

Autonomous systems to support social activity of elderly people

A prospective approach to a system design

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Abstract — The reduction in physical and social activity in elderly people degrades the aging process, causing or increasing suffering to the individual and to his family and friends. Most times, the individual well-being is related to the strength of the social bonds with the family and friends group, so it is important to keep this bonds in the various stages of life, especially in the later life, when the individual has health limitations and is living in a community centre.

This paper proposes an exploratory approach, regarding the use of information technologies systems, as autonomous systems, to assist in supporting and encouraging elderly people to preserve and develop their social activities and the relationships with their family and friends social group. During the course of the aging process, some aging people have their social activity degraded due to health limitations and institutionalization in elderly care centers, in which they are admitted as residents. We propose the design of a software system, capable of running in autonomous devices, such as, robots and other consumer appliances, enabling them to recognize and interact with the users, according to their state of mind and the specific current moment context. The interactions should be simple and focused on keeping the users informed about the current life events of their family and friends, and create the opportunities for the users to interact with the participants of those events by creating interaction proposals.

The systems would monitor the user's family and friends group, regarding their information and actions on the social

media. The system's interactions with the user would be based on that knowledge and on the knowledge of the user's current context. An adaptive user interface would present and manage the user interactions, acting as a mediator between the user and his family and friends group.

Keywords— *Wellbeing, Elderly, Ambient Assisted Living, Human Computer Interaction*

I. INTRODUCTION

From the second half of the twentieth century increased longevity and consequently the significant growth of the aging population have come to constitute an important economic, social and political challenges.

In Portugal population projections point to 2060 a ratio of three elderly people per youth and an average longevity of 81 years. The increase in the elderly population in Portugal, still evident in the results of Census 2011 in which about 19% of the population is 65 or more years old [1].

About 60% of elderly people living alone or in exclusive company also older people [2]. The elderly dependency ratio has been increasing gradually. In 2012 [2] the number was 28.8%, which corresponds to more than a quarter of the active population. This indicator deserves to be examined in the light of the sustainability of health systems and social security.

The reflection on the aging social aspects has been to demarcate it from depicting stereotypes of old age. Elderly people fall into a category of individuals usually identified with isolation, loneliness, disease, poverty and even social exclusion [3]. The World Assembly on Ageing under the theme "Society for all ages" refers to the importance of the full realization of the right of all people to enjoy the maximum physical and mental health. It is a fact that older people are a vulnerable group in social and economic terms, because there are losses on the psychic level and physical level, implying change of social relations and increasing the risk of isolation and loneliness [4].

However, the changes that occur in the family and the modifications of social interaction patterns imply the need to find different solutions to new models of aging, retain emotional stability, physical and mental and social. Thus, a strategic reorientation is needed for healthy aging that promotes intergenerational cooperation, social buildings, community cohesion and social inclusion. The primacy in maintaining healthy social relations is an important factor to minimize psychosocial decline in elderly person who has been a feature inherent in the institutionalization process [5].

It is necessary that the elderly people do not feel, too much, to change its social role, which does not feel great difficulties to adapt to change, particularly with regard to changing routines, to use and engaging in stimulating activities [6].

It is set the challenge for the development of highly technological and communication differentiated features that ensure the design of an aging with quality of life, maintaining social and family interactions, reducing the risk of loneliness and loss of social status in institutionalized elderly.

Without detracting from the importance of the care provided by professionals and the value of humanized personal relationships, there has been the need for additional aid, and social robotics one specialized technological branch, which can support the interactive dimension of the care process. The transfer of this knowledge to residential structures for the elderly, can be critical to the promotion of elderly social interaction [7].

II. ASSISTING SOCIAL ACTIVITY

The process of an individual becoming older or aging encompassed physical, psychological and social changes. It is one of the highest risk factors known for most human diseases and it will introduce limitations to the individual life style [8]. The reduction in physical and social activity will rise these risk factors and degrades the aging process, causing or increasing suffering to the individual and to his family and friends [9]. Most times, the individual well-being is related to the strength of the social bonds with the family and friends group, so it is important to keep this bonds in the various stages of life, especially in the later life, when the individual has health limitations and is living in a community centre [10].

In a study regarding the older people active aging perception, the authors found that the most common perception were related to: maintaining physical health and functioning (43%), leisure and social activities (34%), mental functioning

and activity (18%) and social relationships and contacts (15%) [11]. This study reveals that the maintenance of the social and mental activity accounts for the 57% of the perceive aging and is an important issue regarding successful aging and the Later Life or eight stage of life [12].

