Integration of Fingerprinting and Trilateration Algorithms

for

Improved Indoor Localization

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This dissertation was submitted to the Department of Electronic & Telecommunication Engineering, University of Moratuwa in partial fulfillment of the requirements for the Degree of M.Sc. in Telecommunications

Department of Electronic & Telecommunication Engineering
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Supervisor

Prof. Dileeka Dias

Nilushika Shironi Kodippili

June, 2010

DECLARATION

I certify that this dissertation does not incorporate without acknowledgement any material previously submitted for a degree in any University to the best of my knowledge and believe that it does not contain any material previously published, written or orally communicated by another person or myself except where due reference is made in the text. I also hereby give consent for my dissertation, if accepted, to be made available for photocopying and for inter-library loans, and for the title and summary to be made available to outside organizations.

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Date: June, 2010

To the best of my knowledge, the above particulars are correct.

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Supervisor

ABSTRACT

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Keywords: Indoor localization, positioning algorithm, positioning accuracy, performace indicators, commercial applications, fingerprinting, trilateration, deployment, radio propagation

Many useful commercial, educational, security and health-care applications of location-awareness related to navigation, tracking and detection of people and objects have been developed through out the history. However the demand for the location information has been limited to outdoor applications until many indoor localization requirements appeared recently with the emergence of ubiquitous computing.

The indoor applications inherently call for higher positioning accuracy than those of outdoor. The existing sophisticated outdoor localization techniques like A-GPS do not perform satisfactorily in indoors due to the poor satellite signal coverage and the signal propagation complexities in indoor environments. On the other hand, though a number of different indoor techniques have been implemented and tested hitherto, none of those techniques have displayed satisfactory overall performance adequate for large scale deployment of commercial applications.

The key performance indicator of positioning techniques is the positioning accuracy, which is quantified in terms of error distance. This research was focused on integrating two existing basic positioning algorithms, fingerprinting and trilateration, with a view to improving the performance with respect to positioning accuracy as well as cost, complexity, response time and implementation aspects etc.

The fingerprinting has been used to identify few locations of known coordinates and signal strengths, closer to the target location. The final position estimation is done by applying the trilateration technique over the range between the selected known locations and the target location. The signal propagation model employed in this technique reproduces the real signal propagation behaviour accurately since it is being applied over a short range and hence the distances calculated using the signal propagation model are fairly accurate. Consequently a better estimation of the location can be derived without getting affected by typical practical problems associated with unpredictable nature inherent to the radio signal propagation.

This research thesis describes the design and implementation of the proposed integrated algorithm in an indoor WLAN environment to evaluate its performance in comparison with the basic techniques it is derived from. The proposed technique estimates the location of an object accurately within 1.1 m in less than a second with manageable training grid size at almost no additional cost. The overall satisfactory performance suitable for generic commercial applications demonstrated by the proposed technique could be a good foundation for ubiquitous deployment of indoor localization applications.

DEDICATION

To all who encouraged me to pursue my higher studies

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES