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Usability evaluation of assistive technologies through qualitative research focusing on people with mild dementia

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ABSTRACT

The assistive technologies (ATs) are commonly used for the wellbeing of people with dementia (PWD). Research shows that current ATs are not performing to their best and high rate of AT abandonment still exist. Although empirical evaluations greatly impact AT success, yet only few studies investigated AT usability for PWD. To the best of authors knowledge there is no AT usability evaluation study conducted in the South Asia. Therefore a qualitative study is carried out to identify which AT factors encourage and discourage the PWD through semi-structured interviews. Thematic analysis is used to generate themes and sub-themes. The (happy users, non-happy users and technology and human care) emerged as three main themes while, (communication, monitoring and reminders) as popular AT types. Most PWD use ATs for socialization and health monitoring. Overall the PWD appreciated the role of ATs in their lives, but showed concerns about interface efficacy, function simplicity and elderly requirements adaptation. The already met and unmet needs of the PWD are also investigated. The AT producers should make user interface simpler and tailor future ATs to the specific requirements of the PWD. The user centered techniques should be adopted for the development of new ATs.

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1. Introduction

From recent statistics it is evident that the world population is ageing. According to the United Nations survey, the world population aged 60 years or above stands at 11.7% (841 million people). This figure is expected to rise to 21.1% (2 billion people) by 2050 (Au, Lai, & Ng, 2015). This ageing population is contributing significantly to the number of people with dementia (PWD) worldwide. Currently there are over 46.8 million PWD in the world (Pratchett, 2015). Interestingly this number is more than the individual population of 123 countries. Moreover the world is spending \$818 billion for betterment of the PWD every year. Again this investment is more than the annual GDP of 178 countries of the world (Pratchett, 2015).

Considering these giant social and economic impacts, the companies around the world are developing Assistive Technologies (ATs) for helping the PWD to live better lives. The ATs have potential to help the PWD to live independently (Tchalla et al., 2012) (Boman,

Lundberg, Starkhammar, & Nygård, 2014). The literature highlights that the PWD offer unique challenges to the caregivers and family members (Fukuda, Shimizu, & Seto, 2015). Still the family members prefer that the PWD should stay with them at home rather than at some care homes (Petrovic, 2013). The use of ATs can provide partial solutions like (cognitive or physical help) to these unique challenges due to the nature of dementia and can prolong the stay of the PWD at their own homes.

Currently the trend in academia for research regarding AT design and development for the PWD is on rise. The industry is transforming ideas into reality for the betterment and wellbeing of the PWD (Doukas et al., 2011) (Imbeault et al., 2014). Studies available in literature present new ideas and AT devices for the wellbeing of the PWD (Hoey et al., 2010).

The fundamental goal for the technological industry' like all other businesses is to gain customer satisfaction by providing them with quality products (Asghar & Usman, 2013). The AT usability evaluation studies can serve greatly in achieving this goal by highlighting the likes and dislikes of PWD for the existing ATs. Involving the PWD in such studies promotes their voice in academic research and serves as basis for requirements elicitation for the future ATs. It is strongly believed that technology success

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depends heavily on its end user perspectives. Therefore knowing the point of view of the PWD regarding the usability of existing ATs becomes more important (Scherer, 2005). Yet there are only few studies carried out in this domain (Span, Hettinga, Vernooij-Dassen, Eefsting, & Smits, 2013). Such as (Rowe et al., 2009) in USA (Demers, Wessels, Weiss-Lambrou, Ska, & De Witte, 2001), in Canada (Jedeloo, Witte, Linssen, & Schrijvers, 2002), in Netherlands and (Larsson Lund, Nygård, & Kottorp, 2014) in Sweden have conducted some studies for testing AT usability from the users.

Recently in the South Asia, the researchers started to work on the wellbeing of the PWD and their caregivers (Ali & Bokharey, 2015). The focus of these studies is on the care of the PWD through the caregivers and family members. To the best of the authors' knowledge, there are no AT usability evaluation studies conducted in the South Asian region with focus on the PWD. The importance of this study becomes even more significant as the South Asia holds 25% of Worlds' population (Rasul, 2014). Delphi consensus study reports that there is an annual 1.9% increase in dementia population of the South Asia. According to a recent study statistics, the South Asia has over 4.5 million PWD (Prince et al., 2013).

According to 2013 statistics, there are more than 150,000 PWD living in different parts of Pakistan and this population is increasing at a rate of 1.9% every year (Ahmad et al., 2013). This steady rate of dementia population increase will create a challenge for already weak economy of Pakistan. Considering all these challenges, we therefore conducted this study in Pakistan by involving the PWD into productive talks and explored their point of view regarding the usability of current ATs and their future needs.

