Remote Training via WEB for Operation and Maintenance of a Rain Monitoring Equipment using PHP and GD Library

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Abstract:

The aim of this paper is to present the development and implementation of an interactive environment via WEB for the training of non-centralized technician teams that work with the maintenance of ambient monitoring equipment. The case presented here is concerned to the network of Pluviologgers installed in the State of Santa Catarina, Brazil. The tools used for the construction of the WEB environment and, also, the requirements are detailed. The methodology and the techniques presented in this case can be easily adapted to other kind of equipment or other specific maintenance teams.

1   Introduction

The training and qualification of maintenance teams is a priority in companies which provides technological solutions in the fields of telecommunications, laboratorial equipment, automotive industry, and others. This is an extremely important process for the high quality of the products and services offered by technological companies, where the maintenance is done by specialized teams.

Even when the first training of the members of the maintenance team is given "face-to-face", the constant development of new lines or versions of the products demands new procedures of maintenance and new training.

On a situation that there is a large physical distance between the development centers and the maintenance teams it is economically impracticable to offer frequent "face-to-face" training, which could be considered the best solution. So, logistic and the method of training must satisfy the inversely proportional conditions of cost and quality.

A virtual environment of training can be presented as a good option to satisfy the conditions of interactivity and dynamism, obtaining quality with a low cost logistic.

This paper presents the concept, the tools and the methods used in the development of a virtual training environment. All the applicative tools used in the construction of the system are freeware and many of them are open code, guaranteeing the unrestricted reproduction of the procedures described here.

2   The case – Pluviologger

Pluviologger is an automatic and independent system of collection, treatment and storage of rain data. Its project was conceived by the EPAGRI (Agricultural Research and Rural Extension Institute) aiming to get a better relation cost/benefits when comparative to traditional systems of rain data collection. The selection of components and service providers (confection of printed circuit boards, plastic injection and molds, etc.) prioritized national partnerships, once the objective of the project is to avoid the high costs of imported equipment and to keep an important technological independence for the implantation of such equipment network. The functioning of Pluviologger involves typical characteristics of a conventional rain gauge and an automatic rain measuring station, operating in two distinct modes.

In the first mode, the information concerned to daily rain occurrence can be visualized in a numerical display in the frontal face of the equipment. To get the stored information of accumulated amount of rain on the last 24 hours, it is necessary to use a special pen to touch the CPU of the Pluviologger. In the second mode, the equipment stores the accumulated rain each 10 minutes. The access to these data as well as all the configurations of the system is done with a serial connection to a Laptop.

Epagri have agreements with several institutions in the State of Santa Catarina that guaranteed the installation of 50 Pluviologgers in an area of 95.442 km ². The equipment demands monthly preventive maintenance, what makes impracticable the use of only one maintenance team due to the fact that the Headquarters of Epagri is situated in the Capital (extreme east of the State). Currently three teams are responsible for the maintenance of all equipment, which are distributed according to the Figure 1.

Figure 1. Starting point of maintenance teams in the State of Santa Catarina.

Considering the trend to increase the number of Pluviologgers in the State of Santa Catarina and also in other states of the country, it is obvious increasing the number of maintenance teams. And considering the development of new updated models of Pluviologgers, it is also obvious re-training the "old" teams. This way, it was decided by the administration of Epagri to develop a specific learning methodology to attend "old and new" maintenance teams, with no necessity of traveling to the Headquarters. This action generated a new web environment focused on the virtual training.

The developed environment should be online to guarantee that the updates of new information and data could be constantly accomplished. The web application still has the advantage to be multiplatform and free of software installation, what guarantees the possibility of fast training e accesses in any area with an Internet provider.

3 Used tools in the development of the web environment

The environment should demand dynamism on the added information and on the interactions between the user and the environment, so the use of static pages is no recommended. The chosen dynamic language is the PHP [1], because it is freeware and open code, what guarantees an excellent collection of available sources and the environment runs in an Apache web server, making the operations free of proprietary solutions.

The visual resources are essential for a better understanding and simulation of a real maintenance operation and the images should be easily manipulated without losing the ratio. This way, we used use rendered images capture in three dimensions. The virtual environment simulates the operation conditions of the Pluviologger using images generated by the software SKETCHUP® (*rendering* 3D). The interactivity of the operations is guaranteed by the GD (Graphic Design) library which manipulates the images through the text parameters, similar to a software SCADA® (*Supervisory Control and Data Acquisition*).

3.1 SKETCHUP®

SKETCHUP® is an *easy operation* software for 3D rendering, which was developed by the Last Software Company®. In March of 2006, Google Incorporation® acquired Last Software Company® and launched a free version with some limitations in supported extensions and exportation modes.

Apart of its personalized operation for applications in architecture, SKETCHUP® can be used for modeling of mechanical devices in applications not focused in structural calculations. Each part of rendered equipment can be transformed into an "entity", what guarantees the modularity of the project. These modules can be independently resized, rotated and moved, what facilitates the creation of exploded views. SKETCHUP® can export images in two dimensions in well known formats (JPEG, PNG and GIF).

The basic version of Pluviologger was rendered creating an entity in each part which is possible to be removed by the field technician. Different images of exploded views have been generated by the exportation mode.

3.2 IMAGEMAP®

The developed environment is composed by several web pages (dynamic and static), so the use of the resource *hyperlink* allows a system of modularized exploded views, selected by the user. For the selection of the module to be exploded, the used resource of images mapping is IMAGEMAP®. Using this software, the user can select different areas of the image and get details. The areas are established according to coordinates and format (circular, rectangular and polygonal) parameterized in text format and inserted in HTML code.

As the establishment of these coordinates is an extremely onerous work we used specific graphic software for generation of the parameters of the IMAGEMAP®. An incorporated module of EVRSOFT 1ST PAGE 2006® environment was used in this work that is also freeware. An example of interactive exploded view is shown in Figure 2.
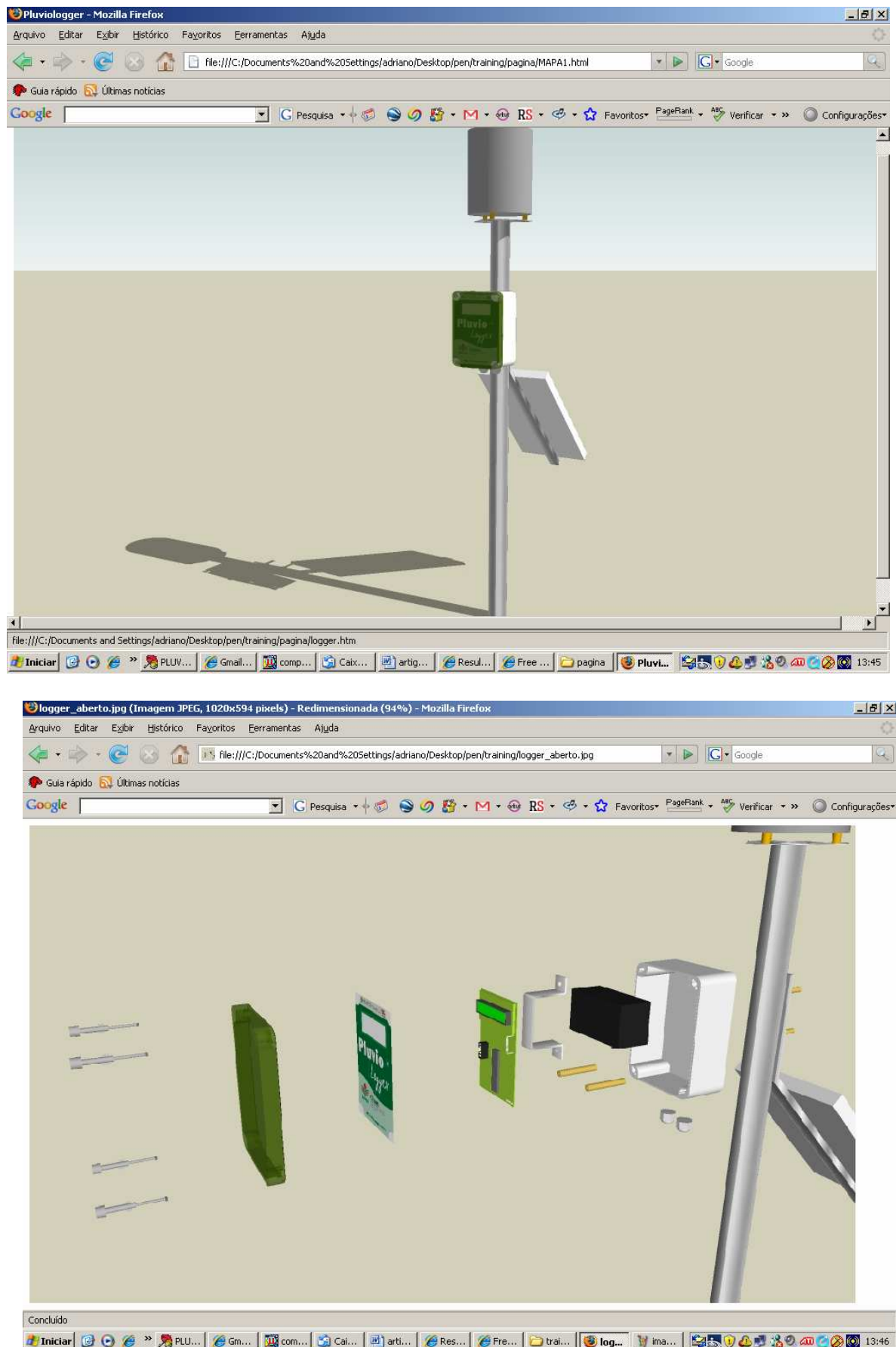
Figure 2. Storyboard of exploded view.

