This project has been funded with support from the European Commission.
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D5 – Remote control prototype module: Abstract

The VLs proposed in literature to perform didactic activities in the field of electronic apparatus are mainly concerned with a common target: to allow the execution of experiments involving actual instrumentation and circuits under test, rather than simulating them, even in virtual reality environments.

The proposed hardware infrastructures are similar, they have a modular architecture and contain multiple reconfigurable sub-systems, hardware, software or both. For example, the IN.TRA.NET laboratory proposed is versatile, in terms of hardware resources, due to the dynamic reconfiguration capability and the low cost of the hardware components. Moreover, this system enables the users to test their own custom circuit designs.

Concerning the software architecture of the VL a set of recommendations can be found in the literature. The main targets are: flexibility, modularity, generality and hardware independence. The software architectures proposed, have a layered structure that makes them suitable for implementation of versatile experimental systems for updating aims. The control software subsystem is hardware-dependent, while the access and communication subsystems are platform independent, so that any application controlling some kind of instrumentation can be remotely controlled. This approach addresses also the reusability of the existing VIs, independently from the language used for developing them.

One of the most relevant problems designing the laboratory subsystem is the remote access to the experiment. The main design objectives taken into account in order to provide the remote access to the Vis were the following: (i) *portability*: the visualization environment has to be portable on different hardware and operating systems; (ii) *usability* and *accessibility*: the visualization and the management of an experiment have to be easy to understand and to perform, even for users that are not expert of information technologies, and the system features have to be accessed easily by users operating at enterprises or at home; (iii) *maintenance*: the maintenance costs should be reduced. This can be made possible through a client-server approach that eliminates the need for installing and upgrading application code and data on client computers; (iv) *client-side common technologies*: the users have to access to the system using their desktop computers based, with no need of powerful processors or high memory capacity, and connecting to Internet through low speed dialup connections; (v) *security*: the remote access of the students through the Internet must preserve the integrity of recorded and transmitted data and of the system as a whole; (vi) *scalability*: the system performance has not to be affected when connected users increase. Most of the proposed VLs

cannot be considered an effective platform for delivering distance education. From the technical point of view the distance learning paradigm is based on LMS and Content Learning Management Systems (CLMS) which are based on the client-server application model to deliver both administrative services and didactical synchronous and asynchronous facilities for the learning process. The administrative services allow to manage learners and to allocate learning resources such as registration, classroom, instructor availability, instructional material, fulfilment and on line delivery.

The IN.TRA.NET system is an innovative distance training system, including the VL for the experimental activities, oriented to teaching of electronic apparatus subjects. The fusion of the innovative VL and the commercial LMS, provides a set of didactical and administrative tools. Most of the LMS allows to track the user's progress and performance across all types of training activities. Moreover, the use of the standard LMS ensures the interoperability and portability of the LOs. The next innovative aspect of the proposed environment is the distributed architecture that involves different physical laboratories which are geographically distributed at national and international level. This distance learning environment, moreover, allows to empower the feeling of working on real instruments and in real conditions.