Towards Building Virtual Community for Ambient Assisted Living

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Abstract

Elder people are becoming a predominant aspect of our societies. As such, solutions both efficacious and cost-effective need to be sought. This paper proposes a design to construct a virtual ambient assisted living community where dwellers make contributions to the community so as to best utilize resources and minimize costs. We use service oriented architecture (SOA) to orchestrate the available resources inside the community, thus bringing social intelligence to the social computing. We also propose building such a virtual community making use of virtual reality and in the form of serious game [10]. Daily activities and instruments (such as sensors, cameras, etc.) in real-life may be translated into their virtual community equivalents, and activities happening in the virtual world will trigger corresponding actions in the real world, so that inter-reality may be obtained through this virtual community. We expect such a virtual community could help not only efficiently utilizing the social resources in maintaining the independent living of the elderly people, but also helping these people maintain their connections to the society and bring them entertainment, so that the quality of their living standard may be improved at the same time.

1. Introduction

As well known, the proportion of elderly people keeps increasing since the end of last century. The European overview report of Ambient Assisted Living (AAL) investigated this trend [1]. The studies of EUROSTAT [2] indicated that the share of the total European population (EU 15) older than 65 is set to increase from 16.3% in 2000 to 22% by 2025 and 27.5% by 2050, while that over 80 (3.6% in 2000) is expected to reach 6% by 2025 and 10% by 2050.

Studies of Counsel and Care in UK found out that elderly people would prefer to live in their own house rather than in hospitals, thus they need support to remain independent at their home [2]. And researches also found that remote clinical therapy at home will not bring negative effect to the therapy process [3]. In order to improve the quality of life for the elderly and disabled people, it is important to guarantee that assistance to those people is timely arranged in case of need.

Assistive devices are developed to facilitate the daily lives of these elderly and disabled people. But assistive devices also have their limitations: For instance, in the AAL country report of Finland, it was remarked that “the (assistive) devices are not useful if not combined with services and formal or informal support and help” [4].

We share this view and deem that human resource is still indispensable. We have developed a design tool to evaluate performance of informal carers in so-called mutual assistance communities [5], i.e. communities whose members may request assistance and at the same time get motivated to play the role of caregiver. Simulations have shown that informal carers are indeed capable to contribute effectively to the community welfare. We have also introduced the “participant” model to encourage the elder people to participate in group activities they are able to, and changing their role from passively requesting to actively participating [6].
The simulations also demonstrate that the participant model can help to effectively utilize the social resources and increase social connections.

As our preliminary investigations illustrate, coordinating the requests of the elder people in a community view is the best way to utilize the social resources. Hence we have developed an infrastructure using service oriented architecture to build up an ambient assisted living community by processing formatted service requests [7]. In order to implement this infrastructure and get high user recognition, we are carefully selecting appropriate social computing software to implement this infrastructure.

With the development of internet and web technology, social computing is raising its popularity in the past years. Tools such as instant messaging, internet forum, web blogs, wikis, and collaborative real-time editors are helping to establish the communications between individuals, and building up “communities” online [8], which help to increase the communication between people, and the exchange of information between users. However, most of the interfaces of the current social computing software are still far away from the look and feel of a real community – people communicating with this current social computing software still do not have the feeling of communicating in a real community.

A noteworthy exception is the case of so-called virtual environments (VE). Virtual environments, also called as virtual reality, is a technology that builds interactive computer generated environment and allows user interact with each other through “avatars” [9]. Most of the VE systems developed in the last century are human-computer interfaces that provide 3-D synthetic environments with multi sensory and feedback, such as VE for pilot training. In the past decade, virtual environment is transitioning into work influenced by (and influencing) video games. In the paper published in IEEE Computer in 2005 [10], Zyda looks ahead into the future of using virtual reality to develop serious games. He described serious games as games where users play in accordance with specific rules that use entertainment to further training, education, health, and strategic communication objectives.

As serious games built with virtual reality technology provide a comfortable human-computer interface, at the same time entertaining the users while supplying them with knowledge, we decided to adopt the form of serious game to build online virtual community to implement our proposed mutual assistance community. This paper describes our prototypic implementation of this concept.

The rest of the paper will be organized as follows: in Section 2, we will introduce the community structure for ambient assisted living. The implementation of this model by virtual community will be introduced in Section 3. Conclusions will be given in Section 4.

2. Mutual assistance community

As mentioned in the introduction, our previous research shows that constructing an ambient assisted living community to provide health service to the elderly people may be an effective approach to save considerably the social resources. This conclusion was
reached by extensive simulations of the effects of such a community. In this section, we introduce the design of such a mutual assistance community with the infrastructure of service oriented architecture.

