



UNIVERSITI PUTRA MALAYSIA

***PERVASIVE HUMAN FALL DETECTION AND ALERT SYSTEM BASED
ON MULTILAYER PERCEPTRON NEURAL NETWORK***

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ON MULTILAYER PERCEPTRON NEURAL NETWORK**

By

HAMIDEH KERDEGARI

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PERVASIVE HUMAN FALL DETECTION AND ALERT SYSTEM BASED ON MULTILAYER PERCEPTRON NEURAL NETWORK

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Falls are major health problems which affect the human life by restricting their movements and independency. With the increase in the human population, more attentions are required in order to prevent the serious effects and problems caused by fall. A system which can identify the occurrence of falls in almost every situation and alert the care center is a helpful solution to care for the human safety. The motivation behind this work is to develop a pervasive system for monitoring the human activities and identifying the occurrence of falls. In this work, a waist worn fall detection system has been developed. A tri-axial accelerometer (ADXL345) was used to capture the movement signals of the human body and detect events such as walking and falling to a reasonable degree of accuracy. A set of laboratory-based falls and activities of daily living (ADL) were performed by healthy volunteers with different physical characteristics while the sensor was attached to their waists. Personal information features which are the volunteers' personal physical features and acceleration features which are taken from acceleration data were considered as feature set. Decision tree method was used to find out the effective features for classification. In order to classify the collected falls and ADL acceleration patterns,

Multilayer Perceptron (MLP) neural network was applied for precise classification of motions and determination of fall events and ADL. The results showed that MLP can detect the falls with accuracy of 91.6 %. Finally, a pervasive fall detection system was developed as a smart phone-based application under the name of *Smart Fall Detection*[©] (SFD). SFD is a standalone Android-based application that works using smart phone resources such as accelerometer sensor and GPS which utilizes proposed trained MLP for fall detection. When SFD detects the fall, a help request will be sent to the specified emergency contact using SMS and subsequently whenever GPS data is available, the exact location of fall will be sent. The SFD performance showed that it can detect the falls with accuracy of 91.25 %. This work resulted in the most accurate, first and only smart phone-based fall detection application which uses MLP neural network to determine the occurrence of fall.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains.

**PENGESANAN KEJATUHAN MANUSIA BERLELUASA DAN SISTEM
ALERT BERDASARKAN PERCEPTRON MULTILAYER RANGKAIAN
NEURAL**

Oleh

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Jatuh adalah masalah kesihatan utama yang memberi kesan kepada kehidupan manusia yang menghadkan pergerakan mereka yang bebas. Seiring dengan meningkatnya populasi manusia, perhatian yang lebih diperlukan untuk mengelakkan kesan yang serius dan masalah-masalah yang timbul akibat kejatuhan. Satu sistem yang dapat memantau kejatuhan dalam setiap situasi dan memberi amaran kepada pusat jagaan merupakan penyelesaian yang berguna untuk menjamin keselamatan manusia. Tujuan penyelidikan ini adalah untuk membangun satu sistem berlakunya kejatuhan yang berkesan untuk memantau aktiviti dan manusia mengenal part. Dalam kajian ini, satu sistem pengesan jatuh yang di pakai di pinggang telah digunakan. Meter pecutan 3-paksi (ADXL345) telah digunakan untuk mengukur isyarat gerakan badan manusia dan mengesan aktiviti seperti berjalan dan jatuh dengan ketepatan yang munasabah. Satu set eksperimen kejatuhan di makmal dan aktiviti-aktiviti dalam kehidupan harian (ADL) telah dijalankan oleh sekumpulan sukarelawan yang sihat dan mempunyai ciri-ciri fizikal yang berbeza dengan memakai alat pengesan di pinggang mereka. Ciri-ciri maklumat peribadi yang merupakan ciri-ciri peribadi fizikal sukarelawan dan ciri-ciri pecutan yang diambil daripada data

