

An Agent-based System to Strengthen the Relationships of the Elders and their Families Living Abroad

Marcela D. Rodríguez^{1,2}, Pedro C. Santana¹, Víctor M. González², Jesús Favela³, Ángel G. Andrade^{1,2}

¹Faculty of Engineering, UABC University, México

²Department of Informatics, University of California, Irvine, USA

³Computer Science Department, CICESE Research Center, Ensenada, México
{marcerod, psantana, favela, aandrade}@cicese.mx, vmgyg@ics.uci.edu

Abstract

The aging of the population is a phenomenon faced by most nations. Growing old is often accompanied by the loss of close companionship which has been shown may aggravate the cognitive impairment of elders. From a qualitative study, key issues emerged regarding unmet needs of elder's communication that we propose to address with an agent-based communication system. This is a family newspaper through which seniors and their relatives not only maintain close social ties by sharing information, personal reminiscences and cultural stories, but enable them to exercise their minds through its entertainment section that can help to delay the cognitive decline that elders experience as they become older. The system provides elders with a richer form of communication with their relatives and facilitates their integration into the networks that currently connect members of their families who use e-mail and IM systems to keep in touch with each other. To facilitate the information capture, several autonomous agents help the user to interact with the system which can be accessed by any electronic display with a touch screen, such as a Tablet PC. By means of autonomous agents we have incorporated a reminder mechanism to enable elders and their relatives to preserve and strengthen their relationships. In this paper, we present the study that motivated the development of the electronic family newspaper, and describe its functionality.

Introduction

The aging of the population is a phenomenon faced by many nations, such as Mexico, where 7.5% of the population is 60 years or older. It is estimated that by 2030 this figure will be more than double, reaching 17.5% (CONAPO 2004). Among those elders, 10% of them live alone with no close family members around them. This condition is more likely to occur in some regions of Mexico as it is related with the ever increasing migration of one or more of their relatives to the USA. The living conditions of those elders can be quite complex as they often faces the impossibility of visiting or being visited by their families as they lack proper documentation (visas or

residency permits). And even when this is not a problem, distance and cost might reduce direct contact to one visit every other year. As it has been found, lack of contact with family members and friends may have a negative impact on elder's health, such as accelerating a cognitive decline (Morris, Lundell et al. 2003). Thus, Mexican elders in this situation face particular challenges that might aggravate some of the well known effects of living with no close companionship.

Our work aims to provide a technological solution focused on supporting the relationship between elder people living alone in Mexico and their relatives living abroad. In order to provide adequate support for this scenario we have to understand, from the perspective of those experiencing this situation, what are the challenges and circumstances around living alone for an elder person. Consequently, for the design of our solution we adopted an empirical approach and based it on a combination of interviews and in situ evaluations. Departing from an initial understanding of the context of the phenomenon, we conducted interviews that served to inform scenarios and to envision a preliminary design of the system. We then built a prototype of the solution that was evaluated by some elders and their relatives living abroad. Results of the evaluation are used to improve the design and consolidate a final and more complete solution.

The central concept of the proposed system is an electronic family newspaper, through which elders and their families: share important information; personal reminiscences and cultural stories; may interact with virtual relatives; and occasionally may interact with their real relatives. It is aimed that the electronic family newspaper will enable elders to feel more engaged and connected with their relatives living abroad as it provides richer forms of communication, and, it will facilitate their integration into the networks that currently connect members of their families who increasingly are making use of e-mail and instant messaging (IM) systems to keep in touch with each other.

Understanding elderly people

The inquiry to derive the design of the system was oriented towards understanding the emotional needs of Mexican elders with families living abroad. We wished to gain knowledge about the experiences of elders in regard to the following five main aspects: communication with relatives, feelings of isolation, health care, keeping updated with things around them such as family events, and being self-dependent.

Initial interviews

An analysis of characteristics of the elder people experiencing our target scenario feed a discussion to determine typical profiles. From there, we identified a number of individuals (4 elders) with those profiles and who were likely to share with us their experiences. We included people older than 60 years, of different gender, living in different geographical regions on Mexico, living alone, and with relatives residing in USA. Our interviews were semi-structured and were conducted within the home environment (e.g. the kitchen) following standards and recommendations for qualitative interviews (McCracken, 1988). Although this initial sample was limited we considered that it covers a rich variety to obtain an initial understanding of the conditions experienced by elders in general. More details of this study are presented in (Santana et al, 2005).