The structure of the proposed community is shown in Fig. 1. Assistive devices will be deployed to construct a smart house environment around the assisted people. The assisted devices will be managed by a local coordinator.

The most important asset integrated in this community, we think, is the people themselves. The community allows disparate technologies and people working together to helping people who suffer from aging or disabilities. People who are able to provide services are encouraged to do so and assist the requesting people as informal carers. Elder people are also encouraged to participate in the group activities, which not only helps to maintain physical and psychological health but also reduces the requests of professional medical resources. Professional carers (such as doctors, specialists etc.) are included in the community to provide emergency and professional medical service. And even commercial vendors are included in, which brings convenience to the user and diversifies the service type, at the same time laying the foundation for economical exploitation. The availability of services will be published as OWL-S services, and the requests of services will be processed with semantic service matching tools. The process of sending requests, receiving help, or organizing group activities are executed by the software infrastructure in the service oriented approach.

Based on our previous analysis, we designed a software architecture, which is shown in Fig. 2, aiming to provide an efficient infrastructural support for building AAL community. It consists of the following infrastructure services which act as basic service components:

**Service Registration**

Service providers register their services in directories along with profiles that describe their various relevant capabilities and characteristics. In order to perform the semantic discovery service, service registry should be extended so as to contain semantic service descriptions.

**Semantic Match Service**

The Semantic Match Service (SMS) is responsible for semantic processing, reasoning and matching the request to service by employing ontology reasoning. Normally, this service consists of a semantic service reasoner and an ontology-based Knowledge Base (KB). The semantic service reasoner has the functionality of providing deduced ontology information from the ontology service descriptions and the KB. The KB consists of a set of sub-domain ontology in the different domains.

**Service Binding**

After the SMS and scheduling Service, if suitable service providers are present in the service registry, the binding service will provide a scheme to sign a “contract” between the service requester and service provider.

The above mentioned three components are key components to deliver services in the community. In the mutual assistance community, people who are able to provide services are encouraged to get their service
Figure 3. Screenshot of Second Life

registered. People who are requesting services or proposing group activities get their requests processed in the coordination center by the SMS service, and if required service is available, obtain confirmation with the service provider by service binding.

3. Implementing the Virtual Community

In Section 2, we introduced the organization of mutual assistance community and sketched its software architecture. By building that architecture, we can translate the user’s requirement in daily life into a format suitable for computer processing. The purpose of building such a mutual assistance community is not only to save the medical resources by utilizing the potential spared resources inside community, but also to keep the elderly people inside the community, to increase their interactions with the outside world, so as to reduce their feeling of loneliness, and to keep them psychologically healthy. In this situation, the interface of our proposed virtual community is quite important – it should resemble as much as possible real life and bring our users the feeling that they are communicating with a real community. In this section, we will introduce some developed virtual community, and how we intend to reuse these existing works to build our mutual assistance community.

3.1 Current virtual communities

Second Life [11] is one of the most popular 3D online digital worlds (communities) with more than 7 million people inhabiting in from around the world. Users of Second Life are preferred to be called as inhabitants rather than players, and they build and own their “world”. Inhabitants in Second Life buy lands and build their houses on; develop their own digital creations for trade, and communicate with others. Fig. 2 is a screenshot of Second Life. Communications between inhabitants in Second Life is similar with the communication in physical life. Moreover, the economical transactions in Second Life are based on so-called “Linden dollars”, and this virtual money can be converted into US dollars.

Second Life is reaching an ever larger success in creating a virtual world imitating the real one, but it is still purely virtual – the activities happening in the virtual world are still detached from those of the real world, except for converting the currency.

There are also other serious games using virtual reality to build communities. Such as the Utrecht Blog [12], has built the 3D model of the city and users are guided around the city and paint the buildings. The NeuroVR [13] is a cost-free virtual reality platform based on open-source software. In the editor mode of NeuroVR, clinical professionals could create the virtual environment for psychological treatment. The weakness of the Utrecht Blog and NeuroVR is that the user can only interact with the environment but there are no communications between different users.

Despite the mentioned inadequacies, these frameworks have made many great achievements: Second Life provides a perfect community model for communication between different users, and create virtual creations (such as virtual vehicles, etc.); the
Utrecht Blog translates the real buildings in city into virtual environment; and the NeuroVR reached success in psychological care. We are inspired by such tools to build up a virtual community which provide rich communication with users, be customizable, and most importantly, entitle it with the ability to interact with the physical world, which is called “inter-reality”.

