Chapter 12
Pervasive Data Capturing and Analysis for Patients with Alzheimer’s Disease

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ABSTRACT
Two of the major considerations in helping patients with Alzheimer’s disease are: (1) the monitoring of activities to minimize the risk in their daily lives and (2) to reduce the worsening rate of the symptoms of Alzheimer’s disease. By introducing our tracking and monitoring system, SmartMind, the authors demonstrate how the latest pervasive and sensing technologies can help the patients living alone while providing immediate assistance if necessary. In addition, patients’ current health statuses can be estimated daily by checking with the Normal Living Habit (NLH) recorded by the SmartMind. Since patients with Alzheimer’s disease may result in serious mood problems, it is important to monitor their mood status. SmartMood, which works with SmartMind, provides estimation on the mood status of a patient by analysing his/her voice data captured from his/her smartphone while he/she is talking with others. Alerts are sent when an abnormal mood status is detected.

INTRODUCTION
With rapid advances in electronic and wireless communication technologies, in recent years, the design and development of novel pervasive computing applications have attracted great interests both in academia and industry. One such important application is pervasive healthcare services. Through pervasive sensing devices, e.g., smartphones and Kinect, various health and activity data about a patient can be captured easily and continuously by embedded sensors. By analysing these health and activity data, novel pervasive healthcare services can be provided to the patient.
In this Chapter, we would like to discuss how to explore the latest pervasive and sensing technologies to provide effective monitoring and tracking services on the daily activities of the patients who have Alzheimer’s disease. Alzheimer’s disease is the commonest type of dementia. According to the Hospital Authority of Hong Kong, there are about 5 to 8% of 65 years old elders in Hong Kong who suffer Alzheimer’s disease, and about 20 to 30% of them are over 80 years old (Hong Kong Hospital Authority, 2014). Even with the modern medical technologies, there is still no cure for Alzheimer’s diseases. Since Alzheimer’s disease could seriously affect the normal livings of the patients, the impacts to them as well as their family members can be tremendous. Due to the memory degeneration and loss of self-caring capability problems in Alzheimer’s disease, the patients who are suffering the diseases, soon or later, will need intensive or even complete cares on their daily lives from their family members or the caregivers. This could be a serious burden to their families and the society. It is not uncommon that the patients with severe Alzheimer’s symptoms are sent to hospitals or rehabilitation centers where medical professionals are available to provide intensive care services to them. Therefore, it is important to find out an effective solution to reduce the worsen rate of the Alzheimer’s symptoms of the patients and help them to maintain an independent life.

In this Chapter, we will first introduce our system called SmartMind which monitors and tracks the daily lives of the patients with Alzheimer’s disease within their living rooms. At the same time, SmartMind provides activity reminders and memory improving activities, called ‘mind training games’ (MTG) that are suggested to be able to reduce the degeneration rates of the memories of the patients (Newport, 2013). The targets of SmartMind are the patients whose symptoms of Alzheimer’s diseases are from mild to moderate. They still can live on their own most of the time in a day. In SmartMind, we use Kinect (Microsoft Crop., 2014) as the main tool for activity detection while smartphones are employed for activity reminder and MTG. The activities to be tracked and monitored, e.g., watching TV, having breakfast and taking medicines, are very important to the patients. The collected activity records can serve as useful indicators on the self-caring abilities of the patients.

In addition to providing useful self-caring information of a patient on his daily activity within his living rooms, the daily activities of a patient captured by SmartMind can also be used to identify his “normal living habit (NLH)”. The NLH is an important reference for assessing the severity of Alzheimer’s disease and identifying any potential health and living problems of the patient. In cases there is a sudden change in living habit of a patient on a day, it may indicate that the patient is sick or the symptoms are worsen on that day. For example, normally, the patient has breakfast at 9am. If he does not come out the bedroom even after 11am, he may be sick and his relatives will be notified so that they will take appropriate actions immediately, e.g., call or visit the patient to check his current health status. Another important goal of SmartMind is to handle emergence situations. In case the patient has an accident at home, e.g., falling on the floor, SmartMind will immediately generate alert messages together with captured images to his relatives.

Note that it is not the purpose of SmartMind to replace the relatives of the patients or the caregivers in taking care of the patients. Instead, with SmartMind, the patients can practice self-caring activities while helps will be provided immediately if necessary. Note that allowing the patients to handle some simple activities is highly important to their health and has been suggested by medical professionals as a good way to decrease the degeneration rates of their memories (Newport, 2013).

A related system of SmartMind is the mood tracking system called SmartMood. The patients with Alzheimer’s disease could have various degrees of mood problems in addition to their