Ph.D. Candidate

Bhuvaneswari Arunachalan

Graduate Academic Unit

Computer Science

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September 12, 2012

10:00 a.m.

Hazen Hall
Room # 127
UNBSJ

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Examining Board:
Dr. Janet Light (Computer Science & Applied Stats.) Supervisor
Dr. Bernd Kurz (Computer Science, UNBF)
Dr. Josée Tassé (Computer Science & Applied Stats.)
Dr. Rose McCloskey (Nursing & Health Sciences) Chairperson

External Examiner:
Dr. Grace Paterson, Assoc. Professor & Acting Director
Medical Informatics, Division of Medical Education
Dalhousie University

The Oral Examination will be chaired by:
Dr. Bruce MacDonald, Associate Dean of Graduate Studies

BIOGRAPHY

Universities attended:
PhD candidate, University of New Brunswick, 2005-2012
Diploma in University Teaching, University of New Brunswick, NB, Canada, 2009.
Master of Philosophy in Computer Science, Bharathiar University, India, 2002.
Master of Computer Science, Avinashilingam University, India, 1993.
Bachelor of Computer Science, Avinashilingam University, India, 1991.

Publications:
Journal
1. Bhuvaneswari Arunachalan, Janet Light, "An Agent-based Messaging Protocol for Mobile Clinical Communication", Journal of Selected Areas in Health Informatics (JSHI), August 2012.
2. Bhuvaneswari Arunachalan, Janet Light, "Mobile clinical message specification for pre-hospital services", Journal of Selected Areas in Health Informatics (JSHI), March 2012.
3. Janet Light, Bhuvaneswari Arunachalan, "Middleware service architecture over cellular network for mobile medical applications." International Journal of Healthcare Technology and Management (IJHTM), October/2006.

Conference Papers
1. Janet Light, Bhuvaneswari Arunachalan, "Agent-based Mobile Middleware Architecture (AMMA) for Clinical Data Transmission using Wireless Networks", 9th International HL7 interoperability Conference, Crete, Greece, October/2008.
2. Bhuvaneswari Arunachalan, Janet Light, "Middleware Architecture for Patient Care Data Transmission using Wireless Networks", ACM International Wireless Communications and Mobile Computing Conference (IWCMC 2007), Honolulu, Hawaii, August/2007.
3. Bhuvaneswari Arunachalan, Janet Light, "A Middleware Approach to Intelligent Emergency Health Care Messaging Using Wireless Networks", The third annual Computational Intelligence in Medicine (CIMED 2007) conference, University of Plymouth, UK, July/2007.
4. Bhuvaneswari Arunachalan, Janet Light, Ian Watson, "Mobile Agent Based Messaging Mechanism For Emergency Medical Data Transmission Over Cellular Networks", 2nd ACM-IEEE International Conference on Communication System software and Middleware (COMSWARE – IAMCOM 2007), Bangalore, India, January/2007.
5. Janet Light, Bhuvaneswari Arunachalan, "Mobile middleware service architecture for EMS application", 1st ACM-IEEE International Conference on Communication System software and Middleware (COMSWARE – SOFTWIM 2006), New Delhi, India, January/2006.
6. Bhuvaneswari Arunachalan, Janet Light, "Middleware service architecture over cellular network for mobile medical applications", Canadian Society of Telehealth 2005 Annual Conference, Winnipeg, Canada, September/2005.
7. Janet Light, Bhuvaneswari Arunachalan, "Mobile IP Infrastructure for Emergency Medical Services", IASTED International Conference on Telehealth, Banff, Canada, July/2005.

Several Posters & Demos/Presentations

Mobile Middleware Architecture for Reliable Clinical Communication

Abstract

Mobile clinical applications are useful in emergency care to capture patient-care data from a remote location and send them to a hospital server in real-time. The digital form of the medical data obtained is called electronic medical record (EMR). The clinical messages generated based on the Health Level Seven (HL7) standard to transmit the EMR, must be delivered accurately and in sequence to avoid duplication of records. Due to intermittent wireless connection problems and the limitations of mobile devices, the reliability of the clinical message transmission process is at risk. The inconsistency in messaging instance causes delivery of multiple copies and sometimes, loss of vital information. To prevent these communication errors and improve the reliability, additional messaging mechanisms are required. In this thesis, these mechanisms are identified and built into a mobile middleware framework. A mobile middleware is defined here as a software component that acts as an interface between clinical applications and network operating systems to provide reliable and loss-free communication of confidential data.

The mobile middleware developed from this research is called Agent-based Mobile Middleware Architecture (AMMA). It uses mobile agents for safe message delivery using an agent migration protocol (AMP). The AMP utilizes a compact message template derived from HL7–Clinical Document Architecture (CDA) specification for protected mobile clinical communication. The protocol is designed to guarantee sequence delivery of an EMR, with mechanisms for conformance checking and exactly-once delivery. In addition, an adaptive intelligent user-interface with event controls is included to monitor the battery power of the mobile device, the active wireless network interface, and the location information.

AMMA was tested using the electronic patient call reporting tool developed for the 9-1-1 emergency medical services of the Saint John regional hospital. The three key mobility parameters: user mobility, signal strength, and bandwidth availability were used for performance evaluation. Evaluation tests for consistency, conformance, and migration of clinical messages demonstrated a high level of reliability with a failure rate less than 0.2. The test results showed that AMMA delivered the clinical data in exactly-once sequence with a reliability score of 4 in a scale of 1 to 5. Equivalent Cs