundant information on work-related risks produced by noise and vibrations, effects (Bedi R.,

2006; Bhattacharya SK., 1991; Yildirim I., 2007) instruments and measurement techniques, there is very little software combining all the information to be considered by the technicians in the prevention of the problems caused by noise and vibrations in industry.

The effects of vibrations and impacts on human beings have been known for a long time. At the beginning of the 18th century, B. Ramazzini in his book "Examination of the diseases of artists and artisans" observed the loads and stress in horse tamers produced by machine vibrations and described the effects in the following way: "..... The force of the vibration shakes the entrails and practically displaces them from their normal position..."

Nowadays, work activities like driving transport vehicles or rotating, alternative drilling or percussion manual tools signify to the worker a prolonged exposure of machine vibrations (Lercher P. 1996), transmitted both to the hand-arm system and to the

whole body. This type of vibration is the cause of such complaints as vascular disorders in the hands, lesions in the lumbar zone in the spinal column and in the nervous system connected to it, or respiratory problems (Guinchar P, Charbotel B, et al. 2008).

In spite of the large number of the working population exposed to this type of vibration, there is a scant culture of prevention existing on exposure to vibrations in work posts. Although there is abundant information on exposure to vibrations, its effects, instruments and measurement techniques, there are very few software containing all the information to be considered by problem prevention technicians on exposure to vibrations.

In recent years there has been a great development of virtual Laboratories in the education of different disciplines (Jimenez, PM, 2009), nevertheless in the whole consulted bibliography we have not found any that this one dedicated to the study of the prevention of labour risks, and especially to vibrations and noise.

With the aim of solving the problem of the scarcity of software on exposure to vibrations, it has been attempted to develop a virtual laboratory on this theme in the labour scenario. It supplies both theoretical and practical information on all the fields covering this topic, and the possibility of interacting with the instrumentation typical of this subject by means of simulating it. The website and virtual laboratories have been created to provide that information thus making it easy for any person wishing to go deeper into the theme to do so.

2 OBJECTIVES

The main objective that it is aimed to fulfil is the development of a software application which makes up for the absence of information experienced by students of technical studies when acquiring theoretical knowledge and carrying out practical classes in laboratories, specifically in the classes corresponding to experimentation with the concrete instruments for the measurement of vibrations and noise.

The secondary objectives are:

- To develop an application containing information referring to the instrumentation and measurement methods.
- The application has direct access to the regulation in force on the protection of the health and safety of workers against risks related to exposure to machine vibrations.
- To include extensive information on the possi-

ble effects on workers brought on by vibrations and noise.

- The software has a complete training tutorial for expert technicians.
- To permit the user to become familiarized with some of the measurement instruments by means of the simulation of their functioning in different work posts.
- To permit the updating of the information it contains through a resource manager with a database which contributes dynamism to the application itself.
- The virtual laboratory has a general interface for the presentation of different applications related to Work-related Risk Prevention.
- The web page works in a “multiplatform” environment. The application can be used in any computer regardless of its operative system.
- It is intuitive and easy to use as it is aimed at people who do not necessarily have any extensive knowledge of the subject.

3 EXPERIMENT DESCRIPTION, MATERIAL AND METHODS

In the developed portal it is aimed to concentrate all the aspects necessary for a specialist in the prevention of work-related risks: noise and vibrations (Figure 1).



Figure 1: First display screen of the Work-Related Risk Prevention portal.

With it, the drawbacks which real laboratory learning entails disappear:

- The high cost of instruments for measuring noise.
- The need for a teacher to supervise the operations carried out in each machine.
- The need to fit out a laboratory in order to carry out these practical classes.
- The need to adopt a timetable to set up the practical classes.

The sections included are:

* A tutorial to guide the technician, supplying him/her with information on different physics fields dealing with noise and vibrations, the instrumentation to be used in measuring them, the regulations in force, updated, to be applied during that measuring process together with the different configuration parameters to be used in controlling noise, and a series of tutorial videos which facilitate the understanding of the handling of the devices related to this theme.

* Gallery in which there is a useful educational illustrated reference with information on all the machines and instruments employed.

* Virtual Laboratory or Simulation that presents measurement and calibration processes of a lot of devices, as dosimeter, sonometer, calibrator, and vibrometers. Also, these sections include calculations and results, interpretation of images, resolution of cases, etc.

The developed web has the following characteristics:

* Flexible interface for access to information available.

* Opportunity for the learner to repeat the practical activities as many times as he/she considers it necessary until the didactic results wished are achieved.

* The learning timetable is established by the users themselves in accordance with their needs.

* Possibility of use of software at all times.

