

Perspective

# Information and communication technology solutions for outdoor navigation in dementia

Stefan Teipel<sup>a,b,\*</sup>, Claudio Babiloni<sup>c,d</sup>, Jesse Hoey<sup>e</sup>, Jeffrey Kaye<sup>f</sup>, Thomas Kirste<sup>g</sup>,  
Oliver K. Burmeister<sup>h</sup>

<sup>a</sup>Department of Psychosomatic Medicine, University of Rostock, Rostock, Germany

<sup>b</sup>DZNE, German Center for Neurodegenerative Diseases, Rostock, Germany

<sup>c</sup>Department of Physiology and Pharmacology "V. Erspamer", University of Rome "La Sapienza", Rome, Italy

<sup>d</sup>IRCCS San Raffaele Pisana of Rome, Rome, Italy

<sup>e</sup>School of Computer Science, University of Waterloo, Waterloo, Ontario, Canada

<sup>f</sup>NIA - Layton Aging & Alzheimer's Disease Center and ORCATECH, the Oregon Center for Aging & Technology, Oregon Health & Science University, Portland, OR, USA

<sup>g</sup>Department of Computer Science, University of Rostock, Rostock, Germany

<sup>h</sup>School of Computing and Mathematics, Charles Sturt University, Bathurst, Australia

## Abstract

**Introduction:** Information and communication technology (ICT) is potentially mature enough to empower outdoor and social activities in dementia. However, actual ICT-based devices have limited functionality and impact, mainly limited to safety. What is an ideal operational framework to enhance this field to support outdoor and social activities?

**Methods:** Review of literature and cross-disciplinary expert discussion.

**Results:** A situation-aware ICT requires a flexible fine-tuning by stakeholders of system usability and complexity of function, and of user safety and autonomy. It should operate by artificial intelligence/machine learning and should reflect harmonized stakeholder values, social context, and user residual cognitive functions. ICT services should be proposed at the prodromal stage of dementia and should be carefully validated within the life space of users in terms of quality of life, social activities, and costs.

**Discussion:** The operational framework has the potential to produce ICT and services with high clinical impact but requires substantial investment.

© 2016 The Authors. Published by Elsevier Inc. on behalf of the Alzheimer's Association. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## Keywords:

Social participation; Intention recognition; Assistive technology; Mobility; Cognitive decline; Disorientation; Situation-aware assistance

## 1. Outdoor and social activities in dementia

### 1.1. The vicious loop of cognitive impairment and social isolation

With aging, the risk of dementia, especially Alzheimer's disease (AD), markedly increases (prevalence of >20% at age ≥80 years). Mild stages of AD dementia are character-

ized by cognitive deficits, some behavioral symptoms, and functional disabilities in the instrumental activities of daily living with progressive loss of autonomy [1]. Mild cognitive impairment (MCI) is a prodromal stage of dementia with manifest memory decline but preserved activities of daily living [2].

Social cognition and activities can have a major impact on the evolution of symptoms and the maintenance of quality of life along the course of dementia [3]. Social cognition in MCI and AD dementia often remains intact until later stages of the disease [4], although early behavioral changes, such as depression or apathy, may affect social interactions.

\*Corresponding author. Tel.: +49-381-494-9470; Fax: +49-381-494-9472.

E-mail address: [stefan.teipel@med.uni-rostock.de](mailto:stefan.teipel@med.uni-rostock.de)

However, social activities are most heavily affected by spatial disorientation, which increases the risk of getting lost and exhibiting wandering behavior (wandering behavior in the broader sense includes forms of confused walking behavior even if it originates from an initially purposeful behavior [<https://www.alz.org/care/alzheimers-dementia-wandering.asp>]) [5]. Consequently, patients reduce outdoor mobility leading to a more sedentary lifestyle and social isolation, with a primary worsening of the quality of life and with a secondary negative impact on cognitive functions, cardiovascular tone, brain plasticity, and mood. Therefore, support of social activities is a major theme for future clinical research as well as treatment and prevention of dementia.

