中文摘要

據世界衛生組織的報告，世界老年人口將在 2050 年上升至近 25％，已開發國家甚至達到 33％，老年照護的議題日漸重要，因此本論文主要解決的目的為(1)養老智慧照護系統設計、(2)運動狀態下心率偵測、與(3)跌倒偵測驗算法的建立。

本研究所提出的養老照護系統硬體主要由三部分組成(1)智慧衣與感測元件：負責生理接收資料、(2)照護機構管控平台：健康數據分析與異常提醒、(3)行動裝置：負責資料的顯示，提供走動式的服務。智慧衣主要藉由 4 個電極貼片接收人體心電訊號，再藉由織物電極傳遞訊號至感測元件，感測元件將類比訊號轉換成數位訊號，元件中的微處理器透過演算法可以即時分析心電訊號以及姿態數值藉由 BLE 傳出中控中心，管理平台再將這些值轉換成有意義的數據，最後顯示於護理站或是照服人員手機。

本研究所規劃之養老智慧照護系統主要提出以下功能(1)生命徵象的監控、(2)生理機能的追蹤、(3)活動場域的監控、(4)防走失與跌倒偵測、(5)緊急求救、(6)裝置配戴偵測、(7)裝置低電量預警等。所提出的演算法有 (1)動態下心率偵測：動態下心率偵測是藉由經驗模態分解(EMD)來濾波，再使用 MWqrs 找出 R 點進而算出心率，動態心率偵測實驗結果顯示，總體偵測 R 點的正確率達到 96.57％，敏感度則

為 98.92％。(2)使用隱馬爾可夫模型(HMM)建立老人跌倒判斷準則，跌倒偵測實驗使用隱馬爾可夫模型的跌倒檢測正確率為 97.33%，敏感度為 86%，特異性為 99.6%。(3)室內定位則是使用接收 BLE 訊號強度，完成區域定位。整個研究成果已經正式導入台灣長照機構，待系統於醫療機構成功驗證後，將進一步往健康社區與居家養老發展，達到在地養老的目的。

關鍵字:智慧照護系統、智慧衣、物聯網、心率偵測、跌倒偵測

Abstract

Aged society has already become one of the worldwide major social issues in 21st century. According to the report of the World Health Organization, in 2050, world ageing population will rise to nearly 25%, and will be up to 33% in developed countries. Elder accident prevention becomes more and more important. Falls can cause elder's fragile body severe physical injuries or even lethal, and could cost significant financial burden to the family and society. So a reliable fall detection method is essential in reducing fall-related injury. This study proposes a framework of intelligent care system which includes several important accidents detection by smart clothing and sensor.

The smart clothing composed of fabric clothing stitch with 4 fastened electrodes sensor can detect three leads ECG signals of the wearer. And the signals will be collected by gateway on the chest of smart clothing. The major component of gateway includes (1) A accelerometer to provide posture information, (2) ECG collection which can collect the ECG signals from smart clothing for heart rate detection, (3) Microcomputer (MCU) converts the accelerometer and ECG signals to features for post analysis. (4) The BLE module transfer data to server. After having smart clothing sensors and gateway, we construct a beacon environment to receive BLE broadcasting frame per second. According to RSSI, we can know the location information.

We implemented the MWqrs with EMD for heartrate calculation and Hidden Markov Model (HMM) for fall detection. The accuracy and sensitivity of two algorithms had been validated by the experiment. The experiment results show that the improvement of accuracy of heart detection by using Empirical Mode Decomposition (EMD) is 96.57%, and sensitivity is 98.92%. The accuracy of fall detection by using HMM is 97.33%, sensitivity is 86% and specificity is 99.6%. We will evaluate the clinical effect through constructing whole system at long term care institution.

Keywords—intelligent care system; smart clothing; internet of things; heart rate detection; fall detection;