3.3 Wink

SKETCHUP® can generate multiple "scenes" and show them sequentially, creating the effect of animation for presentations. However, the freeware version does not allow the exportation in video formats, requiring the full SKETCHUP® for the visualization.

The generation of equipment animations is a very useful resource for training, once the images are in an acceptable format for Internet navigators. For that, WINK® Software [2] was used to capture partial or integral samples of images, which are shown in the video output in predefined intervals of time (frames) and to render them in an animation, on the format SWF (FLASH®). This animation can incorporate a narrative captured by a microphone, creating an interactive tutorial.

One of the diverse options of WINK® is the possibility to omit the mouse cursor, so it is possible to capture the work area of SKETCHUP® and to get the effects of camera rotation and entities manipulation without the perception of the manipulation of the mouse.

The animations generated by SKETCHUP® and WINK® can be used to present equipment parts identification, modules opening procedures, cleaning procedures, software operation procedure, and mechanical principles of functioning. WINK® also allows the inclusion of subtitles.

3.4 GD Library

GD Library (Graphic Design) is a module of PHP language, which is capable to generate and to manipulate images in different formats by inserting text parameters in the source code of the program [3]. The main applications of GD Library are the validations of characters in forms (captcha) and the creation of graphics.

GD is used to build virtual simulations of the maintenance operation and the collection of data with a portable computer, dynamically creating the image to be shown in the monitor of the computer.

3.5 PHP BB

To exchange other experiences and practical procedures that the web environment does not provide, it is possible to the users to participate of a Forum, which is one more tool incorporated to the software. The development of a Forum to be included in the environment with all functionalities is not needed, because there are many ready tools that are open source, freeware and configurable. One of the most famous Forum is the PHP BB, which has been chosen because it needs the same requirements of the others components of the systems (WEB Server, PHP).

4 The integrated environment

The disposal and topics division in the training environment are crucial for the acceptance and motivation of the users. Initially it was used PHP-NUKE to show the information under the portal form, however the information overload caused repulses in part of the technician during the tests stage.

Then environment was remodeled focusing on the simplicity and objectivity. This methodology was successfully used in other Internet solutions, as GOOGLE® Search Engine. Figure 3 shows the screen of the integrated environment.

Figure 3. Screen of integrated environment.

4.1 Main

In the first page shown in the environment, the user can learn about the modules by a descriptive briefing of each one. Here, some images of the system development and operation and an animation where the user knows the main parts of Pluviologger (sensors, logger, metallic structure and solar panel) are also presented.

4.2 Parts

It is imperative that the user knows each part of the equipment during the training. The best way to present the different parts of an equipment is by using an exploded view, however this kind of presentation has the inconvenience to show many information that can confuse the technician (in the case of an unique exploded view for all the equipment). To prevent this inconvenience, the exploded view is divided in modules, where the user can select a specific part of the equipment to get the view. When the user tries to select a part that he or she is not allowed to access during the real maintenance, only a general description is shown with no more details.
Figure 4 shown an example of a exploded view.

