iCarer Project: Intelligent Care Guidance and Learning Services Platform for Informal Carers of the Elderly

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Abstract

The increasing ageing population is demanding new care approaches to maintain the quality of life of elderly people. Informal carers are becoming crucial agents in the care and support of elderly people, which can lead to those carers suffering from additional stress due to competing priorities with employment or due to lack of knowledge about elderly people's care needs. Thus, support and stress relief in carers should be a key issue in the home-care process of these older adults. Considering this context, this work presents the iCarer project aimed at developing a personalized and adaptive platform to offer informal carers support by means of monitoring their activities of daily care and psychological state, as well as providing an orientation to help them improve the care provided. Additionally, iCarer will provide e-Learning services and an informal carers' learning network. As a result, carers will be able to expand their knowledge, supported by the experience provided by expert counsellors and fellow carers. Additionally, the coordination between formal and informal carers will be improved, offering the informal carers flexibility to organize and combine their assistance and social activities.

1. Introduction

Nowadays, the increasing ageing population makes customized care necessary to maintain the quality of life for older adults at home. As modern societies recognize their commitment to taking care of elderly citizens, new and innovative models of care must be deployed, in which informal carers play a crucial role as one of the most important sources of care for older adults [1].

Prolonged home-based care of elderly people typically involves informal carers (often a spouse or close relative), who run the risk of developing depression, stress or other symptoms of over-work themselves [2]. The informal carer supervises the patient's daily activities, spends a lot of time with him/her and assists in the care process. In addition, they may not be adequately prepared for some situations, causing increased anxiety. Thus, support and stress relief for carers should be a key issue in the home-care process of these older adults [3].

The use of ICT can provide new approaches that carers could employ to satisfy the growing demand for attendance and support [4]. However, these solutions should be tackled from a holistic perspective to address the problems that informal carers suffer. Their quality of life can be improved by detecting their stress at an early stage, improving the assistance they provide and increasing their sociability. Moreover, the informal carer has individual characteristics which have to be considered when a solution or service is offered to them.

Consequently, the *iCarer* project proposes the design and implementation of a cloud inspired platform which will offer informal carers support to decrease the stress they suffer and improve the quality of care they provide and hence their quality of life. The platform will monitor the informal carers' psychological state and the "Activities of Daily Care" (ADC), in order to detect the early signs of a carer's distress. Moreover, a learning service with sharing and management contents capabilities will allow the informal carer to improve those activities which currently cause them significant stress. Additionally, with the aim at decreasing the stress and worry when the informal carers are away from the older adult's home, the *iCarer* platform will monitor the older adult's activities of daily living (ADL), guide them to a correct action when a problem is detected and notify the informal carers.

The platform's end-users will be clustered in two groups: informal carers living with elderly adults (co-residents, commonly another elderly adult) who suffer cognitive impairment at any stage (from mild to severe); and carers

who don't live with them (non-residents) but assist them periodically and require support to improve the quality of the care they provide.

2. Related works

Currently, there is significant potential for new technologies to enhance the lives of elderly people and their carers. As a result, several ICT platforms [5-7] have focused on checking the older adult's actions, identifying potential dangerous situations and warning their carers. These can relieve the burden on informal carers thanks to the real time notification of problems occurring with the older adult. However, these ADL monitoring solutions identify the older adult as their unique target user, treating the informal carer as a mere recipient of information about the older adult's state. Moreover, the older adult remains dependant on the informal carer's assistance, as the system only provides a notification to the carer without offering any assistance to the older adult to cope with the problem. Other ICT solutions [6-9] allow informal carers to interact between themselves through social networks, sharing experiences to reduce distress and their feelings of loneliness. Some of these solutions [8, 10] do not provide the informal carer with personalized support aimed at coping efficiently with the burden caused by taking care of the older person.

Considering the weak points of the solutions reviewed, the *iCarer* project is intended to address the support of elderly ADL performance as well as informal carers ADC through an holistic approach. In contrast, *iCarer* combines monitoring services with information resources and e-Learning services, providing informal and formal carers with the information and knowledge necessary to make informed choices about their care activities. *iCarer* will also provide a connected care experience where carers are able to contact other carers and share resources and information about the care they should provide, the skills they need and the best techniques to manage the stresses related with their caring responsibilities.

3. Objectives

Considering the contextual situation of the elderly and their carers, the *iCarer* project proposes a personalized and adaptive platform to offer informal carers support by means of monitoring their activities of daily care and psychological state, as well as providing an orientation to help them improve the care provided. Monitored information will be registered by means of home-installed and personal sensors, which will be as inconspicuous as possible for the house inhabitants. Registered data will be analysed and fed into the platform in order to model the Activities of Daily Care (ADC) based on behavioural patterns. With this information, and if the informal carer is absent at the time, the platform will act as a "virtual carer", giving support to the older adult and providing information to the carer in case a daily activity is done incorrectly. Additionally, *iCarer* will provide e-Learning services and an informal carers' learning network. As a result, carers will be able to expand their knowledge, supported by the experience provided by expert counsellors and fellow carers. The coordination between formal and informal carers will be improved, offering the informal carers flexibility to organize and combine their assistance and social activities.

