Chapter 12
Portable Wireless Device for Automated Agitation Detection

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ABSTRACT

The objective of this chapter is to provide an overview of existing portable medical devices. The chapter then focuses on portable automated agitation detection. The design and prototyping of a device capable of portable wireless agitation detection is detailed. In addition, the agitation detection algorithm, which uses Support Vector Machines (SVM) based on the measurement of skin conductivity, skin temperature, and inter-beat interval, is described. Experimental results pertaining to the performance of the device and the agitation detection are provided. The chapter concludes with challenges to the development of medical portable devices in general and to agitation detection specifically. Some potential future research directions are highlighted.

INTRODUCTION

The changes in population demographics together with continued advancement in medical science have resulted in shifts in the healthcare sector. The population has become older and sicker. There are more chronic illnesses and there is more emphasis placed on prolonging life. Hospital stays have become shorter and complex care is currently being provided at home. Additionally, more emphasis is placed on providing high quality care at lower price and on efficient and effective

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ways of coordinating and managing care. Interdisciplinary collaboration, bridging the home with the hospital, and effective use of information and technological systems are no more a luxury but constitute at the moment a need. The advanced worldwide use of mobile and wireless networks has made them widely used in many current and emerging healthcare services. Due to their reduced size, portable wireless devices make it possible to monitor patients in a transparent way with minimal effect on the quality of life. By providing remote monitoring capabilities, patients' hospitalization duration is reduced, which has positive impacts on both the patients and the healthcare system. In addition, such devices enable immediate response in case of emergency. Also, the data available from the long term monitoring can be very valuable for diagnostic purposes.

In the coming years, the number of older patients potentially accessing the healthcare system is expected to double, increasing from 35 million in 2010 to 72 million by 2030 (He, et al, 2005). This population boom, a 78 percent increase, will result in 1 in every 5 Americans being over the age of 65 by the year 2030 (He, et al, 2005). The rapidly growing elderly population brings new healthcare issues into sharp view, particularly that of caring for elders with Alzheimer's Disease, which is the leading cause of dementia (He, et al, 2005). Dementia is an acquired syndrome of decline in at least one function of the cognitive system such as language, attention, problem solving, visuospacial and memory, and is sufficient to disturb the social and occupational life of an alert person (Task Force, 1994). Dementia is very common in aging population but can hit also at an early age and at any stage of adulthood. A very common sign of an advanced stage of dementia is the disorientation in time and/or in place for persons carrying this syndrome. It is in the long term care setting that the effects of dementia are particularly felt, as the disorder results in negative behavioral symptoms in 54% of patients (He et al, 2005). This negative behavior is primarily due to agitation, and can interrupt patient care and frustrate caregivers. Caring for elders with dementia is psychologically demanding, and can result in psychiatric symptoms of caregiver "burnout" (Rosenblatt, 2005). The loss of skilled health care providers will undoubtedly be felt in the often short-staffed world of long-term care. The care of elders with Alzheimer's disease and related disorders, such as agitation, carries high costs. These costs in the United States only are approximated at 80 to 100 billion dollars annually, which creates further burden on presently strained healthcare delivery systems. In order to control costs, provide optimal patient care, and prevent the burnout of skilled professionals, efficient methods of agitation measurement and management must be implemented to aid nursing staff in their efforts.

This chapter addresses portable intelligent devices for healthcare. Specifically the chapter details the design and experimental results of a portable wireless device for automated agitation detection. Section II provides a review of existing portable wireless devices for healthcare use in general and of the different methods used for agitation detection in particular. Section III details the design of the wireless portable device. It introduces the device architecture, the sensors, as well as the algorithm used to fuse these sensors and predict the state of the patient. The hardware and detection experimental results are presented in section IV. Section V discusses the challenges of both portable e-health devices and automated agitation detection techniques.

BACKGROUND

In this section previous work is presented. The work is addressed according to the two aspects of the chapter: healthcare portable devices and emotion detection or affective computing.