3.1 Functioning

An application has been set up to permit the handling of the different sections detailed in the definition of the real problem.

The user can gain access to each of those sections by selecting the corresponding option.

By using a multimedia platform in which, through animations and an attractive interface which makes learning a pleasure for the user, all the necessary theory is provided for the latter for an optimal understanding in the field of industrial noise and vibrations, as well as a complete description of the instruments required in the measuring and prevention of both the noise and machine vibrations, together with explanatory video-tutorials making it easier to manage them (Figures 2 and 3).

Furthermore, in this application a file has been included by all the legislation relating to risks prevention, which is permanent updated by the web administrator and which in addition can be downloaded by the student.

With regard to the laboratories and depending on

the apparatus with which work is going to be done virtually, the technician has to insert data for their correct working. Similarly, there is a possibility of consulting the explanation of the working of the apparatus and to manipulate it. To ensure that the user learns correctly, the system guarantees that if this is the first time h/she accesses to it, h/she should carry out some basic activities on it, then, later, be able to increase their difficulty (Figure 4).



Figure 2: Image gallery.



Figure 3: Tutorial and legislation.

In addition, the practical activities (virtual laboratories) present in the programme include the principle of “learning while practising”, with which the user will acquire the necessary capacity to handle the machines in real life and interpret their results. H/she will be able to verify analytical solutions and experiment with different configuration parameters.



Figure 4: Working of the dosimeter.

3.2 Environment

The interface was aimed to be simple, friendly and intuitive so that all its users, regardless of their degree of knowledge on the theme, would be capable of handling it (Figure 5).



Figure 5: Interface on training in work-related risk from vibrations.

The system is directed both at Work-related Risk Prevention technicians and learners in the field of industrial noise and machine vibrations, who should have basic knowledge of Office Automation and Windows, and a computer with the resources necessary for executing the programme.

The application has been developed with the ActionScript programming language and the database MySQL, so that for its modification it will be necessary to dispose of Macromedia Flash 8 and an Oracle system. For its use and visualization only a browser will be needed since this programme is accessed through the website of the Department of Applied Physics at Córdoba University <http://rabfis15.uco.es/>, by either Explorer 6.0, Firefox, Netscape, with the installation of the plug in of Flash Player being considered necessary.

3.3 External Aspect

The interface is intuitive and ergonomic to handle. It has shades of eccentricity and tries to be very clear and perceptive. Its objective is to facilitate access to different units of the programme easily and quickly.

The constant use of a multitude of sounds and of continuous movements is not recommendable since this may slow down the execution of the applications and prevent the user from achieving his/her objectives at any speed.

There is a striking presentation of the information as it makes use of multimedia techniques to attract the user's attention.

From the user's point of view, the interface should permit him/her to locate the information and carry out his/her operations quickly as can be verified in most web pages.

It has been attempted not to distract the user too much with the design but at the same time make the application attractive, reaching a halfway point in the animations employed.

The developed product is available at all times in the website <http://rabfis15.uco.es/> of the Department of Applied Physics at Córdoba University.

Together with the application developed the documentation generated during its creation process is supplied. This includes the technical handbooks, which contain the general information on the process of analysis, design, implementation and system test, and the Code Manuals in which the source codes of the applications developed are described.

A user's guide is also included with all the information necessary for a good management of the application. Screen captures are carried out on all and every one of the sections of the application to support the information offered in it.

4 RESULTS OBTAINED AND AVAILABILITY OF USE

A web portal has been created for training in work-related risk prevention, which is being used in the Master in Work-related Risk Prevention at Córdoba University, and is permanently available in the server <http://rabfis15.uco.es/> of the Physics Department.

4.1 Virtual Laboratory Actions

The following are the possible actions that the normal user can perform in the execution of the programme:

4.1.1 Consult a Technical Tutorial

The user has at his/her disposal a tutorial divided into different sections with the aim of facilitating his/her study of the theory of machine vibrations and noise.

The information given in the tutorial is structured in the following way:

- Physical properties of vibrations and noise: in this section an extended definition of vibrations and noise is made.
- Parameters which define the vibrations and noise at work: In this section each of the parameters intervening is defined.
- Spectrum analysis of vibrations: In this section some physical aspects of the vibrations phenomenon are described in relation to their study in the frequency domain.
- Vibration and noise measurement techniques: In this section, the diverse practices employed in measuring are described, depending on the situation, the objective, the place and conditions

of the environment in which these measurements are made.