4. Platform and service description

In order to achieve the previous goals defined, the *iCarer* platform will be composed of a suite of modules which provide the different services to support the informal carer, as shown in Figure 1 and described below.

4.1. Intelligent & Interaction Monitoring

The *iCarer* platform provides a monitoring environment where the assistance tasks which carers provide (ADCs) are monitored to detect early symptoms of burden and stress. With the intention of increasing the informal carer's peace of mind when they are not at the older adult's home, *iCarer* will monitor the older adult's ADL in order to supervise their performance and detect possible problems.

Project	Intelligent Monitoring	Guidance & Orientation	Virtual Carer	eLearning (Care Contents)	Informal Carer Networks	Carer Coordination
Remote[5]	✓	-	✓	-	-	-
Agnes [6]	✓	-	✓	-	✓	-
PeerAssist [7]	-	-	✓	-	✓	-
Caregivers in Touch [8]	-	-	-	-	✓	-
Aladdin [9]	✓	-	-	-	✓	✓
LivingLab 4 Carers [10]	-	-	-	✓	-	-
iCarer	✓	✓	✓	✓	✓	✓

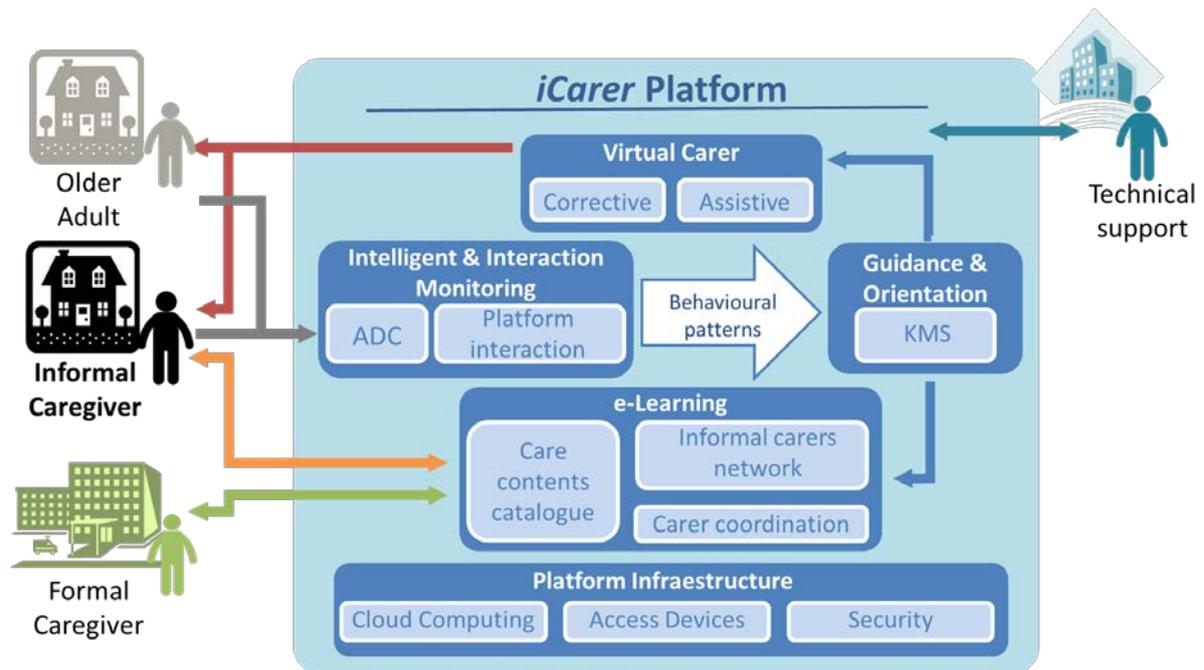**Table 1.** *Reviewed projects aimed at supporting informal carers (✓: supported; -: not supported)*

Figure 1. iCarer platform architecture

As a technological approach, one of the main issues to achieve in the *iCarer* platform is the unobtrusiveness of monitoring the tasks. Therefore, the sensors employed in the monitoring environment (motion sensors, room occupancy, bed sensors, electrical appliance usage sensors, etc.) will be distributed in the older adult's home and transparently register the actions that carers and the elderly perform.