### 1.2. Ideal information and communication technology solutions for user's outdoor mobility

Information and communication technology (ICT) solutions can support autonomous outdoor mobility empowering participation in social events of patients with mild dementia. Such functionality is supported by assistive technology devices (ATDs), typically in the form of wearable devices which contain hardware and software that create a location-based service using global positioning system (GPS), cellular, and other signals. Ideally, such devices should efficiently fulfill the following functions:

1. Acquire active or passive user's inputs (typically, the user will actively input his/her destination into the system. Alternatively, the system can learn typical routes from the user's daily behavior and infer the intended destination from the actual user behavior [passive input]) about routes and goals. The system should integrate these inputs into the individual context of the user, considering cognitive and physical resources, personal habits and preferences (for example, valuation of autonomy vs. safety), and environmental

factors, such as social networks, and availability of socially salient places and events;

2. Acquire real-time information on the local conditions (for example, weather forecast, traffic, public transportation, and hours of social events);
3. Recognize route obstacles (for example, critical street conditions), user's psychophysiological stress, irregular locomotion or falls, and dynamic changes of the planned routes and goals of outdoor transitions;
4. In case of disorientation, provide step-wise guidance through a transition routine or suggestion of alternative routes and request of feedback on intended goals; in potentially dangerous situations, provide hierarchical alarms to predefined stakeholders.

Challenges for the fruitful use of ATDs supporting outdoor mobility in users are the harmonization of communication systems among different stakeholders, the shared information of these devices raising the issue of user's privacy, and the user's level of cognitive impairment and resources (see Table 1 for an overview). An ideal ATD for supporting outdoor social activities in mild dementia should detect and support user intentions and goals. It should flexibly and automatically adapt to changes of a user's plans and goals, interpreting deviations from typical behavior in the context of (1) actual extrinsic factors, such as traffic situation, opening hours, (2) actual intrinsic factors, such as the user's level of psychophysiological stress and residual perceptual, cognitive, motor, and coping abilities, and (3) long-term intrinsic factors, such as favorite pattern of transportation, and social activity routines. Furthermore, the ideal ATD should combine a high level of safety with a high valuation of user preferences for autonomy and privacy. These key features of an ATD can be represented in terms of a balance across at least three target dimensions:

1. System usability versus feasibility;
2. System reliability versus flexibility; and

Table 1

Cognitive and behavioral characteristics of people with mild dementia, support provided by assistive technology devices, and minimum user's requirements for the use of these devices for outdoor navigation

Mild dementia deficits	ATD support	Minimum user's requirements
Disorientation, wandering, and getting lost in unfamiliar environments [6]	Psychological support, encouragement, and navigation inputs for wayfinding [6]	Relatively preserved personality [6], interests, motivation [7], and drive; ability to understand a simple visual or auditory cue [8,9]. Requirements tested by standard clinical scales
Spatial memory, visuospatial processes, planning, decision making, directed attention, and processing of multiple tasks [10] during outdoor transitions	Prompts on routes and strategies by one sensory channel at a time and only the next goal (no sequence)	Relatively preserved abilities to use a step-wise support [11] by ICT-based ATDs. Requirement evaluated by an assessment test with the device
Abstract reasoning and planning [12] during problems to find the way	Concrete prompts directed to the next goal	Relatively preserved abilities to follow instructions formulated in simple concrete terms [11] by ICT-based ATDs. Requirement evaluated by an assessment test with the device
Operation on technical devices to ask for support in case of disorientation	Detection of barriers, stress conditions, and generation of automatic prompts	

Abbreviations: ATD, assistive technology devices; ICT, information and communication technology.

Download English Version:

<https://daneshyari.com/en/article/5623834>

Download Persian Version:

<https://daneshyari.com/article/5623834>

[Daneshyari.com](https://daneshyari.com)