

中文摘要

高齡人口比例快速攀升，失智症會嚴重影響老人的生活品質以及相當大的家庭與社會成本。本研究希望就原本臨床方式外，思考如何於日常生活中即可進行相關重要指標的收集，長期追蹤其失智症指標的變化，當出現衰退或異常時，可盡快安排檢查與治療。透過資訊技術、人機界面以及醫學理論，針對使用者的認知能力狀況進行監控，產生可供臨床診斷、評估與檢測所使用的有用資料。期許能發現早期的失智症預兆，提早給予治療，達到減緩認知能力衰退的目的。

本論文中提出一具有娛樂性，易用性以及方便性的監控機制。使其可以融入日常生活中，成為生活的一部份，讓我們有效的長期監控各項危險因子的變化。於研究當中我們開發三項系統：(i)互動式認知能力測驗遊戲：發展各種認知能力面向的互動遊戲，透過易懂、易學以及有趣的人機介面，不僅僅是一認知能力測驗，更是一認知能力訓練遊戲。透過實驗中發現：(i)該項互動遊戲與MoCA量表評估結果的關聯性達0.83，為一相當高的關聯性；(ii)科技接受度的評估結果，從整體、性別以及教育程度等三種不同角度觀察，對於該系統皆有一高接受度，並表明學習使用上面的難度並不高；(iii)在大規模收案資料中發現在動物命名的遊戲時間以及正確度、數字順序記憶的遊戲時間以及記憶廣度、數字逆序記憶的記憶廣度、顏色搜尋的遊戲時間以及錯誤次數、變化盲視的遊戲時間以及正確度、反義詞的遊戲時間以及正確度與連線測試的遊戲時間以及錯誤次數上都呈現顯著差異，表示我們所開發出的設備與系統有分辨出認知能力正常與異常使用者的能力。(2)光學感測設備：開發出以光學感測的方式取得心臟搏動時的血流變化情況，由於模組輕便，易於組裝，不需要在身上貼上電極貼片，易於跟手錶或手環進行結合，有利於進行長時間的監控，其所感

測到的心臟跳動部分藉由心電圖進行比對，10名的受測者中PPI與RRI的相關性為0.96585，顯示本研究所開發出的光學感測設備與演算法具有高度的可靠度。(3)電學感測設備：透過導電編織技術與衣物結合，從衣物上即可感知心臟的搏動，實驗結果發現(i)藉由智慧衣感測到的訊號品質皆達37db以上，皆為一良好的訊號品質；(ii)QRS演算法偵測R波的準確度在資料庫數據的測試下，sensitivity和positive prediction 平均在 99% 左右。

關鍵字—失智症、互動式認知能力測驗遊戲、光學感測、電學感測



Abstract

With rapidly rising proportion of the elderly population, dementia will seriously affect the quality of life of the elderly and families. This study thinks about how to collect important features in daily life, long-term track changes features of dementia. When there is a recession or abnormal, examination and treatment can be arranged as soon as possible. The cognitive abilities are monitored through information technology, human-machine interface as well as medical theory. Useful information in clinical diagnosis and assessment is generated. Once Dementia can be early detected, early warning and early treatment can be given. The purpose of slowing cognitive decline can be achieved. This thesis proposes an entertaining, ease of use and convenience of monitoring mechanism. It can be integrated into daily life and become a part of life. That way we have an effective long-term monitoring of the changes in risk factors.

Three systems are developed: (1) Interactive cognitive ability test game: a variety of cognitive interactive games are developed. The games and device are easy to understand, easy to learn and interesting man-machine interface. That is not just a cognitive ability test, but also a cognitive training game. In experiments we found that (i) the correlation between MoCA and our system is 0.83. It is a high correlation. (ii) From technology acceptance questionnaire, system got a high acceptance in general, different gender and different education level. (iii) The significant difference between normal aging and mild cognitive impairment can be found in varies of games except game time of backward digit span and antonym. (2) Optical sensing device: optical sensing module is

developed. That can detect blood flow because heart pulsation. Module has features such as lightweight, easy to assemble, no need electrode. It is favor in long time monitoring. The heart rate we calculated compared with Electrocardiography (ECG). The correlation between PPI and RRI is 0.96585 in 10 volunteers that means our device and heart rate detection algorithm has high reliability. (3) Electrical sensing device: the clothes combine with conductive fiber and then the heart beat can be got from clothes. From experiments (i) the signal-to-noise ratio from clothes is 37 db and that is a good signal quality. (ii) The average of sensitivity and positive prediction of our QRS detection algorithm is around 99%.

Keywords - Dementia, Interactive cognitive ability test game, Optical sensing device, Electrical sensing device