

博 士 学 位 論 文

Doctoral Thesis

内容の要旨

及び

審査結果の要旨

Thesis Abstract

and

Summary of the Thesis Review Result

第 10 号

The Tenth Issue

平成19年12月

December, 2007

The University of Aizu

はしがき

博士の学位を授与したので、学位規則(昭和28年4月1日文部省令第9号)第8条の規定に基づき、その論文の内容の要旨及び論文審査の結果の要旨をここに公表する。

学位記番号に付した「甲」は学位規則第4条第1項(いわゆる課程博士)によるものであることを示す。

Preface

On granting the Doctoral Degree to the individuals mentioned below, abstract of their thesis and the thesis review result is herewith publicly announced, in according to the provisions provided for in Article 8 of the Ruling of Degrees (Ministry Of Education Ordinance No.9, enacted on April 1, 1953)

The Chinese character, “甲”, at the beginning of the diploma number represents that an individual has been granted the degree in accordance with the provisions provided for in Paragraph 4-1 of the Ruling Of Degrees (what in called “Katei Hakase,” or the Doctoral Degree granted by the University at which the grantee was enrolled.)

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Name 氏名	Zhaomin Zhang 張 兆敏
The relevant degree 学位の種類	Doctoral degree (in Computer Science and Engineering) 博士(コンピュータ理工学)
Number of the diploma of the Doctoral Degree 学位記番号	甲 I 博第 20 号
The Date of Conferment 学位授与日	September 21, 2007 平成 19 年 9 月 21 日
Requirements for Degree Conferment 学位授与の要件	Please refer to the article five of “University Regulation on University Degrees” 会津大学学位規程 第5条該当
Thesis Title 論文題目	Telehealthcare via Mobile Networking: A Multimedia Teleconference System and a Feasibility Study for ECG-based Security Solution モバイル通信を用いる訪問看護情報システムに関する研究: マルチメディア・テレカンファレンスシステムと心電図を用いるセキュリティに関する研究
Thesis Review Committee Members 論文審査委員	University of Aizu, Prof. D. Wei (Main Referee) University of Aizu, Prof. M. Cohen University of Aizu, Associate Prof. S. Bhalla University of Aizu, Associate Prof. W. Chen 会津大学教授 魏 大名 会津大学教授 M. Cohen 会津大学上級准教授 S. Bhalla 会津大学上級准教授 陳 文西

1. Thesis Abstract

As most research and development for homecare services have focused on providing connections between home and service centers, the goal of the present work is to develop techniques and create realtime communications to connect service centers and homecare workers in mobile environments. A key technical issue for this research is how to overcome the limitation of bandwidth in mobile media and networks. Effort has been made to balance performance of communication and basic demands in telehealthcare through optimized system design and technical implementation. Implementations using 3G (third generation) FOMA (Freedom Of Mobile multimedia Access) and PHS (Personal Handyphone System) were developed and evaluated. We conclude that the system we developed based on 3G FOMA provides sufficient and satisfactory functions for use in homecare services.

Furthermore, we adopt some security policies for system security enhancement. These policies include: 1) three-tier architecture for database access security; 2) firewall to prevent unauthenticated network access; 3) IPSec encryption to secure the data transmitted though the internet; and 4) a novel ECG-based biometric authentication method. Previous research showed that biometric recognition has better security in personal authentication because the physiological characteristic represented from one person is a “password” that is very hard to fake. In the field of telehealthcare, Electrocardiogram (ECG) is most common measurement for diagnosis and monitoring. Thus personal authentication using ECG is a convenient method. The experiments were carried out on the ECGs from 501 persons. The experimental results show that the ECG-based authentication performance is acceptable and it is possible to verify a person only using lead I.

Chapter 1 (Introduction)

This chapter presents telehealthcare background and our research objectives.

Chapter 2 (Mobile Telehealthcare Services)

This chapter describes a solution to provide realtime homecare service support for doctors at homecare center and nurses at client home via mobile network. Such a support is achieved by a teleconference system which is a subsystem of the homecare service support system (HSSS). Because our telehealthcare system is built for mobile internet application, we address some technical issues such as the low speed of data transmission. Furthermore, we propose several security policies to enhance system security.

Chapter 3 (Implementation of Teleconference System)

Chapter 4 (ECG-based Biometric Authentication and Its Feasibility to

Telehealthcare)

In this chapter, a biometric personal authentication and identification using ECG features is described. The features of each ECG beat from client are extracted and matched against the templates from a database. Then by similarity analysis, a decision, acceptance or rejection, is made. Two discrimination methods, Mahalanobis distance discrimination and Bayesian discrimination, are employed for comparison. The experimental results show that the identification performance using Bayesian discrimination is better than Mahalanobis distance discrimination, while the authentication performances using both discrimination methods are save and acceptable.

Chapter 5 (Discussion)

In this chapter discussion is given.

Chapter 6 (Conclusion)

In this chapter a conclusion is given.

2. Summary of the Thesis Review Results

As a result of the thesis review, the thesis has been recognized as qualified for conferment for an academic degree

The study is rich enough and satisfactory to demonstrate Zhang's scholastic aptitude. Implementation of the system was well done. The live demonstration in the presentation was impressive.

There was an opinion common to the referees that the title was too general and does not adequately capture the contents. Following the suggestion from the referees, the title was changed to be more descriptive in order to reflect author's particular contribution.

[Referees' comments]

The referees mentioned that the author should better

- more completely describe the ECG signal processing by mentioning important parameters like sampling frequency, and describe at least generally the motivation.
- evaluate or at least discuss the difference between networking performance in Internet and that in Intranet.
- provide a comparison with "Telehealthcare via fixed-line Networking" in terms of qualitative and/or quantitative improvements.
- state the drawbacks and unsolved problems associated with the proposal.
- overview the security requirements in telehealthcare and drawbacks of available schemes.

[Publications]

<Peer-reviewed Journals>

- Zhaomin Zhang, Aiguo He, and Daming Wei, "A Mobile Network-based Multimedia Teleconference System for Homecare Services," *Telemedicine and e-Health*, accepted.

<Peer-reviewed Proceedings>

- Zhaomin Zhang, Aiguo He, and Daming Wei, "Whiteboard Functions in a Mobile Teleconference System for Homecare Services," *Proc. of 2004 IEEE Int'l Conf. on Computer and Information Technology (CIT 2004)*, pp.927-931, Sep. 2004, Wuhan, China.
- Zhaomin Zhang, Aiguo He, and Daming Wei, "A Mobile Teleconference System for Homecare Services," *Proc. of 27th Annual Int'l Conf. of the IEEE Engineering in Medicine and Biology Society*, pp.3935-3938, Sep. 2005, Shanghai, China.
- Zhaomin Zhang, and Daming Wei, "A New ECG Identification Method using Bayes' Theorem," *Proc. of IEEE Region 10 Conf. (TENCON 2006)*, Nov. 2006, Hong Kong, China. (CD format)

[Scholastic Aptitude]

- Fundamental Scholastic Aptitude: Good
- English Language Proficiency: Good

[Opinions of the Review Committee]

The Review Committee agrees that Mr. Zhang is qualified to be awarded a doctor's degree.

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