

Chapter 47

Using a Smartphone as a Track and Fall Detector: An Intelligent Support System for People with Dementia

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ABSTRACT

This chapter proposes a smartphone-based system for both indoor and outdoor monitoring of people with dementia. The whole system comprises wandering detection, safety-zone monitoring, fall detection, communication services, alert notifications, and emergency medical services. To effectively track the elderly, the proposed system uses a smartphone camera to take real-time pictures along the user's path as he or she moves about. Those photos, accompanied with time and GPS signals, are delivered to and stored on the Cloud system. When necessary, family caregivers can download those data to quickly find a way to help the elderly individual. Additionally, this study uses tri-axial accelerometers to examine falls. To assure individuals' data is safeguarded appropriately, an RSA method has been adopted by the system to encrypt stored data. This reliable and minimally intrusive system provides people with dementia with an opportunity to maintain their social networks and to improve their quality of lives.

1. INTRODUCTION

Today, people live longer than they did in the past century. Consequently, most countries, from Europe and the United States to Asia, are facing

aging problems among their populations. Research indicates that in 2005 about 10% of the world's population was over 60 years old; this proportion will be more than doubled by 2050 (Pollack, 2005). Although recent advances in medical technology

DOI: 10.4018/978-1-4666-8756-1.ch047

greatly extend life expectancy for people, several aging problems such as dementia have been a serious threat to the quality of life for older adults. Research also finds that the prevalence of dementia increases with age (Landau et al., 2010; Hebert et al., 2013). In other words, the older adults have a greater potential for suffering from this disease. In 2010, the United States had 4.7 million individuals aged 65 years or older with Alzheimer's disease (AD) dementia (Hebert et al.). That number is growing rapidly; it is estimated that in 2050 there will be 13.8 million people in the United States with AD dementia.

People with dementia (PwD) usually exhibit a gradual loss of their sense of time and place (Naumann et al., 2011; Wherton & Monk, 2008). They are prone to getting lost when they go out alone. Such a risk not only becomes a source of burden for caregivers, but is also a source of frustration and low self-esteem for the elderly individuals. However, most PwD expect to live independently. They are unwilling to be a burden to others (Naumann et al.). Given those expectations by the elderly, it is vital that our societies learn how to use emerging technologies to support this group of people in their desire to live at home, to be able to maintain their social networks, and to keep their quality of life.

At present, a number of technological devices have been developed to support PwD living at home, for instance, using global positioning systems (GPS) to locate a missing person (Sposaro, Danielson, & Tyson, 2010), using accelerometers and gyroscopes to detect falls (Yavuz et al., 2010), and developing dedicated algorithms to improve the performance of technological devices (Yavuz, Kocak, Ergun, & Alemdar, 2010). However, a critical characteristic of dementia is that recent memories and skills are damaged or lost (Naumann et al., 2011). PwD have difficulty learning how to use new devices or operating complicated tools. Hence, newer technology products developed for this group of people are better than the existing, familiar ones that are already in their daily lives.

It is evident that smartphones are prevalent and popular among various age groups. Their components—such as GPS, accelerometers, gyroscopes, cameras, microphones, and other audio units—can be used to collect data and to support specific events (Moore, Barolli, Xhafa, & Thomas, 2013). Therefore, in this study, we use a smartphone to track and locate a missing elderly individual with dementia. Furthermore, the proposed system is able to detect falls and can automatically provide appropriate alerts and required medical aid for PwD.

In short, the purpose of this study is to design a system, named the Smartphone-based Track and Fall System (STFaS), which tracks a missing elderly individual by taking pictures of his or her walking route and delivering those pictures and relevant information to the Cloud. The system also allows the limits of the individual's safety zones to be set and checks whether the monitored elderly individual is within the established safety zones. Furthermore, the STFaS monitors a fall occurrence for the elderly individual. When necessary, it is capable of issuing an alert to caregivers as well as calling for emergency medical assistance so as to assist the elderly individual in a timely manner.

Additionally, to ensure that all pictures and relevant information are securely protected, in this study, we employ the RSA method as the encryption/decryption algorithm. We believe that all personal data is stored in a very safe and secure manner.

2. BACKGROUND AND RELATED STUDIES

In recent years, dementia has been recognized as a serious threat to most older adults. It is estimated that about 5% of people over 65 and more than 40% of people over 90 have dementia (Moore, Barolli, Xhafa, & Thomas, 2013). How to use technology to assist those groups of people has been a critical challenge for research. This section

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