The Ambient Assisted Living embraces the concept of helping senior citizens to improve their quality of life and expand their participation in the community by using systems to overcome their special needs, based on based on ubiquitous sensing, individual-environment interaction, context awareness, and learning information systems [13]. The European overview report of Ambient Assisted Living (AAL) researches this concept and aims to find out an efficient solution to help these elderly people independently living [14]

The usage of ICT has been researched as a tool to support the therapeutic process, in which the main actors are the physicians [15]. The usage by the patients themselves is a new approach and requires the patient ability to properly use a system [16].

The usage of ICT by older adults is complex and extends well beyond the dichotomy between 'successful users' and 'unsuccessful non-users' [16]. In fact, the successful adoption of ICT solutions by older people is related to attitudes, experience of use, and perceived benefits [17], with many studies emphasizing the potential benefits of the use of ICT for elderly people, particularly by allowing them to stay connected to what is happening around them and to interact with others [18] [19] [20].

III. A SYSTEM TO AUTONOMOUSLY ASSIST IN SOCIAL ACTIVITIES

This prospective proposal has the objective of design and implement a system to monitor and support users with age related limitations, in order to promote their daily well-being. Most times, these users are living in an institution and have health limitations affecting their social activity. They also have limitations on using modern information and communication based equipment. This systems aims to overcome those limitations by promoting and reinforcing the bonds between the user and the elements of his family and friends group with the usage of information and communication technologies.

The software system should enable autonomous equipment to recognize and interact with the users, according to their state of mind and the specific momentary context. The main features should provide the ability to identify the users and have a set of interactions to inform the users about the everyday life of their family and friends group. It should promote interactions with them in order to mitigate the tendency for social isolation and its negative consequences.

Due to the user's limitations, the system's user interface should be designed by following the adaptive interfaces paradigm [21] in accordance with the user profile and the context. It should use simple interactions, based on natural language [22], in order to be user friendly to the expected age group.

The system is meant to be installed in autonomous equipment, such as autonomous robots or consumer appliances,

and should be tested in elderly care institutions, such as social support centres, where users are admitted as residents. Specific testing plans should be designed as intervention plans suited to test the equipment and the software in order to evaluate their suitability and feedback the system development project.

This assistive system should forge a new type of relationship with the users by maximizing their social activity and maintenance of the relationship with their family and friends social group, which is often degraded due to the user's limitations and institutionalization.

IV. METHODS

The teams working on the system development should have two distinct backgrounds: software engineering; and health care. The work should be done in short, interactive, cycles, in which the healthcare team should validated the requirements; verify the usability of the developed features; and test the features with real users. The software engineering team should develop the system using the state of the art technologies, following a user centric development method in order to meet all the usage requirements, related to the user's limitations [23] [24].

The development and implementation of this system should have two main phases. A first phase, focused on software development and a second phase, focused on the field tests

In the first phase it should be designed and developed the system software, with the necessary features in order to accomplish the main objectives. The main areas of software development will be related to:

- Image acquisition and analysis, for the users identification and state of mind recognition;
- Application design with databases and social media APIs, for the development of the user activities;
- Natural language and adaptive user interfaces, for the development of the system's user interface;
- Remote equipment management, for the planning and execution of the equipment deployment during the field tests.

The software development should be executed using agile methods in an incremental process. In this phase, the healthcare professionals should be part of the team in order to create the requirements and specifications as well as to monitor the development results.

On a second phase, the focus should be on the field tests and the monitoring of the system usage by the real users. Some development will still be necessary in order to adjust and develop some features accordingly to the users monitoring feedback. In this phase, a strong effort should be done to monitor the users in different usage contexts.

The autonomous equipment should be adapted for usage in the testing institutions, including the necessary adjustments for the remote management of the equipment.

V. REQUIREMENTS AND FEATURES

The system should provide a set of basic functionalities, features or requirements, related to the interaction with the users, namely: user identification; state of mind assessment; current context; personal information retrieval; a set of activity proposals.

To identify the user, assess his of state of mind and his current context, in order to choose a suitable activity proposal. The user identification and state of mind evaluation will be based on image acquisition and analysis, after which the system should retrieve the user profile and decide on an activity proposal. The activity proposal could be as simple as a personalised greeting or a more complex interaction, according to the current context and the user state of mind.

The context, personal information and state of mind, should include information about: gender, age, special needs, personal preferences, time of day, time of year, physical location, state of mind (sadness, joy, etc.), etc.

The interactions with the user should be developed as a set of activities that can be proposed and executed with the user. Some activities to be developed are: (1) Basic greeting; (2) Email management; (3) Social Network management; (4) Social and family events management; and (5) Social games.

