

A DISTRIBUTED MEASUREMENT LABORATORY CAPABLE OF ON-LINE MONITORING OF INSTRUMENTS BASED ON AN OBJECT-ORIENTED APPROACH

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ABSTRACT. *A distributed measurement laboratory (DML) having instruments scattered in different geographic areas is proposed in this paper. Such a system allows users to practice any distributed instrumentation and simultaneously monitor it via real-time video. The system is characterized by use of object-oriented technique to integrate the scattered electronic instruments and video capture devices to form the DML, leading to a flexible and extendable architecture. Finally, evaluations of the DML have been conducted to verify the effectiveness of the proposed system.*

Keywords: E-learning, Distributed remote control, Electronic instrumentation, Video streaming, Object-oriented approach

1. **Introduction.** Due to the popularity of computer-controlled instrumentation and the wide diffusion of networks, laboratory experiments and instrumentation remotely operated via the Internet have been utilized extensively in both academic and industrial settings [1-22]. Via virtual instrument control panels, students and engineers can remotely practice and control apparatuses at any time and from any location. Such applications play an important role in distance learning since they can allow students to learn instrument control and operation in a guided or self-explanatory way.

In the literature, Guo presented a remote measurement and control experiment used in chemical engineering education [1]. Wang demonstrated a distanced experiment for real-time monitoring and remote control of a network Computer Numerical Control (CNC) machine [2]. In [3,4], an e-learning simulate system in regard to Computer-Aided Design (CAD) was proposed. A remote precise multi-location riveting system was developed in [5], while remote experiments for environment testing and for learning mechatronics module were introduced in [6,7], respectively. However, most of the existing relative works are stand-alone and designated merely for one specific experiment, causing that a user has to login different system portals or download different software for accessing/conducting different experiments. To solve this awkwardness, the better handy way is to provide an integrated portal in order to redirect users to any desired experiment automatically. To achieve this goal, one of the most substantial issues is how to unite those scattered experimental resources. By utilizing distributed software technology, many costly experimental resources spread over different geographic areas can be integrated and shared as a DML.

Benetazzo has proposed features and architectures of such a DML, based on Web technologies and remote measurement [8]. As shown in Figure 1, a DML is made available