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Oponent Review

Doctoral Thesis

Author:	Michal Gerža, MSc.
Title:	Intelligent Measureserver for Controlling Remote Real Experiment with Embedded Simulations and Advanced Diagnostics
Study programme:	Engineering informatics
Field of study:	Engineering informatics
Tutor:	Prof. Dr. František Schauer, DSc.
University:	Tomáš Baťa University in Zlín, Faculty of Applied Informatics
Scope of work:	134 pages, 73 images, 5 tables, 50 bibliographic links and list of 13 author publications

The oponent review was drawn up on the basis of appointment by the opponent, by the letter of dean of the Faculty of Applied Informatics, Tomáš Baťa University in Zlín from 11.9.2017.

Presented dissertation consists of 7 chapters, conclusion, list of references, author's publication activities and his curriculum vitae. The work is clear, the analyzed problems are explained in details and logically arranged. Formally, the dissertation is processed in high quality.

The dissertation thesis solves from a technical point of view a very interesting and highly current issue from the field of design, development and implementation of software components related to the Measureserver unit of remote laboratories. The solved topic is current and it belongs to the study programme of Engineering informatics.

The objectives of the dissertation are described in the fourth chapter. They are written clearly. They are focused on software improvements and developments related to MS (MeasureServer) and its components. All the objectives of the dissertation are fulfilled.

Selected methods and problem solving were appropriately selected and the dissertant successfully solved a number of partial problems that arose during the solution of the problem.

In the sixth chapter of the dissertation thesis are presented the results of the solution of the goals of dissertation, which are formulated in the fourth chapter. The first goal was the design and implementation of a module called Data Archiving Management (DAM), which is responsible for collecting, filtering and storing measured data and putting experiments into xml files. Another task was to design and implement the Measureserver Unit Diagnostics (MUD), which is used as the first level diagnosis. This module provides administrators of remote laboratories with information that ensures the correct operation of Measureserver to prevent or reduce failures caused by various influences. Another problem has been the design and implementation of the Physical Modules Diagnostics (PMD) module, which is used as a second-level diagnosis. This module provides remote laboratory system administrators with a feature to detect and monitor physical modules such as gauges, sensors, probes, and other devices connected to the system to prevent malfunctions or disconnections during measurement. The last aim of this dissertation was to design and implement the Embedded real-world Phenomena Simulation (EPS) module that extends the Measureserver mathematical functions library.

The dissertant has demonstrated through his work that he is able to solve challenging technical and scientific problems and that he successfully uses and controls methods of scientific work at the current world level.

In my opinion, the dissertation is a great contribution to the scientific area of Engineering informatics in the field of remote laboratories, which are currently developing very strongly. The proposed methods of the dissertant were also practically verified what I consider to be a very significant contribution of given works.

I have the following questions to work:

1. How does the system perform the detection and monitoring of physical modules? Is it possible to fix a remote module malfunction?

2. How is the system protected from manipulating the measured data or from degradation of physical modules by users?

Final evaluation:

I consider the dissertation "Intelligent Measureserver for Controlling Remote Real Experiment with Embedded Simulations and Advanced Diagnostics" as excellent work. Author provides a comprehensive solution to a defined problem with practical verification and the application of theoretical knowledge to the real form. The presented work fulfills all the requirements for dissertation work. The author has solved a number of partial problems, demonstrating the ability of independent creative research and development.

On the basis of the doctoral thesis and the list of publishing activities, I can state that the doctoral candidate has fulfilled the requirements for doctoral thesis and therefore I recommend it for defense and after successful defense to grant to Michal Gerža, MSc. a title Ph.D. in the study field of Engineering informatics.

In Košice, 5. 10. 2017

Assoc. prof. Peter Frankovský, PhD.

prof. Ing. Mikuláš Huba, PhD.
Slovak University of Technology in Bratislava
Faculty of Electrical Engineering and Information
Technology
Institute of Automotive Mechatronics

Review of the Doctoral Thesis

Michal Gerža, MSc.

Intelligent Measureserver

for controlling remote real experiments

with embedded simulations and advanced diagnostics

Bratislava
20.10. 2017

Content

Besides of abstracts written both in English and Czech, the submitted thesis written in English consists of lists of figures, tables, attachments, symbols and abbreviations, introduction, 2 chapters defining the main thesis framework, goals of the thesis, used methods, main results, own contributions, conclusions, references, publications of the author and Curriculum Vitae.

The introduction explains basic motivation for dealing with remote laboratories and the local and international situation in this area. The subsequent two chapters deal with hands-on and remote laboratories built on the Intelligent School Experimental System ISES. After defining the thesis goals and the methods used, the main results of the work are presented. This interesting and well elaborated chapter is then summarized by a short overview stressing contribution of the work and by conclusions.

Goals of the PhD thesis

Goals of this doctoral thesis are focused on the software improvements and development related to the Measureserver (MS) and its components:
1. Measured data archiving to structured data files
2. Continuous clients' activities monitoring and recording to text files for the purpose of didactical analysis,
3. First level diagnostics of the integrated software modules for avoiding or reducing occasional failures,
4. Second level diagnostics of the physical hardware modules to prevent their failures or disconnections,
5. Embedded simulation and visualization of real-world phenomena with the control on the client's web page for a motivation before the real measurement as the introductory step to better acquaint the measured phenomenon.

Actuality of the topic

The motivation of the thesis is clearly explained and research interests in the domain are clearly documented by the survey of the references.

Comments and questions

When going to the history of remote experiments in Slovakia and Czech Republic, you write in Chapter 1.2 "Historically, the first two RLs have occurred in Slovakia, nearly simultaneously:
o In the field of automatic control in the Department of Automatic Control, Faculty of Electrical Engineering of the Slovak University of Technology in Bratislava, that has been developed by the research team of Prof. Mikuláš Huba in 2007 [2][3],
o In the field of "Electrochemical cell" in 2008, in the workplace of the Department of Physics, Faculty of Education in the University of Trnava in Trnava, has been developed by team of Prof. František Schauer and Assoc. Prof. Miroslava Ožvoldová [4][5]."
However, in Bratislava the first activities related to remote experiments started much earlier - in 1995 by proposing a new Tempus project that in the period 1996-99 continued by developing in cooperation with the FernUniversität in Hagen several

remote experiments both in Hagen and in Bratislava, as well. The first results from this development have been described in

R. Ondrejková: Vizualizácia a analýza výsledkov meraní diaľkovo riadeného experimentu v mobilnej robotike. Diplomová práca, FEI STU Bratislava 1999. Remote experiments have been presented as an important component of a student-centred approach at the IFAC symposium

Huba, M., K. Žáková: Integrated Learning Environment for Control Education. IFAC Conference Advances in Control Education ACE'00, Brisbane, Australia, 2000 Thereby, a special attention has been given to the role of experiments, including also the remote experiments

Žáková, K., Huba, M., Zemánek, V. a M. Kabát: Experiments in Control Education. IFAC Conference Advances in Control Education ACE'00, Brisbane, Australia, 2000. Besides of numerous other publications (presented regularly e.g. at the Virtual University conference in Bratislava), our experience gained with the first decade of developing and using this new approach (including remote experiments and a virtual laboratory WebLAB) appeared in a special call in Industrial Electronics in

Huba, M., Šimunek, M.: Modular Approach to Teaching PID Control. IEEE Trans. on Industrial Electronics, 54, 6, December 2007, 3112-3121 The impact factor 6.76 should guarantee a sufficient „visibility" of the paper, which is documented by its 52 Scopus citations. Thus, the presented inaccurate information leads to a question, if the author paid sufficient attention to the problem considered.

pp.27 – you use without explaining an abbreviation LR(1) (not in the list of symbols and abbreviations), it is explained just much later on pp. 52...

pp. 77, Chapt. 6.1. – why do you write the archive data to xml file and not to some other format, or to a database?

pp.79 – you declare work with msxml.dll as a part of MS Internet Explorer 5. But, students like to use also Chrome and Firefox, did you register some compatibility problems? Or this library does not depend on the Explorer itself?

I may agree that comparison of simulation and experimentally achieved results plays a very important role in modelling and control. However, today you might take the simulation tools from numerous specialized and well developed open source programs. Why did you choose your own development from scratch?

One may understand your motivation to write your thesis in English. However, I am not sure, if you reach (without a corresponding polishing) all your aims – sometimes it is hard to understand.

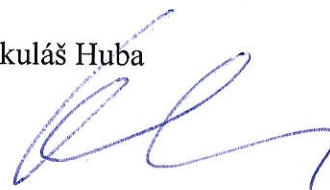## Achievements and contributions of the thesis

Without repeating the aims of the, it is possible to conclude that they have been fulfilled. However, because of the fact that the thesis represents a part of a team product, I would ask the applicant to define more explicitly his own contributions and the overall scheme of the division of work in the carried out development.

Conclusions

The applicant has shown the ability to work both in the theoretical and in the application domain and in an international framework. I recommend his thesis for the defense and I also recommend to the committee to award the applicant the PhD degree.

Bratislava, October 20, 2017   Mikuláš Huba

REVIEW OF THE DISSERTATION THESIS

REVIEWER:

DR. JAVIER GARCÍA-ZUBÍA

Department of Computer Science, Electronics and Communication Technologies
Faculty of Engineering. University of Deusto,
Avda. Universidades 24, 48007 Bilbao (Spain)

THESIS TITLE:

Intelligent Measureserver for Controlling Remote Real Experiments with Embedded Simulations and Advanced Diagnostics.

AUTHOR:

Michal Gerza, MSc.

SUPERVISOR:

Prof. Dr. František Schauer, DSc.