1.1. Characteristics of people with mild dementia

The dementia often causes gradual weakening of the memory and decline in some mental functions. Dementia grows rapidly for some people, whereas for others it may take years to go from initial to advance stage. At mild stage of dementia the people may perform some functions independently. Still, they will experience cognitive challenges that will affect their daily functioning, like forgetting things or words. The mild dementia include common symptoms like: changes in personality, forgetting recent events and weakening of memory, misplacing things and getting lost, challenges in collecting and stating thoughts and opinions, difficulty in solving complex tasks and difficulty in independent travel etc. (Reed-Guy, 2016).

2. Literature review

Researchers treat ATs as one of the best available solutions for the wellbeing of the PWD, which resultantly increased the production of ATs (Tchalla et al., 2012) (Fardoun, Mashat, & Ramirez Castillo, 2015). The manufacturers also claim that ATs are helping the PWD to live independently. However these claims can be validated by conducting empirical studies with the real subjects. Empirical studies are getting importance in recent years as these studies "are based on observed and measured phenomena and derive knowledge from actual experience rather than from theory or belief" (Cahoy). Due to scope of this study, this section highlights the empirical studies related to AT usability for the wellbeing of the PWD.

The opinion of 22 PWD relatives regarding AT support was investigated through questionnaires. The relatives showed positive opinion about the AT use for the wellbeing of the PWD (Engström, Lindqvist, Ljunggren, & Carlsson, 2006). Another study investigated the staff members' satisfaction with AT usage for helping the PWD. This study also used questionnaires to collect data from 33 staff

members. Data was collected before and six months after the implementation of AT support at the nursing home. The monitoring and reminders ATs were used for the test. The overall results showed that AT use significantly improved the staff members satisfaction with their work (Engström, Ljunggren, Lindqvist, & Carlsson, 2005). A similar work investigated 14 staff members' perception of AT support through interviews before, during and after the implementation of ATs. At start staff members had diverse perceptions, but after the AT implementation most of the perceptions were on the positive side (Engström, Lindqvist, Ljunggren, & Carlsson, 2009).

An automated reminder system was analyzed by involving eight PWD in 60 trials. The PWD completed more steps with the help of the reminders and reduced the number of interaction required between them and their caregivers (Labelle & Mihailidis, 2006). Another study investigated the use of a reminder system in hand washing activity by involving six PWD. The PWD completed 11% more steps independently and caregivers interactions also reduced by 60% (Mihailidis, Boger, Craig, & Hoey, 2008).

The comprehensive work in this field came from the Australian researchers who used a systematic review to identify empirical studies on AT use for the PWD. Their search identified 178 potentially relevant studies. The evaluation criteria excluded 142 studies, while remaining 32 studies received validity assessment using the approach from (Forbes, 1997). The results showed only eight studies as strongly, nine studies as moderately and 19 studies as weakly relevant. Further analysis showed that there was only little empirical evidence of supporting the PWD through ATs. The study concluded that there was still a high rate of AT non-acceptance as existing ATs were often unreliable and brought little difference to practical outcomes. They further emphasized on the need of better designed empirical studies based on large samples (Fleming & Sum, 2014).

Although some AT usability empirical studies have been conducted recently, but their focused population is different (i.e. school children, people with disabilities, caregivers etc.), therefore researchers still believe that empirical studies focused on the PWD are ignored in literature (Span et al., 2013) (Imbeault et al., 2014). Moreover current ATs are not tailored to the needs of the PWD, which contribute to high rate of AT abandonment (Carrillo, Dishman, & Plowman, 2009). Literature further suggests having direct interaction with the PWD to explore their requirements for the future ATs (Torrington, 2009) (Aloulou et al., 2013) (McCabe & Innes, 2013). The direct interaction will result into tailoring future ATs as *per* user requirements. The current study was initiated to fill these research gaps by empirically investigating AT advantages, limitations, functionalities and impacts on the PWD and exploring their future requirements. The objectives of this study are achieved by answers the following research questions.

RQ1: What are major ATs used by the PWD?

RQ2: Which factors encourage and discourage the PWD to use ATs?

RQ3: What are the requirements of the PWD for the future ATs?

3. Methods

Fig. 1 summarizes the research process followed throughout the study. It includes (i) interviews template design and validation, (ii) survey participants, data collection and analysis and (iii) study context and ethical considerations.

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