pecutan dianggap sebagai set ciri. Pokok keputusan kaedah telah digunakan untuk mengetahui ciri-ciri yang berkesan untuk pengelasan. Untuk tujuan klasifikasi data terkumpul mengenai kejatuhan dan corak pergerakan dalam aktiviti harian, satu Perceptron Multilayer (MLP) rangkaian neural telah digunakan bagi memastikan klasifikasi yang tepat. Data yang terhasil menunjukkan yang MLP mampu mengesan kejatuhan dengan ketepatan sehingga 91.6%. Akhir sekali, satu sistem pengesan kejatuhan secara meluas telah dibangunkan sebagai aplikasi telefon bimbit yang dipanggil *Smart Fall Detection*[©] (SFD). SFD merupakan aplikasi Android sendiri yang menggunakan sumber dalam telefon bimbit seperti pengesan pecutan dan GPS yang bergantung kepada MLP untuk mengesan kejatuhan. Ketika SFD mengesan kejatuhan, permintaan untuk bantuan akan dikirimkan kepada nombor kecemasan yang sudah ditentukan melalui SMS dan seterusnya akan menunjukkan lokasi yang tepat apabila data GPS diperolehi. Prestasi SFD menunjukkan yang ia dapat mengesan kejatuhan dengan 91.25% ketepatan. Kajian ini telah menghasilkan aplikasi pengesan kejatuhan untuk telefon pintar yang menggunakan MLP untuk menentukan kejatuhan dengan tepat.

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I certify that a Thesis Examination Committee has met on **29 June 2012** to conduct the final examination of Hamideh Kerdegari on her thesis entitled “**Pervasive Human Fall Detection and Alert System based on Multilayer Perceptron Neural Network**” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science. Members of the Thesis Examination Committee were as follows:

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institutions.



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Date: 29 June 2012

TABLE OF CONTENTS

ABSTRACT	ii
ABSTRAK	iv
ACKNOWLEDGEMENTS	vi
APPROVAL	vii
DECLARATION	ix
LIST OF TABLES	xiii
LIST OF FIGURES	xiv
LIST OF ABBREVIATIONS	xvi
CHAPTER 1	
1 INTRODUCTION	1
1.1 Motivation	1
1.2 Problem Statement	2
1.3 Objectives	2
1.4 Thesis Overview	3
2 LITERATURE REVIEW	4
2.1 Overview	4
2.2 Fall Detection Methods	4
2.2.1 Wearable Device Approach	5
2.2.2 Video-based Approach	9
2.2.3 Ambience Device Approach	11
2.2.4 Pervasive Approach	12
2.3 Windowing Technique	14
2.4 Feature Extraction Approaches	16
2.5 Learning and Classification Algorithms	17
2.5.1 Artificial Neural Network	21
2.5.1.1 The Input Layer	21
2.5.1.2 Number of Hidden Layers	22
2.5.1.3 Number of Hidden Neurons	22

2.5.1.4 The Output Layer	23
2.5.1.5 Transfer Function	23
2.5.1.6 Backpropagation Learning	24
2.6 Summary	25
3 MATERIALS AND METHODS	26
3.1 Overview	26
3.2 Accelerometer Sensor	26
3.2.1 Tri-axial Accelerometer (ADXL345)	27
3.2.2 Android Phone Accelerometer Sensor	28
3.2.3 Sensor Placement	29
3.3 Data Collection	30
3.3.1 Personal Information	33
3.3.2 Data Labeling and Data Trimming	35
3.4 Windowing Technique	36
3.4.1 Sliding Window Approach	36
3.5 Feature Extraction	38
3.5.1 Personal Information Features	38
3.5.1.1 Decision Tree	39
3.5.2 Acceleration Features	40
3.6 Supervised Learning Method for Classification	43
3.6.1 Proposed MLP Neural Network	44
3.6.1.1 Transfer Function	46
3.6.1.2 Number of Training Epochs	46
3.6.2 Evaluation of Fall Detection	47
3.7 A Pervasive Fall Detection System	49
3.7.1 SFD Design	49
3.7.1.1 System Overview	50
3.7.1.2 Implementation	55
3.7.2 Experimental Design	56
3.8 Summary	57
4 RESULTS AND DISCUSSION	59
4.1 Overview	59
4.1.1 Window Size Evaluation	59
4.1.2 Feature Verification	60
4.1.3 Evaluation of ANN Performance	63
4.1.3.1 Evaluation of Number of Hidden Neurons	64
4.1.3.2 Training Epochs	65
4.1.3.3 Training Time	66
4.1.3.4 Evaluation of Transfer Function	67
4.1.4 Evaluation of Fall Detection Results	68
4.2 Smart Fall Detection (SFD) Application Evaluation	69
4.2.1 SFD Application Performance	69
4.2.2 Resource Consumption Performance	70
4.3 Summary	70

5 CONCLUSION AND RECOMMENDATION FOR FUTUREWORK	72
5.1 Conclusion	72
5.2 Future Work	73
BIBLIOGRAPHY	74
APPENDICES	81
BIODATA OF STUDENT	99



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