Aim, scope and structure

The thesis forms a dissertation in the field of remote experimentation and remote laboratories, applying advanced tools and concepts of engineering informatics. It presents the state of the art in remote experimentation to remark the main drawbacks of remote experiments, and to solve them in the hardware level. All these advances are based in informatics sophisticated methods and tools. The thesis is well-structured and the extent is appropriate.

The remote experimentation is a research area connected to Technology Enhanced Learning and it started around middle 90's and it is focused in allowing students and users accessing real experiments in a remote way using the Internet as their hands, eyes and brain. This thesis is part of the project "Internet School Experimental System" (iSES) leaded by Franz. Schauer, the supervisor of the thesis what is a world reference in this research area.

Originality, scientific value

A remote laboratory contains several remote experiments, and even each remote experiment can have several instances (rigs) of it. There are two parts to allow a user to access the remote experiment: the client and the experiment. In general terms the client is the software part, and the experiment is the hardware part.

Currently the experiment is designed and implemented by an expert, and then it is connected with the client. The communication between the parts is not so rich: the client sends to the experiment the commands to be executed, and the experiment sends to client the results to be shown. The experiment is not an active part of the remote laboratory, it is a passive part.

The thesis manages this situation improving the communication between the experiment and the remote lab. In general the efforts made in this research area are more connected to the administration, pedagogy and software engineering than to the remote experiment. The results of this thesis improve the state of the art of the remote experiments.

Attending to this approach the experiment is enriched with two different services: logging and diagnosis.

- Logging with the DAM (Data Archive Management). All events, actions, command, and results sent or received by the remote experiment are stored and managed by the DAM (based in XML). This is not usual in other remote labs, and it will allow the owners of the remote laboratory to analyze the behavior of the remote experiment to improve it. Or using these data the final users could be helped during the experimental sessions. This approach allows the development of Learning Analytics, which is one of the most active research areas, specifically in the educational area. This result not only improves the quality of this thesis, but also opens a new area for other researchers.
- Diagnosis with the MUD (Measureserver Unit Diagnostics) and the PMD (Physical Modules Diagnostics). One of the main problems of the remote experimentation is the reliability. If user (student or teacher) access to a remote experiment and it does not run properly, the experience is significantly bad. The thesis has implemented a novel method to analyze and communicate the state of the remote experiment at different levels. After this process every remote experiment can be marked as available (green) or unavailable (red). And if a remote experiment is unavailable, it can be auto-recovered by the designed system. This is a clear advantage, and it will increase the confidence of the users in the remote experimentation.

The implementation of the MUD and the PMD is based in an advance use of Finite State Machines using LR(1) parser, context-free grammars and other tools that are not commonly used in this research area, but they are powerful and adequate for this research. This is a remarkable result of the thesis.

Additionally to the previous results, the Ph.D. candidate implements the EPS (Embedded real-world Phenomena Simulation), it is a simulator that will be included in the client of the remote experiment. In this case the student/teacher can compare the real results with the expected results attending to the simulation.

The scientific value of the thesis can be analyzed attending to the publication of results in journals and conferences. The most important conference in remote experimentation is REV (Remote Engineering and Virtual Instrumentation) and the most important journal is iJOE (International Journal of Online Engineering, http://online-journals.org/i-joe). The results of the thesis have been published in iJOE (2 papers) and in REV (5 papers). REV proceedings are included in WoS (web of science) and iJOE will be included the next year in JCR (it is expected). Other results have been presented and published in other journals and conferences helping to the dissemination of the remote experimentation. The publications remark the high scientific level of the thesis.

Formal quality

The thesis (the summary in English) is well-written and clear. The thesis has a structure that presents the general idea, the objectives, the methods and the results. Finally the thesis connects the different sections among them. When a result is established, it is connected with one objective. Using this approach it is very easy to review the thesis.

The bibliography is rich, containing both well-proved monographs and fresh content from respected journals and conferences.

Remarks and queries

I have some questions after reading the thesis, but I imagine that all of them are because I have read the English version of the thesis, and it is a summary of the original one.

I would like to have a deeper description of the psc file to understand better the MUD and the PMD processes, because they are very relevant and important for the thesis.
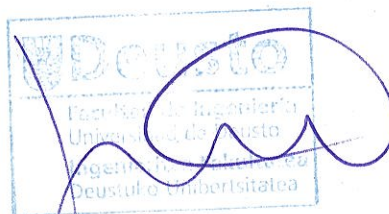
The thesis describes a new method for simulation (EPS). The EjsS tool is described in the thesis as an alternative for this task, but there is not a comparison between easyJava and the EPS.

Also it is important to delimitate the future work connected with thesis. This aspect will remark the level of the current thesis and the expectations for future theses.

Final evaluation and recommendations

The thesis and its contents are of the high standards required for a Ph.D. candidate. **I recommend it for presentation and for acceptation as the Ph.D. thesis in partial fulfillment of the requirements of the Ph.D study in the field of Engineering Informatics. I also highly recommend with pleasure to award Ing. Michal Gerza the Ph.D. degree in the mentioned field of study.**

Bilbao, 3.10.2017

Dr. Javier García-Zubía