After analysing the data monitored, a behavioural pattern of both informal carers and older adult will be inferred. In the case of the informal carer, the behavioural pattern will be combined with psychological stress measurement questionnaires to determine assistance tasks which generate significant burden and stress. On the other hand, adult's behavioural patterns will be automatically generated in order to automatically detect problems in ADL execution. Both behavioural patterns will be sent to the "Guidance & Orientation" module to decide the actions to be performed.

4.2.   Guidance & Orientation

Once the behavioural patterns have been sent from the monitoring module they will be processed in the guidance module with the aim of detecting possible problems in the informal carer's ADC performance and any stressful situations. As a result, suitable guidance will be generated to improve the activity of the informal carer. The Knowledge Management System (KMS) will be responsible for deciding the most appropriate recommendation to the informal carer depending on their needs or preferences. When the carer is not at the older adult's home, possible problems may occur during the older adult's ADL execution. These will be detected and guidance will be provided to the older adult to correct that problem.

The KMS will personalize and adapt the guidance provided by means of an ontology which manages knowledge about the platform users' profiles. If the behavioural pattern belongs to an informal carer the generated guidance will be sent to the e-Learning module to provide the informal carer with contents according to the guidance proposed. In the case of the older adult's behavioural pattern, the virtual carer module will receive such guidance.

4.3.   Virtual Carer

The *iCarer* platform through the "Virtual Carer" module proposes a service to automate the caregiving process reducing the carer's burden and providing, at the same time, an alternative solution to the older adult when they are alone at home. Once the older adult's behavioural pattern is inferred and a problem or mistake is detected in ADL performance, the "Virtual Carer" will provide the older adult with feedback for correcting or enhancing their ADL execution. There are two types of assistance that the "Virtual Carer" will provide. Firstly corrective feedback to the older adult will suggest actions which will correct deficiencies in ADL execution. Secondly the assistive feedback will provide the older adults with recommendations to promote and improve their ADL. In addition to assisting the older adult in their ADL, the "Virtual Carer" will notify the informal carers about problems experienced by the older adult.

4.4.   e-Learning

Based on the informal carer's psychological state and the carer's ADC performance, a selection of personalized informal e-Learning contents will be recommended to the carer in order to reduce their workload and improve the effectiveness of the provided care. Contents about psychological and assistance support techniques will be provided to help informal carers to address cognitive, functional, behavioural and personality changes, especially disorders, of their elderly relatives. Contents provided will be adapted and personalized depending on

the assistance tasks that most heavily burden the informal carer. The e-Learning module will offer intelligent management of contents by allowing informal carers to be provided with contents depending on their preferences and needs. Moreover, free browsing through the library of available contents will be also possible. Additionally, an authoring tool will be provided to informal carers for creating and editing contents about the assistance tasks informal carers perform.

Apart from e-Learning contents access, informal carers will be able to share contents through an informal learning network. The informal carers will be able to contact other users, sharing experiences and creating an informal carers community. To supervise the access to contents and the participation of informal carers in the learning network, there will be a forum manager (a role performed mainly by a professional carer). Moreover, as a support service to the informal carers, the *iCarer* platform will offer a coordination and management service to allow carers to work collaboratively in their care duties by sharing their care schedules and coordinating with their older adult's activities. A "case manager", performed by an informal carer, will coordinate the assistance appointments or tasks with the older adult's availability as well as other carers.

4.5. Platform infrastructure

The use of cloud computing as an underlying architecture technology to support the *iCarer* platform allows distribution of data management and processing load across the network. Services provided by the *iCarer* platform will be accessible from any device capable of connecting to the cloud. Additionally, cloud computing will eliminate the need for informal carers to keep their hardware and applications constantly up to date. Finally, the cloud architecture must guarantee the confidentiality when handling sensitive user information.

On the other hand, the devices used to access the *iCarer* platform's services will be mobile devices (tablet and smartphones) and computers.

5. Conclusions

According to an increasing demand of new elderly care approaches and a necessary support for informal carers, the *iCarer* project proposes a platform to guide the care assistance by providing learning contents and coordination mechanisms with the aim of reducing the workload and stress levels suffered by carers.

Therefore, the carer's Activities of Daily Care are monitored with the aim of detecting problems in the care they provide and the reason for possible burden suffered. Depending on the situations inferred from the data monitored, a set of suitable learning contents will be provided. Furthermore, a carer's coordination service is offered to enhance the assistance that different carers provide to a specific older adult. The *iCarer* platform will also supervise the older adult's ADL performance, detecting possible problems and offering appropriate guidance for improving the situation. Finally, a holistic approach combining both carer and older adult situation is

taken by *iCarer* taking into account the personal characteristics of their users. To achieve this an ontology models platform user profile which will be employed to personalize and adapt the *iCarer* services.

Currently, the project is identifying the functional requirements by means of a set of meetings with informal carer associations. Next, a technical design will be performed to develop services described in this article.

Acknowledgements

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