POLYTECHNIC UNIVERSITY OF TIMISOARA

CIVIL ENGINEERING DOMAIN

PHD THESIS ABSTRACT

with the title:

DEEP WATER WELLS MONITORING FOR WATER SUPPLY

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Abstract

Monitoring water wells and various processes specific to the water supply sector through digital integration is highly complex, with the main causes being the variety of representation systems and structural schemes potentially participating in these processes.

The use of SCADA/Smart SCADA technology in a complex field and with a perpetual and fast dynamics as that of water supplies seems to be the a optimal solution, traditional methods of insitu verification often have deficiencies, so the collection and monitoring of information can be accomplished only with the involvement of man.

Achieving a high level of functional independence in the process of integrating monitoring and efficient operation leads to increased automation, reduced execution time and costs in terms of human resource factor, efficient monitoring and data-driven decisions that can provide a proactive and predictive operational response with the effect of maximizing capital investments.

The thesis treats aspects of retrofiting with the best engineering practices of the capture fronts as well as the integration of SCADA systems niche in the field of water supply and approach hydraulic modeling through specialized applications with the perspective of integration in a smart SCADA concept, being designed around applications that implement original solutions.

Objectives of the thesis:

The fundamental objective of the paper is to define an original framework for the retrofiting of water wells and the integration of a monitoring system through SCADA System for the water wells, respectively the realization of a hydroinformatics model as a tool for analysis and prediction.

In view of its belonging to the field of groundwater resources, the paper also aims to achieve the following specific objectives:

- presentation of the current context and perspectives on water supply from groundwater sources worldwide, in Europe and in Romania;
- study of groundwater resources on the chosen discretion area
- proposals and solutions for retrofiting and modernization of water wells through best engineering practices;
- monitoring and control of water wels for water supply through SCADA systems

- schematization of hydrostructures by concepts regarding the application of computer-assisted modeling for the chosen discretization area
- Consideration of smart SCADA

In order to achieve these objectives, the use of specific applications is considered, for the acquisition, storage, management and dissemination of data, information. The excellent tools offered by this technology, and the scientific and engineering community in particular.

The results of the research should lead both to the choice of a structural, functional and computerized optimization solution of water wells for water supply of Timișoara, and to the development of a hydroinformatics model as an analysis and prediction tool for rational exploitation and protection of water source.

Thesis structure (chapters)

In order to achieve the proposed objectives, the thesis was structured in chapters, each including several subchapters.

Chapter 1 it is intended for general introductory aspects, theme, motivation and objectives of the paper, presentation of the structure of the paper and highlighting some implementation solutions.

Chapter 2 outlines theoretical aspects of the capture and flow of subterranean layers.

Chapter 3 in which the western region of Timiș and the municipality of Timișoara were briefly presented, respectively the current situation of the water supply systems of the municipality of Timișoara and periubanities through the prism of the regional water operator - AQUATIM S.A.

Chapter 4 is intended for the management of the operation and maintenance of the water wells field intended for water supply.

Chapter 5 deals with the issue of representing the concepts of modernization and automation through essential smart elements in the field.

În **chapter 6** are presented aspects related to the research undertaken in the field of knowledge representation and management.

At the end of the paper is presented **chapter 7** dedicated to contributions and conclusions.

Original contributions

The paper brings a series of contributions, of a theoretical and practical nature, meant to support the permanent dynamics of a vast field, with a strong interdisciplinary character.

The theoretical contribution consisted in the extension of SCADA, in a SCADA model niche in the field of water supply, with a set of predispositions and specifications for their use, aiming at creating a mechanism of definition specific to the field of water supply.

Development of SCADA drivers and comparison between WinCC and Ignition models, the two approaches aimed at demonstrating the capabilities of the solutions.

This objective was achieved through development licenses of AQUATIM S.A. The approach has a number of benefits that support potential beneficiaries of infrastructure modeled through SCADA systems, providing a vision / concept developed to formalize knowledge relevant to SCADA systems.

Defining a hydraulic modeling through a specialized application PMWIN, and as a result of running the program, obtained the levels, transit flows in the whole field.

Expressing some considerations regarding the imprint of the knowledge engineering specialist on the concept of Smart SCADA with technologies and methods at the forefront of IT&C.

Future research directions

Analyzing the ways of developing the urban environment and not only in terms of quality of life, environmental protection and resource efficiency, it is recommended to focus research on results with potential for capitalization in the form of a smart platform to integrate or report to different entities. The realization of such a smart platform interconnected with different actors such as town hall, basin administration, environmental agency, service operators, etc., in order to achieve a decision support system, would induce progress, efficiency and transparency, otherwise it would lead to the concept of Smart City.

It is recommended to develop such an open architecture concept that later interconnects and integrates other services or systems, the exchange of data to be done in a standardized way based on a REST API (full web services) interface, able to guarantee users the right to remotely access the information provided by the process management system via broadband connectivity, thus increasing flexibility and efficiency.

Such a concept is an environment to create a better understanding of the complexity of strategic and operational decisions in a dynamic smart environment.