- Effects or pathologies of vibrations and noise on people: In this section, a detailed description is given of the effects that the work-related risks being studied can cause.
- Control systems: In this section, the methods for remedying the vibrations and noise or for restricting them to tolerable levels are described.
 - Control systems in the source
 - Vibration uncoupling systems
 - Control systems by Individual Protection Equipments (EPI).
 - Administration controls.
- Vibrations and noise in industry: In this section the risks that it is possible to localize in industry are detailed.

4.1.2 Consult a Legislation Tutorial

The user disposes of a tutorial with the legislation in force in order to find out the legal regulations concerning vibrations and noise in a job of work.

The information given is classified in accordance with the existing norms, including laws, royal decrees and directives.

4.1.3 Consult a Photo Gallery

The user can gain access to a gallery in which he/she can observe the different apparatus and instruments used. The user can identify, become acquainted with and study the general characteristics of these instruments.

4.1.4 Simulation of the Phenomena: Measurement and Treatment

The user can access to a laboratory in which he/she is shown a series of simulations in order to prepare him/her in the measurement of vibrations and noise and the interpretation of his/her results. As an example, some of the simulations available are:

- Calibration process: Simulation of the calibration process of a vibrometer controlling a possible incorrect calibration.
- Vibrometer: Simulation corresponding to the handling of this measurement device.
- Simulation in work posts.

4.1.5 Consult Video-Tutorials and Consult Help

The user, by using videos which provide comple-

mentary information on certain aspects included in other modules of the application (Figure 6).



Figure 6: Video-tutorials.

In each of the programme's modules the help section can be accessed to from that module. It is easy to use and very useful to the user for solving problems arising when browsing through the application.

To finish, the possible actions which the user at an administrator level can perform by executing the application are detailed. To gain access to these actions the user must fill in a form to confirm that he/she is a user at an administrator level.

4.1.6 Manage Users

The user-administrator can enrol other user-administrators so that they can gain access to the application's management tool. Each user-administrator can modify his/her own password to enter the management tool of the virtual laboratory, and, if necessary remove him/herself from the application itself. No user-administrator can change the password or remove any other user-administrator.

The user can insert, modify and even remove the address of the virtual laboratories referring to Work-related Risk Prevention from the access list to laboratories.

The contents permit the user-administrator to manage the information of the application's tutorials. The user-administrator can insert, modify and remove contents from the different tutorials in the virtual laboratory. In the same module there is an option for showing the information from some section of the tutorials to see if it is correct.

The user-administrator can update the information contained in the virtual laboratory guide. In the same module, the user-administrator can insert, modify and remove links of interest within the application.

The user-administrator can upload files of images for the tutorials and pdf files for their subsequent downloading for the normal users of the

application. The module shows all the images uploaded.

5 USEFULNESS AND SELF-EVALUATION OF THE EXPERIMENT

The web portal developed has only been finished and implemented for a short time in the web server, and, therefore, it has not been used with the students. However, some pilot validation qualitative tests have been done with different users taken at random and all of them have underlined two important aspects of this programme. On one hand, how easy it is to use, and, on the other, they say that it has helped them to improve concepts. Most of them have also mentioned that the section corresponding to the videos in which the handling of the apparatus was explained and visualized was of great interest to them.

In a second stage of investigation, this tool will be implemented with the students and the results obtained studied.

The quality and reliability of the software are two of the most important characteristics to be taken into account in the creation of the software. That is why the application developed with this work has been submitted to pertinent exhaustive tests in order to minimize, as far as possible, the risk of any failure.

However, as the application has to be accessed by Internet, the speed at which it returns the data will depend to a great extent on the quality of the connection both of the computer in which it is installed and the users who access to it.

6 CONCLUSIONS

A software application has been developed which compensates for the lack of information experienced by technical students when acquiring theoretical knowledge and doing practice exercises in the laboratories corresponding to Work Hygiene: work-related risk prevention, especially in the practical classes on experimentation with specific instruments measuring vibrations and noise.

The portal and laboratories implemented have the following characteristics:

- This application contains extensive information referring to the instrumentation and methods for measuring machine vibrations and noise.

- It has direct access to the legislation in force on the protection of the health and safety of workers against risks related to machine vibrations and noise at work
- It includes ample information on the possible effects on workers which can be brought on by vibrations and noise.
- It has a detailed training tutorial for expert technicians.
- It permits the user to become familiarized with some of the instruments for the measurement of machine vibrations and noise by means of the simulation of their working in different job posts.
- It permits the updating of the information contained in it through a resource manager with a database which makes the application more dynamic.
- It has a general interface for the presentation of the different applications related to Work-related Risk Prevention.
- It functions in a “multiplatform” environment. The application can be used in any computer regardless of its operative system.
- It is intuitive and easy to manage since it is aimed at people who do not necessarily need any broad knowledge in the subject.

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