JOHANNES KEPLER
UNIVERSITY LINZ

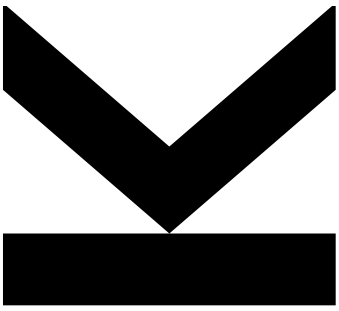
Submitted by
Nada Ossama Ezzeldeen

Submitted at
FAW

Supervisor
Prof. Josef Kueng

June 2017

Connecting Small Hydro-Electric Power Stations for Decision Support



Master Thesis

to obtain the academic degree of

Master of Science

in the Master's Program

INTERNATIONALER UNIVERSITA TSLEHRGANG INFORMATICS:
ENGINEERING & MANAGEMENT

JOHANNES KEPLER
UNIVERSITY LINZ
Altenbergerstraße 69
4040 Linz, Österreich
www.jku.at

Acknowledgment

Abstract

Contents

List of Figures

Chapter 1

Introduction

1.1 Reading Instructions

1.2 Foreword

1.2.1 Motivation

1.3 Problem Statement

1.4 Goal and Approach

1.5 Original Contribution

1.6 Outline of the Thesis

Chapter 2

Decision Support Systems

2.1 Foundations

2.2 Functionality

2.3 Interfaces

2.4 Implementation

2.5 Evaluation and Impact

Chapter 3

Connect Hydro Project

Chapter 4

Decision Support in Connect Hydro

Chapter 5

System Architecture and Details

5.1 Frameworks and Technologies

5.2 Database Design and Implementation

5.3 Web Portal

5.4 Data Visualization

5.5 Decision Support

Chapter 6

Evaluation

Chapter 7

Conclusion

7.1 Summary

7.2 Lessons Learned

7.3 Future Research

7.3.1 Machine Learning

7.3.2 No-SQL Database

Abbreviations

JSON JavaScript Object Notation

Bibliography

[1] Transaction-centric reconciliation in disconnected client-server databases. *Mob. Netw. Appl. 9*, 5 (Oct. 2004), 459–471.

[2] GSON library. https://code.google.com/p/google-gson/, 2014. Accessed: 13/4/2014.

[3] Agarwal, S., Starobinski, D., and Trachtenberg, A. On the scalability of data synchronization protocols for pdas and mobile devices. *IEEE Network 16* (Jul/Aug 2002), 22 – 28.

[4] Ajila, S., and Al-Asaad, A. Mobile databases - synchronization and conflict resolution strategies using sql server. In *Information Reuse and Integration, 2011. IRI '11. IEEE International Conference on* (2011), pp. 487 – 489.

[5] Balakumar, V., and Sakthidevi, I. An efficient database synchronization algorithm for mobile devices based on secured message digest. In *Computing, Electronics and Electrical Technologies (ICCEET), 2012 International Conference on* (March 2012), pp. 937–942.

[6] Charland, A., and Leroux, B. Mobile application development: Web vs. native. *Commun. ACM 54*, 5 (May 2011), 49–53.

[7] Fielding, R. T., and Taylor, R. N. Principled design of the modern web architecture. *ACM Transactions on Internet Technology (TOIT) 2* (May 2002), 115 – 150.

[8] Gamma, E., Helm, R., Johnson, R., and Vlissides, J. *Design Patterns: Elements of Reusable Object-oriented Software*. Addison-Wesley Longman Publishing Co., Inc., Boston, MA, USA, 1995.

[9] Garg, V., and Skawratananond, C. Timestamping messages in synchronous computations. In *Distributed Computing Systems, 2002. Proceedings. 22nd International Conference on* (2002), pp. 552–559.

[10] Gollmick, C. Replication in mobile database environments: A client-oriented approach. In *Proceedings of the 14th International Workshop on Database and Expert Systems Applications* (Washington, DC, USA, 2003), DEXA '03, IEEE Computer Society, pp. 980–.

