中文摘要

本研究擬開發之穿戴式人體感測網路衣將規劃整合多項訊號感測元件,其中心電訊號將以導電纖維搭配彈性纖維做為電極,再與人體感測網路衣結合,而感測元件則裝置於特定位置以取得生理訊號, 擷取之生理訊號將透過編織導電纖維網路進行傳遞; 而本研究開發之外反搏裝置將整合充氣加壓馬達以及智慧衣,透過智慧衣傳送之訊號做分析,經過運算之資料運用在體外反搏裝置的控制。本研究重點包括(1)智慧衣關鍵性模組研發:主要目的為開發可穿戴的生理訊號無線傳輸智慧衣,蒐集使用者的生理訊號,包含:心跳、姿態等不同的複合資訊,監測身體健康狀況,並分析其心電訊號之變化情形,結合訊號模組彈性化設計,降低感測織物與皮膚之間的相對運動並提高智慧衣穿戴的舒適性,讓使用者願意長時間穿戴。(2)體外反搏裝置研發:建立QRS複合波偵測演算法,分析智慧衣回傳之心電訊號,並計算加壓開始時間點,再依序加壓下肢各部位,當加壓結束後全部同時除壓排氣,如此不斷循環持續一小時,每天一小時,持續每週五天,持續七週以達到體外反搏治療效果。體外反搏治療可改善心絞痛等因血管壁狹窄而引起的身體不適,對於改善高血壓和低血壓也有不錯的效果,對於心血管等疾病病患有莫大的貢獻。

針對本研究所提出的方法與服務模式，為驗證其可行性、信效度以及智慧衣之生理訊號量測的準確度，共設計了三項實驗：(1)QRS複合波偵測演算法準確度驗證：使用兩個MIT-BIH 資料庫執行演算法並與MIT-BIH 結果比較，平均準確度高於 96%，顯示本研究所使用之演算法具有高度的準確度。(2)智慧衣訊號品質分析實驗:使用心電圖模擬器測試不同心跳下智慧衣的訊號品質，藉

由雜噪訊號與原始訊號的比較計算出訊噪比，得到了訊號品質為優良的結果。(3)體外反搏裝置加壓時間間隔，過往皆使用50ms 為加壓時間間隔，而我們藉由實驗做出在高心率時調整加壓間隔來應對加壓時間間隔過長的算法。

由實驗結果證明本研究之方法信效度皆具備一定水準以上，透過本研究之生理訊號監控，能有效的讓使用者了解自己之生理狀況。

關鍵字－智慧型穿戴式裝置、智慧衣、心跳感測、加速度訊號、矩陣編織導電纖維網路

Abstract

The goal of this study is to develop a home-based EECP (Enhanced External Counterpulsation, EECP) device for cardiovascular disease. There are four key technologies including Intelligent Body Sensor Technologies, Conductive fiber Technologies, Wireless Communication Technologies and EECP control algorithms. The research goals include two parts: (1) To develop the Smart Clothes: The main goal is to develop the smart clothes made from conductive fibers which can detect the ECG signal. We also develop the algorithm to analyze ECG wave signals. These analysis results will be the indicator to control EECP automatically. (2) To develop the EECP Devices: EECP device calculate 6 cuffs pressurization time sequence in different position including calf, lower thigh and upper thigh. Repeat this action for an hour per day, 30 days one month, can improve health. Our systems try to help patients suffered by cardiovascular, hypertension and hypotension disease to have a better life.

In order to validate the performance and accuracy of the physiological measurement system we proposed, we designed three experiments including (1) The accuracy of R peak detection algorithm: We use two MIT-BIH's database to execute the algorithm and compare the result with MIT-BIH. The average accuracy is higher than 98%. It indicate that the algorithm we used in the research has high accuracy. (2) Smart cloth signal quality analysis experiment: We use ECG simulator to validate the signal quality of smart cloth under different heart rate. The ratio which we derived by noise signal and original

signal show the signal quality we get by smart cloth is excellent quality.
(3) The inflation interval of EECP therapy is 50 milliseconds in the past, and we defined the formula which will adjust the inflation interval in high speed's heart rate by experiment.

Keywords - Smart Wearable Device 、Smart Cloth 、Heart Rate 、Accelerometer、Conductive Fiber.