應用組
Application Group

A18-153

非直接接觸式生理與活動訊號感測方法於長期照護之應用

Non-direct Contact Physiological and Physical
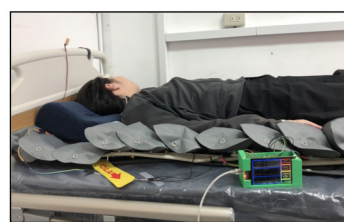Signal Sensing Methods for Long-Term Care

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研究領域
嵌入式系統設計、生醫電子工程、FPGA系統設計與應用、智慧型手持裝置在醫學工程上的應用、穿戴式裝置設計、生理訊號處理。

作品摘要

世界衛生組織聲明在2050年後，全球將會有20%的人口年齡高於60歲，意味著長期照護的需求將與日俱增，而對於免疫力較低且無法自由行動的長期臥床病患，照顧者必須付出更多的時間及醫療成本，若照顧者並非專業長照人士或是沒有確實地替病患進行翻身、拍痰，很容易併發出相關疾病。根據台北榮民總醫院-高齡醫學中心的調查，各類長照併發症致死率最高的前兩名為，因皮膚長期間受壓迫而導致受傷的一壓瘡（50%以上）以及痰積於肺部引發細菌繁殖的一肺炎（6-28%）。

以往針對長期照護的監控系統中，大部分都需要在病患身上加裝感測器或是穿戴式裝置，此方法易造成病患不舒服，而且有電池更換等問題，因此不適合長期監控。近幾年來，基於攝影機之非接觸式量測技術被提出，透過一般高解析度攝影機，擷取連續的臉部影像來偵測皮下組織內血管的脈搏訊號，雖然具有高舒適性與便利性，卻可能涉及病患隱私問題。

有鑑於上述的問題，在此提出一套以氣墊床為基礎的長照輔助系統，本作品並不需要穿戴任何感測器於病患身上，適合長期監控且沒有隱私問題，再加上氣墊床本身有預防壓瘡的功能，可以同時實現預防及監控的效果。

本系統主要有兩大功能。

I. 姿態辨識與生理訊號量測
此功能目的在於：預防壓瘡、減少照顧者的照顧負擔。本作品利用氣墊床實現非直接接觸式的生理與活動訊號感測方法，會自動紀錄病患的生理及活動訊號，並使用相關機器學習分類演算法提高姿態辨識的準確率，若病患維持同一姿態過久或是生理訊號異常時，將發出警示通知照顧者進行更一步的處理。

II. 拍痰音辨識
此功能目的在於：降低肺炎罹患率、提升照顧者的照顧效率。照顧新手或是家屬往往不知道拍痰的正確手勢，就貿然的拍擊病患背部，不僅造成疼痛與不適，且無利於排痰效果，本作品利用安裝於床頭的麥克風收集拍痰時造成的聲音訊號，再藉由數位訊號處理與相關自定義演算法後，能判別出拍痰手勢的正確性，並使用機器學習中的分類演算法使聲音辨識的準確率提高。

本作品在未來可以廣泛地運用於長期照護中心、醫療院所或是居家照護，希望可以減少照顧者的負擔，提升照護品質。

- 呼吸率
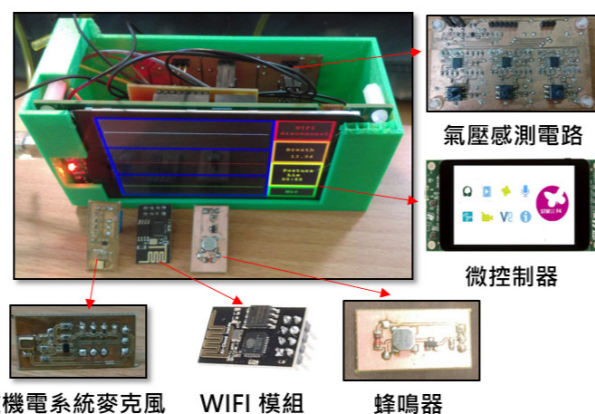- 當前姿態及維持時間
- 判別拍痰手勢的正確性

以氣墊床為基礎的長照輔助系統
圖1. 本作品的主要功能

本作品裝置與組成

氣壓感測電路
微控制器
微機電系統麥克風　WIFI 模組　蜂鳴器

圖2. 本作品的裝置實體照片

Abstract

The World Health Organization (WHO) stated that after 2050, 20% of the world's population will be older than 60, meaning that the demand for long-term care will increase day by day. For long-term bed-ridden patients who have low immunity and cannot move freely, the caregiver must pay more time and medical costs. If the caregiver is not a professional long-term caregiver or because he is overworked and does not really take care of the patient, It is easy to issue related diseases. According to a survey conducted by the Senior Medical Center of Taipei Veterans General Hospital, the two diseases with the highest fatalities are the pressure ulcers (more than 50%) that are injured due to compression during the long period of skin, and pneumonia (6-28%) that caused by bacteria accumulation in the lungs.

In the past, most monitoring systems for long-term care required the installation of sensors or wearable devices on the patient. This method is likely to cause discomfort to the patient and there are problems such as battery replacement. Therefore, it is not suitable for long-term monitoring. In recent years, non-contact measurement technology based on cameras has been proposed. Through a general high-resolution camera, continuous facial images are taken to detect the pulse signals of blood vessels in the subcutaneous tissue, although it has high comfort and convenience. However, it may involve patient privacy issues.

In view of the above problems, a long-term care assist system based on an uses alternating pressure mattress is proposed here. This work does not require any sensor to be worn on the patient, is suitable for long-term monitoring and has no privacy problems, and the uses alternating pressure mattress itself has the function of preventing pressure sores can realize the effect of prevention and monitoring at the same time.

This system has two main functions.

I. Posture detection and physiological monitoring
The purpose of this function is to prevent pressure sores and reduce the caregivers' burden of care. This work uses alternating pressure mattress to implement non-direct contact physiological and active signal sensing methods. It automatically records the patient's physiology and activity signals, and uses related machine learning classification algorithms to improve the accuracy of posture recognition. If the patient maintains the same posture for a long time or if the physiological signal is abnormal, an alert will be issued to notify the caregiver to perform further processing.

II. Sound recognition of slapping back
The purpose of this function is to reduce the incidence of pneumonia and increase the caregiving efficiency of caregivers. The novice caretaker or family member often does not know the correct gesture when slapping the back. Using the wrong gesture not only causes the patient pain and discomfort, but also does not have any effect of expelling the sputum. The system uses the microphone installed on the bedside to collect the sound signals generated when slapping the back, and after performing the digital signal processing and related custom algorithms, we can determine the correctness of the gesture when slapping the back, we also using machine learning classification algorithms enable improved sound recognition accuracy.

This system can be widely used in long-term care centers, medical centers, or home care in the future. It can not only reduce the loading of carer, but also increase the quality of the care.