3.2 Virtual Community for Mutual Assisted Living

The prototype of the virtual community we propose for mutual assisted living is based on the organization we showed in Fig. 1. We will emphasize the interactions between the physical and the virtual-life.

3.2.1 Customizable smart home environments

Users of our virtual community will have their home in the virtual world. Such home environment will be highly customizable, and could profit from the current researches on building smart houses in ambient assisted living.

Many researches aim at building intelligent environments around people who need assistance, such as Aware Home [14], Smart In-Home [15], I-Living [16]. The common feature of these researches is to deploy wireless devices to detect the status of the occupant, collect these data by an intelligent terminal, and trigger consequent actions. Devices such as RFID, motion or fall detectors, etc. are used to accomplish tasks such as activity reminding, health monitoring, personal belonging localization, emergency detection, and so forth.

In the proposed virtual community, we also propose to build up smart environments around the elder people in physical life, but we are also proposing to translate the information obtained from these smart devices into the virtual world, through inter-reality management. We have developed a prototype of adaptive feedback-loop control systems to realize the inter-reality management [17]. The data retrieved from sensors will be analyzed by computers which will trigger an alarm when the monitored people are assessed to be in danger, e.g. because the motion detector found the user is standing still in the kitchen for more than 5 minutes. Users may choose to install sensors based on their requirements. By building such inter-reality smart environment around elder people, their safety is strengthened with the people’s help from virtual community, e.g. an alarm signal may be observed by the community master and the neighbouring residents. Video cameras may also be installed in the smart environment, so that authorized people, such as the children of the elder people, may observe their movements.

When the users are building their “smart home”, they should be required to specify their location, and people from the same location should build their “virtual house” in a nearby area, so that the neighbourhoods in the virtual community are also living nearby in the physical world. This will help to publish the real-world requirements in the virtual environment, and bring the virtual activities into the physical world. The users are not necessarily to expose their real streets name and house numbers to all the other users – this information shall only be available to residents through their authorization, for privacy concern.

3.2.2 Elder people in the community

When people are getting old, a relevant source of frustration comes from their losing physical strength, but what torches them most is in psychology: they are becoming a passive consumer of the society rather than active creator, thus they are losing their self-esteem. Also because of their immobility after retirement, they are probably suffering from losing their social network and becoming isolated.

These problems are well addressed within the proposed virtual community. In the virtual community, the powers are not coming from physical strength, but from the creativity and knowledge, and the level of activeness to communicate with others. Elder people may use their knowledge to regain their self-esteem in the virtual world. They may teach the youth, and find their “second career” in the virtual community.

In the proposed virtual community, requests from the elder people are taken care of by other inhabitants and the master of the community, and fulfilled in physical life. But due to the health conditions, some of the requests are impossible to realize, such as traveling to some places where he/she had good memories as a youth, etc. These requests may also be realized in the virtual community by taking a virtual tour. The virtual community we intend to build is to deliver services in the physical world to elder people, and bring them entertainment. If requests can not be realized in the physical world, with our system we have the chance to reformulate it in a virtual context, where physical abilities are less important. By doing so the self-esteem of the people is improved.

4. Conclusions

In this paper, we proposed the prototypic design for building a virtual community for ambient assisted
living. Its most significant characteristic is the inter-reality, that is, the interactions between the virtual world and physical world. Requests in the real world may be published in the virtual world; agreements made in the virtual world should take effect in the real world. Inhabitants in the virtual community are encouraged to provide their help to the people in need and their avatars may increase their moral image by making such contributions. Helps provided by these informal carers may greatly reduce the burden on medical resources and thus on society. Requests and providers of services are organized by service oriented architecture. Assistive devices will be installed around the needed people in the physical world, and the information collected from these devices will be analyzed in the virtual world and act upon the corresponding avatar in the virtual world.

Through activities in the virtual communities, elder people will receive services in the real world. Besides maintaining their physical health, the psychological health will be greatly improved by playing in such virtual community. Their social networks are maintained and may even expand through activities in the virtual community. Their knowledge is valuable to help them build good image of their avatars, and they can also make their contributions to the other inhabitants with their experience. Activities that they are not able to take in the physical world may be realized in the virtual world, so that they are psychologically satisfied.

In conclusion, the proposed virtual community will be built based on the interaction between virtual and physical world. It will greatly reduce the dependency on the limited medical resources by the contributions from community inhabitants. Elder people will be kept healthy both physically and in their psyche, and they will also make contributions to the community. Such a community is powerful with collective intelligence from every inhabitant and will greatly reduce the need for public resources.

Further work will focus on developing prototypic implementation using open source software and exercising it in real-life settings.

5. References


[2] Counsel and Care, Community Care Assessment and Services, April, 2005.