- The basic greeting activity is a simple greeting interaction, in which the system greets the user accordingly to the state of mind and context of the moment.
- The email management activity should provide a personal email box to each user and inform the user about the current messages status. In particular dates, such as family anniversaries, the system should offer the user a chance to send a congratulations message.
- The social media management is a more sophisticated activity in which the system monitors the user group of family and friends, regarding their activity in the social networks, e.g., facebook, twitter, Instagram, etc., and informs the user about relevant updates.
- The social games activity has the objective of adapt and create a set of social games, e.g., cards, trivia, etc., that the user can play in the system.

The email and social media management are specially targeted to strengthen the user bonds with the elements of his family and friends. The user should be kept up to date with the course of lives of his friends and family and the systems should provide opportunities for the user to interact with those person on the social media networks. In

is described the basic workflow of an interaction with a user. As previously described, the system engages with the user and based on the available data about the user and the current context, it proposes an activity in order to forward an interaction.

The set of features should be extensively tested with real users in order to evaluate their tangible contribution to the main objective and their usability, considering the user interface and

the user's limitations. So, a series of interventions plans should be created in order to test the system and the equipment in several real scenarios, together with partner institutions. For each intervention, a specific plan should be created, considering the specific conditions such as: the user's characteristics; the context of the hosting institution; the technical resources available.

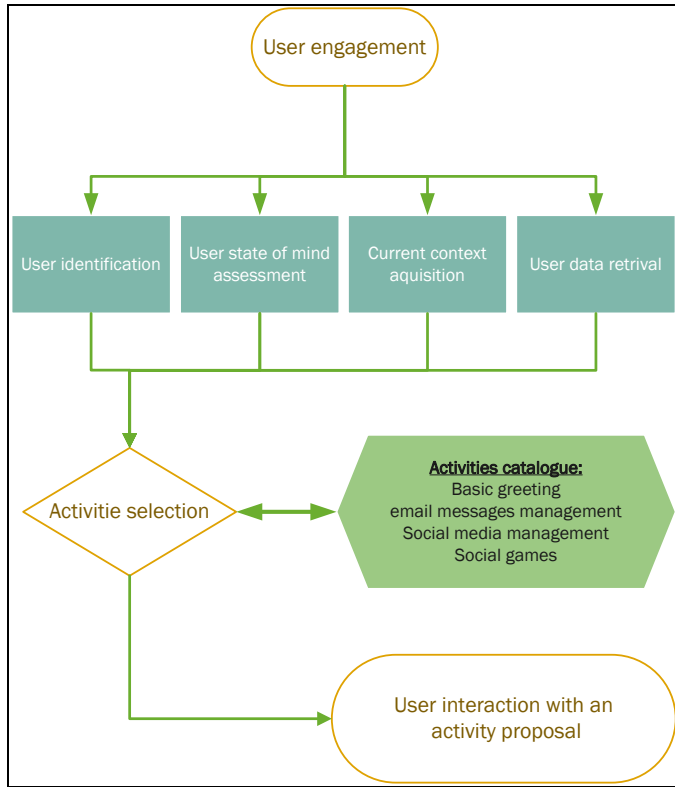


Fig. 1. System workflow

VI. CONCLUSION

In

is presented the general systems workflow, regarding an autonomous user interaction. Although it is a simple workflow, the strict software implementation depends of a diverse set of concepts and technologies. The field tests and implementation, with real users in real institutions, are a main care endeavour and its constant feedback is determinant to the success of the system development.

The success of this proposal is dependent of two main fiends of study: software engineering and elderly care. In such a sensible context, of elderly users with age related limitations, the subtle details of the system, in particular the user interface usability, are paramount and an excellent multidisciplinary team management is necessary. In TABLE I is summarized the features and the related research areas that the software system combines.

TABLE I. FEATURES AND RESEARCH AREAS

Features	Research areas
User identification	Image processing (face recognition)
State of mind assessment	Image processing (emotion detection)
Context acquisition	On-line services APIs Localization services Image proecessing (Object detection and recognition)
Data retrieval	Databases
Social media related activities	Social media APIs
Social games	Gaming and Serious games
Natural language user interface	Adaptive interfaces Natural language

The success of the features implementation must be assured by a user centric development with the continuous participation of the health care team elements. They should also act on behalf of the users in order to assure a user participated development.

This system proposal is intended for usage with autonomous systems such as robot devices, but it can be adapted and incorporated in other user appliances, such as set-top tv boxes or even mobile phones. We didn't refer to a system architecture, but in a real systems, with an extensive catalogue of user interactions and activities proposals, it should be considered the usage of a cloud backend implementation and a user device front end.

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