[11] Guturu, P., Pal, J., Heaven, T. E., Jordan, W. J., and Zhengya, Z. Message replication and consumer database synchronization algorithms and system for highly available high performance intelligent networks. *IEEE Trans. on Consum. Electron. 53*, 2 (May 2007), 375–383.

[12] Hadzilacos, T., and Hadzilacos, V. Transaction synchronisation in object bases. *J. Comput. Syst. Sci. 43*, 1 (Aug. 1991), 2–24.

[13] Hao, S., and Lim, H. B. Data synchronization in distributed and constrained mobile sensor networks. In *Proceedings of the 4th International Conference on Ubiquitous Intelligence and Computing* (Berlin, Heidelberg, 2007), UIC'07, Springer-Verlag, pp. 673–683.

[14] Hejtmanek, L., and Matyska, L. Distributed data storage with strong offline access support. In *Proceedings of the International Multi-Conference on Computing in the Global Information Technology* (Washington, DC, USA, 2007), ICCGI '07, IEEE Computer Society, pp. 16–.

[15] Itani, Z., Diab, H., and Artail, H. Efficient pull based replication and synchronization for mobile databases. In *Pervasive Services, 2005. ICPS '05. Proceedings. International Conference on* (2005), IEEE, pp. 401 – 404.

[16] Janssen, C. Data synchronization. http://www.techopedia.com/definition/1006/data-synchronization, 2014. Accessed: 12/4/2014.

[17] Jiao, Y., Jin, Z., and Ma, Z. A cross-layer method to improve mobile database synchronization performance. In *Proceedings of the 5th International Conference on Wireless Communications, Networking and Mobile Computing* (Piscataway, NJ, USA, 2009), WiCOM'09, IEEE Press, pp. 5540–5543.

[18] Microsoft. Types of replication. http://msdn.microsoft.com/en-us/ms152531, 2014. Accessed: 15/3/2014.

[19] Minsky, Y., Trachtenberg, A., and Zippel, R. Set reconciliation with nearly optimal communication complexity. *IEEE Network 49* (Sept 2003), 2213 – 2218.

[20] Pautasso, C., Zimmermann, O., and Leymann, F. Restful web services vs. "big"' web services: Making the right architectural decision. In *Proceedings of the 17th International Conference on World Wide Web* (New York, NY, USA, 2008), WWW '08, ACM, pp. 805–814.

[21] Pethig, F., Kroll, B., Niggemann, O., Maier, A., Tack, T., and Maag, M. A generic synchronized data acquisition solution for distributed automation systems. In *Emerging Technologies Factory Automation (ETFA), 2012 IEEE 17th Conference on* (Sept 2012), pp. 1–8.

[22] Rabinovich, M., Gehani, H., and Kononov, A. Efficient update propagation in epidemic replicated databases. In *Extending Database Technology, 1996. EDBT '96. Proceedings. 5th International Conference on* (1996), pp. 207 – 222.

[23] Sethia, D., Mehta, S., Chowdhary, A., Bhatt, K., and Bhatnagar, S. Mrdms-mobile replicated database management synchronization. In *Signal Processing and Integrated Networks, 2014. SPIN '14. International Conference on* (2014), pp. 624 – 631.

[24] Tanenbaum, A. S. *Modern Operating Systems*. Pearson Prentice Hall, 2009.

[25] Tian, Y., and Li, J.-P. Research and implementation of data synchronization with syncml. In *Wavelet Active Media Technology and Information Processing (ICWAMTIP), 2012 International Conference on* (Dec 2012), pp. 302–304.

[26] Trachtenberg, A., Starobinski, D., and Agarwal, S. Fast pda synchronization using characteristic polynomial interpolation. In *Twenty-First Annual Joint Conference of the IEEE Computer and Communications Societies. Proceedings, 2002. INFOCOM '02. IEEE* (2011), vol. 3, pp. 1510 – 1519.