4.3 Simulation Environment

This module consists on a virtual simulation environment that emulates collection and configuration operations, very similar to the real operation of a Pluviologger. The commands can be typed in a text field and submitted to be processed by the system. The typed parameters are submitted to the algorithm of the simulator and stored in data base for posterior analysis of the operations of the users. Animations generated in flash format can help the user to simulate the configuration of the system, and to accomplish maintenance procedures and routine operations. In this module, it is also available all text material in PDF format for reading and printing. Figure 5 shows an example of the simulator environment.
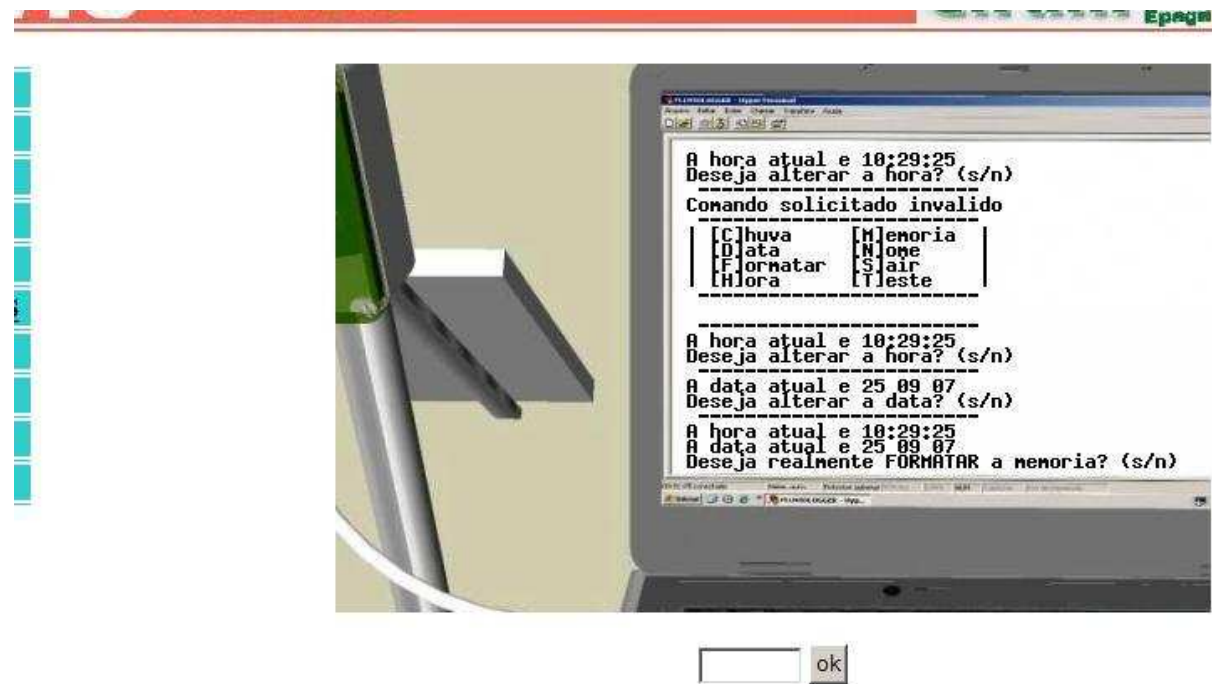
Figure 4. Example an exploded view frame.

Figure 5. Simulator environment.

4.4   Forum

The objective of this module is to keep the exchange of experiences between the technicians and instructors and technician. Each user of the system can register his/her consideration or service proceedings, and report questions.

4.5   Chat

In many cases where it is necessary fast consultation or exchange of information in real time, the Forum is not a good alternative. The Chat module can establish a fast connection between users and instructors.

4.6   Contact

The Contact module is used to report the doubts, suggestions or claims about the use of the environment, which can be directly sent by email to the system supervisor system.

5   Conclusions

The first version of the web environment is already in an online operation for evaluation by the future users and the managers of the projects. The first suggestions was used to improve the system, eliminating not necessary modules, however, in general all the system was successfully accepted by the users.
The training of the maintenance and operation teams of Pluviologger is now a priority for the Company to capacitate new and "old" teams, so the system should be improved by the contribution of all the actors of the process.
The new version of the web environment has personalized access to the system in order to monitor the attitudes and individual difficulties of the users and at the same time, to restrict the access to the main project information. The system registers all operations accomplished by each logged user and an objective questionnaire is submitted to all of them. These actions give statistics from the main operation activities and feedback the process for the development of new versions of the software.

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