

An Interactive Multimedia System for Monitoring the Progressive Decline of Memory in Alzheimer's Patients

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Abstract. This paper describes an assistive technology designed for longitudinal monitoring of memory decline for people with Alzheimer's Disease (AD). While there are systems designed for rehabilitation of people with AD, supporting caregivers, and psychosocial intervention, there is a lack in technology support that provides quantitative measures of progressive memory decline that can assist physicians in clinical settings. An interactive autobiographical memory repository of images and sound recordings was developed to facilitate measuring memory recall and recognition. The system functionality and the user-centered design approach of involving geriatric psychiatry specialists and caregivers are described.

Keywords: Alzheimer's Disease, Memory Decline, Caregivers, Elders, User-Centered Design, Caregiver Burden.

1 Introduction

Accelerated cognitive decline and memory loss is a concern for rapidly aging populations. One of the most common reasons of memory loss is Alzheimer's Disease (AD), a neurological disorder which is an irreversible progressive form of Dementia affecting memory, cognition, and behavior [2]. Prevalence is growing worldwide affecting many facets of life. In Saudi Arabia alone, 50000 people were estimated to have been diagnosed with AD [9]. AD is also considered to be the sixth main cause of death in the United States [10]. An equal number of caregivers are affected who support People with AD (PwAD) with their physical needs of aging and episodic memory impairments. In 2008, there was an estimate for AD that 9.9 million caregivers provide 8.5 billion hours of care at a cost of \$94 billion in the US [1]. Caregivers are often a spouse or a close relative of PwAD, and are considered the second or hidden victim of AD. Caregivers' burden lies in the challenge of assisting PwAD physically and mentally, while at the same time trying to keeping track of progressive decline in cognitive abilities in interventional therapy.

Recent research has suggested that earlier diagnosis facilitates earlier treatment of the disease, when medications have been shown to be most effective [8]. A challenge

resides in monitoring memory loss at the onset of AD symptoms and for patients with Mild Cognitive Impairment (MCI). Recently, there has been increasing interest in the design and development of assistive technologies for PwAD. While this research serves the purpose of providing solutions for people who need them (e.g. individuals with AD, their caregivers, physicians), it also gives researchers opportunities to investigate and learn from people with AD whose requirements challenge the extent of designers' and developers' understandings [6]. Of particular interest to our current work are research studies examining technology solutions for people with AD that have been shown to be effective in facilitation social interaction and eliciting memory cues. Systems have been designed for early diagnosis, rehabilitation of AD patients [10], supporting caregivers [1][6], assisting them with their daily lives [4], and intervention [8]. Clinicians involved in the caring for people with AD often find it difficult to assess memory decline based on caregivers' anecdotal evidence. This has led to the question of whether technology can assist physicians in accurately keeping track of accelerated memory decline. Zplay has been recently introduced for clinical and home use, which facilitates monitoring; however, longitudinal monitoring still relies on subjective or manual recording, which does not involve direct interaction between PwAD and the system [8]. The need for supporting physicians in monitoring decline of memory abilities signals opportunities for technology development. This has motivated us for developing "Monitoring Memory Streams", which is a software program aimed to help caregivers and physicians with that process. The inadequate understanding of the needs of users in this context has entailed adopting a User-Centered Design (UCD) approach for iterative needs assessments and evaluation of prototypes. Monitoring the accelerated decline in memory for patients with AD is a challenge in home settings. In clinical settings, physicians rely on neuropsychological measures. Longitudinal data is difficult to ascertain due to the challenge in eliciting accurate reports described by caregivers. A better understanding of how clinicians measure memory decline can help identify opportunities for technology to help this process and consequently reduce the burden on the caregivers.

Reminiscence Therapy (RT) is a common psychosocial intervention for people with AD. RT involves eliciting memories with tangible objects such as photographs or artifacts. Evidence suggests that having PwAD engage in activities that are cognitively stimulating can slow down the rate of decline in cognitive abilities [1]. Multimedia that can be readily recognized by PwAD such as photos with faces of people familiar to PwAD or places of interest are often advocated in RT [8]. A better understanding of effective conversational prostheses and what visual and auditory stimuli are effective in triggering memories of past experiences can help improve the functionality of a monitoring system in assessing recognition rates over extended periods and consequently provide objective measures of decline.

The aim of this project is to develop a system for monitoring the decline in memory for people with AD. The hypothesis is that a monitoring system used regularly by PwAD can help provide an accurate measure of cognitive abilities over long periods of time between clinical visits, decrease caregiver burden, by automatically keeping track of recognition rates of visual images and auditory cues. In this paper, we first present an overview of the system that we developed for monitoring memory decline of people with AD. Following that, we discuss our user-centered design approach in the design