[27] Xhafa, F. Data replication and synchronization in p2p collaborative systems. In *Proceedings of the 2012 IEEE 26th International Conference on Advanced Information Networking and Applications* (Washington, DC, USA, 2012), AINA '12, IEEE Computer Society, pp. 7–.

Nada Ossama

Date and Place of Birth: July 23rd, 1990 in Cairo, Egypt
Gender: Female
Nationality: Egyptian
Marital Status: Single
Address: 10 Julius Raab Strasse, 4040 Linz, Austria
Mobile Phone: +43 688 64246359
Email: nadaossama90@gmail.com

Education

Sep 2016 - Present :	Master in Informatics,Johannes Kepler University (JKU)- Graduate July 2017.
Sep 2008 – Jul 2012:	Bachelor of *Science,* GPA: 2.76**, German University in Cairo (GUC)*
Sep 2005 – Jul 2008:	British IGCSE High school certificate, Grade: 110%, *Egyptian Language School, Cairo*

**GPA on a scale of 1-5.0, with 1 being the highest GPA possible and 5.0 being the lowest GPA possible.*

Work Experience and Internships

July 2012 – July 2016: **Customization Engineer**, *Amadeus IT Group*

- Participated in Workshops with Customers to determine their needs and propose a solution
- Wrote functional/technical specification and Solution Architecture documents
- Wrote User Guide and Deployment Guides
- Developed applications as per functional specifications document using .NET framework and Amadeus Web Services, followed by testing and delivering the applications
- Provided second level support and training
- Trained new Members and offered them support

July 2011 – Sep 2011: **Software developer Intern**, *Mash Ltd*

- Worked on Various Applications using Ruby on Rails

July 2010 – Sep 2010: **Database Administration Intern**, *Vodafone Egypt*

- Developed an Enterprise Manager application using Java
- Learned different Types of support by rotating with the support Team

Technical Skills

Programming Languages:	C#, Java, VB.NET
Web Technologies:	HTML, JavaScript, Spring, ASP.NET, XML, WPF, Web Services
Databases:	MS SQL Server, SQLite, MySQL
MS-Office:	Excel, Word, Access, Powerpoint

Courses

Dec 2012:	Delivering the Extra Mile, *Logic Training & HR Development*
Nov 2012:	Amadeus Cryptic Basic Course, *Amadeus IT Group*
Sep 2012:	Presentation Skills Course, *Logic Training & HR Development*

Extracurricular Activities

Feb 2012 – May 2012:	Junior Teaching Assistant, *Introduction to computer science II for 2nd semester management students, German University in Cairo*
Feb 2012 – May 2012:	Junior Teaching Assistant, *Introduction to computer programming for 4th semester engineering students,, German University In Cairo*
Jul 2011 – May 2012:	Vice-president, *GUC Theater and Cinema School , German University in Cairo*
Feb 2011 – May 2011:	Junior Teaching Assistant, *Introduction to computer science for 1st semester management students, German University In Cairo*
Feb 2010 – Mar 2010:	Head Of Ushering Team, *Google I/O Event, German University in Cairo*
Feb 2010 – Mar 2010:	Planning Team Member, *Google I/O Event, German University in Cairo*
Jul 2007 – Jul 2009 :	Events Committee Member, *Flying Colors Team, British Council*

Language Skills

Arabic: Mother Tongue
English: Fluent
German: Basic (Learning)

Awards and Achievements

Sep 2016:	Scholarship at the Johannes Kepler University
Sep 2007:	Scholarship at the German University in Cairo

Hobbies

Sport activities
Reading
Bike Riding
Travelling and discovering new places

Egypt, October 21, 2016

Eidesstattliche Erklärung

Ich erkläre an Eides statt, dass ich die vorliegende Masterarbeit selbstständig und ohne fremde Hilfe verfasst, andere als die angegebenen Quellen und Hilfsmittel nicht benutzt bzw. die wörtlich oder inhaltlich entnommenen Stellen deutlich als solche kenntlich gemacht habe.

Hagenberg, Juni 2017 Nada Ossama