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# Enhancing Social Interaction in Elderly Communities via Location-Aware Computing

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**Abstract**

We describe a project, now in its early stages, to develop assistive technology that can facilitate increased social integration in residents of assisted living facilities (ALFs), including residents with mild forms of cognitive impairment. Many older adults face shrinking social networks, which can result in social isolation that may be exacerbated by relocation to an ALF. To address this issue, we are exploring technology that uses wireless sensor networks to track the location and co-location of ALF residents, using the collected data to construct social network models, and then analyzing the models to provide input to a system that gives personalized real-time “prompts” to users. These prompts will suggest that they participate in activities that may be of interest and/or may currently involve the participation of other residents in their emerging social network.

**Keywords**

Assistive technology, social networks, wireless sensor networks, location tracking

**ACM Classification Keywords**

H.5.2. Information interfaces and presentation (e.g., HCI) --- User-centered design, J.4 Social and Behavior Sciences --- Sociology

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## **Introduction**

Social participation and interpersonal relationships are quite important to the physical, mental, and emotional health of older people. Studies show that social involvement has a positive effect on elders' emotional well-being and physical health and predicts a lowered risk of death [4,5]. Elders of advanced age (over age 80) often lose potential benefits of social participation and relationships through reduced opportunity. The size of their social network shrinks through decreased social ability caused by cognitive impairment, the death of friends, and/or relocation to a retirement community, assisted living facility (ALF), or nursing home [7]. Our interest lies in creating assistive technology that can increase the social integration of ALF residents, some of whom may have mild cognitive impairment.

To achieve this goal, we are investigating technology that deploys wireless sensor networks to track the location and co-location of ALF residents and then constructs a social network model. Social network theory [14] is then employed to analyze the models, to derive information that enables the automated generation of personalized real-time "prompts" that suggest to a user that he or she might participate in a particular activity. The activity might be inferred to be of interest to the user, and/or it might currently involve the participation of other residents in their emerging social network. We expect users to be most responsive to intervention that is aligned with their own interests and social relationships. The tracking technology will also enable us to evaluate our system's effectiveness.

## **Motivation**

ALFs are an attractive living option for many older adults, as they can help ensure that an elder's needs

are met, in a less medically-oriented setting than a traditional nursing home. However, the move to an ALF can be quite disruptive to a person's social network. Friends typically provide essential emotional support for elders [6,15], thus declining social interaction poses challenges to maintaining good mental health, well-being, and self-identity.

One source of difficulty for ALF residents may be mild forms of cognitive decline, which can result in decreased social skills, including reduced initiative in making new friends [1,13]. Physical proximity is known to be an important factor in the formation of these friendships [3,10], as it increases casual contacts and conversations that build viable friendships [8]. Consequently, an intervention aimed at repeatedly bringing elders with similar interests and common friendships into close proximity may be of significant value in fostering new friendships that can contribute positively to health and well-being.

## **Building and Using Social Networks**

Understanding the structure of social relationships in an ALF can help us in the design of technological interventions in several ways. First, it can enable us to identify the people who are most likely to benefit from the technology: the "low social participators". For example, we are investigating the approach of "turning on its head" social networking research that has been applied to marketing, where the goal is to determine how to apply advertising so as to maximize the spread of influence throughout the network [9]. We can reverse the procedure used in that work to identify those ALF residents who minimize the spread of influence; we hypothesize that these will be the residents who are most socially isolated.

Second, a social network model can provide information useful in determining when and how to prompt or interact with a user. For example, we can analyze the social network to identify not only the friends of a given individual, but also cliques of friends. This information can then drive the suggestions that an individual participate in activities: for instance, recommending not only activities in which current friends are participating, but also friends of those friends. Social network researchers have studied link prediction problem of networks [11], and this technique could allow us to encourage social relationships that have not yet developed, but might be likely to develop, based on the network structure.

Finally, social network models provide us a means of evaluating our system: we can assess whether the social roles of individuals change in a positive manner as a result of their use of the system.

In the past, modeling social networks typically required extensive direct observation by a researcher, along with the use of surveys and questionnaires that asked individuals about their social contacts. More recent research has instead considered the use of a variety of sensors that are deployed in the environment and/or worn [12]. In our project, we are restricting ourselves to very simple sensors—location-tracking devices. In particular, we are employing a commercial software package [2] that performs location tracking by measuring and analyzing the signals it receives from wireless-access points in the environment. The tracking system can be deployed on handheld computers (personal digital assistants) that are carried by the ALF residents; these handheld devices also serve as the platform on which prompts are delivered.

A key research question is the quality of the social network models that are produced using the sensor data: will they be accurate representations of the actual social situation? An early effort in our project will be to assess the quality of the networks produced, by comparing them with networks constructed using more traditional methods, including questionnaires given to ALF residents and their caregivers. Although similarity between the two models is one evaluation metric, we will also evaluate our model based on its success in supporting our intervention system. If a particular social network model more positively influences social interactions, then it can be considered a successful model, regardless of how it compares with the survey-based network.

### **Intervention Tool**

The intervention tool we construct must have an interface that is extremely simple to use, given that some residents may be cognitively impaired. Additionally, the prompts themselves must maximize the likelihood of user response, and must be designed so as not to appear irrelevant, and, hence, annoying.

The decision of which events to prompt the user for will be largely based on the analysis of the social network model that has been constructed. For example, it may be effective to prompt a user to attend an activity that many of his or her friends, and/or friend's friends, are likely to attend. On the other hand, we may also want to prompt a user to consider attending an event of a type of activity that he or she particularly enjoys, regardless of the current participants. This could allow users to meet people with whom they do not currently interact, but with whom they may share common interests. The function that determines when to issue

a reminder will be dynamic: machine learning techniques will be used to infer, over time, the types of prompts that are effective *for a given user*.

### Conclusion

The relocation of an elderly person to an ALF can have a profound impact on his or her social health, which in turn can affect both physical and emotional well-being. Social isolation may be compounded when the person has begun to experience cognitive decline. We are in the early stages of a project aimed at addressing these issues by developing assistive technology that provides personalized, targeted prompts that suggest activity participation, within a very simple user interface. One key aspect of the project is its use of wireless sensor networks to observe the location of ALF residents, using this information to infer what activities they participate in and with whom; another is its use of social-network theory to analyze the sensed data; and a third is its emphasis on designing interfaces that are simple enough for use even by a mildly impaired person.

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