CURRICULUM VITAE

Adrian Lucian Cococeanu was born in Caransebeș on November 10, 1986 and attended the Industrial High School in Oțelu Roșu, between 2003-2007. As a result of graduating from the Faculty of Hydrotechnics at the Polytechnic University of Timișoara, in Timișoara, in 2011 he obtained the title of Bachelor of Engineering in Civil Engineering, specializing in Hydrotechnical Design and Construction. In 2012 he completed the postgraduate course of the Faculty of Hydrotechnics at the Polytechnic University of Timisoara, specialization - Sustainable development of water resources, and in 2013 at the same faculty, he obtained a master's degree in - Optimization of Hydrotechnical Systems.

Since October 2016, he has been pursuing doctoral studies at the Polytechnic University of Timișoara, his field of professional interest including issues related to water resources and Information Technology such as knowledge representation formalities, decision systems, communication technologies, measurement and control equipment.

The research theme addresses these concerns and aims to theorize and implement aspects of monitoring and integrating water wells for water supply using a dedicated platform, emphasizing the interaction between upgrading infrastructure and data integration in a smart concept to achieve a decision support system.

The research activity materialized in a number of 13 articles published in the volumes of scientific events in the country and abroad, 6 of them being indexed in international databases and other 4 indexed by ISI Proceedings.

LIST OF PUBLICATIONS RESULTING FROM THE DOCTORAL THESIS, PUBLISHED UNDER UPT AFFILIATIONS

1. Scientific papers published in ISI indexed journals

2. Scientific papers published in volumes of scientific events (Proceedings) indexed ISI Proceedings

[1]**AL. Cococeanu**, IA. Cretan, GN.Pelea, Mi. Cojocinescu and TE. Man, " Water Wells Monitoring Using SCADA System for Water Supply Network, Case Study: Water Treatment Plant Urseni, Timis County, Romania", World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium (WMCAUS) 245, Conference Proceedings, ISBN: 978-80-270-1974-8, June 12-16, 2017, Prague, Czech, 2017. (Web of Science).

[2] **AL. Cococeanu**, TE. Man, and C. Florescu, "Water Sourse Assesment for Drinking Water. Assesment/Optimization for Water Treatment Technologies", 15th National Technical-Scientific Conference on Modern Technologies for the 3rd Millennium, Scientific Conference, Modern Technologies for 3rd Millennium, 2016, ISBN 978-88-7587-724-8, pp 99-104, Oradea, România, 2016. 99-104 (Web of Science).

[3] GN. Pelea, IA. Cretan, TE. Man, and **AL. Cococeanu**, " Current management issues in exploitation and maintenance of irrigation systems in western part of Romania. Case study of water quality for irrigation", 16th International Multidisciplinary Scientific Geoconference (SGEM 2016), Ecology, Economics, Education and Legislation Conference Proceedings, SGEM 2016, VOL I , pp.223-230, Sofia, Bulgaria, 2016. (Web of Science).

[4] M. Tamas, TE. Man, GN. Pelea, R. Beilicci and **AL. Cococeanu**, "Study on Water Source Protection - Case Study of Lake Buhui – Anina City, Caras - Severin County, Romania", World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium (WMCAUS), World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium 2016, WMCAUS 2016 161, pp.2203-2208, Prague, Czech, 2016. (Web of Science).

3. Scientific papers published in BDI indexed journals

4. Scientific papers published in the volumes of scientific manifestations (Proceedings) indexed BDI

[1] **AL. Cococeanu**, GN. Pelea, Mi. Cojocinescu, TE. Man and IA. Cretan, "Study of surface water resources availability for irrigation arrangements. Case study: Bega river, Timis county, Romania", 17th International Multidisciplinary Scientific GeoConference SGEM 2017,www.sgem.org, SGEM2015 Conference Proceedings, ISBN 978-619-7408-04-1 / ISSN 1314-2704, June 18-24, 2017, 633-639 pp, Sofia, Bulgaria 2017 (*Scopus*).
[2] **AL. Cococeanu**, GN. Pelea, IA. Cretan and TE. Man, "Advanced and precisely process of clorine disinfection for drinking water",17th International Multidisciplinary Scientific GeoConference SGEM 2017, www.sgem.org, SGEM2015 Conference Proceedings, ISBN 978-619-7408-04-1/ISSN 1314-2704, June 18-24, 2017, 25-31 pp, Sofia, Bulgaria, 2017. (*Scopus*).
[3] **AL. Cococeanu** and TE. Man, "Water Resources, Nature of Contaminants, Impact on Health and Water Quality", Book Springer, Cham, **Online ISBN**978-3-030-76008-3, 2021 (*Scopus*).
[4] **AL. Cococeanu** and TE. Man, "Methods and Characteristics of Conventional Water Treatment Technologies", Book Springer, Cham, **Online ISBN**978-3-030-76008-3, 2021 (*Scopus*).
[5] **AL. Cococeanu** and TE. Man, "Water Security Safeguarded by Safe, Secure and Smart Water Management Solutions", Book Springer, Cham, **Online ISBN**978-3-030-76008-3, 2021 (*Scopus*).

5. Scientific papers published in the volumes of international scientific events (Proceedings) from abroad

[1] A. Anton, D. Mos, S. Muntean, I. Draghici and **AL. Cococeanu**, "A software tool for the efficiency assessment of hydraulic generators operation in Timisoara's drinking water system using android-powered mobile devices", CIVIL COMP 2019 Conferences, Riva del Garda, Italy, 2019.