Results

From analyzing the interviews, we found that the main mode of communication with relatives living abroad was the telephone which basically is used to update each other about news and recent family events. Phone calls are not always frequent and are more likely to occur at special occasions such as birthdays or holidays or when some emergent issues arise (e.g. accidents or other major problems). All our informants expressed their preference to being in constant communication with their families, but recognized that this is not always possible. One of our informants expressed that the impossibility of communicating on a more regular basis sadness her. Those facts point to the relevance of providing appropriate mechanisms to help elders feel connected to their families. We noticed that a central component that is missed whenever families get separated is the ability to share day-to-day experiences. Many times the content of communications is limited to basic information in regards to the well-being of the persons, health, financial situation, or relevant events. However elders and their families have little chance to share the little things that sometimes make life enjoyable and they used to share when they were together: local events, conversations, to ability to see each other and other emotionally important facts. Our results also highlighted the importance given by elderly people to photo albums. It is a real treasure to

them. One of the interviewed seniors commented: "Our grandchildren love to look at the album and asks us what her mother used to do when she was a kid". Moreover, they intend to acquire a video camera to record all the visits of their relatives. This showed us that pictures are artifacts from which we could take advantage of, due to the stories and emotive load associated to them.

Finally, it was interesting to find that those interviewed elders show disposition to engage in learning new things. As a way to keep them active, some of them are taking courses (e.g. English lessons). Similarly, another person is going to elementary school and is very proud of her achievements and motivated to continue her studies for as long as she can. This disposition to learn can be very relevant for the purposes of introducing any technological solution.

Based on these findings and our preliminary understanding of the phenomenon, we engaged in designing a system to support the emotional ties among Mexican elders and their families living abroad, focusing on a way to enhance their communication. Our approach is described in the following section.

Design Decisions

As a result of our analysis, we envision that to ameliorate the loneliness of Mexican elders, a system needs to provide the following functionality:

Enable elders and their family to feel close and maintain contact in an entertaining way. We envisioned an electronic family newspaper to help users to share information, such as personal memories, anecdotes, or traditions that elders would like to transmit to their younger relatives, or vice versa, the family residing abroad sharing the new customs they have adopted. The information transmitted through the family newspaper, is categorized in different sections. For instance, in the social section the family may publish photos or a video (e.g. a graduation ceremony of one of the grandchildren). The entertainment section provides activities for elders, such as a memory game, in which the elder may play with a virtual relative.

Encourage elders and their families to maintain contact. As found in our study, elders and their families used to communicate more frequently at the beginning of the separation. For this, we are exploring to use a reminding mechanism that makes users aware of the last time they posted information to the newspaper, and then provide the means to encourage them to communicate with the elders with some periodicity.

Enable an easy way for elders to use the system. We consider that for elders we need to propose an easy way to use the system based on a pen-computing based system. The system enables elders to contribute to build the newspaper by using digital cameras, and scanners to get printed photos or images of documents that they want to publish in the newspaper.

Make accessible the system for the elders' family. As most of the elders' families already use Internet communication tools for being in contact others, we can use the Internet as a channel for them to access the family newspaper. Thus, the system integrates web technology already known by the users living abroad which can facilitate its adoption.

Elders may access and use the system in several places within the home. The family newspaper is presented in a display that can be hanged on any wall or left on any surface of the elder's home.

To clarify how these features are addressed by the electronic family newspaper, we elaborated several scenarios of use to illustrate the system's functionality. The creation of scenarios enabled us to generate and communicate design ideas for our system and to better understand the implications of particular design solutions (Carroll, 2000). Next, we present some of the use scenarios in which we envision how elders may ameliorate their loneliness through the electronic family newspaper.

Scenario 1. Mrs. and Mr. Valenzuela are old adults living alone in Guadalajara, Mexico with two daughters and a son living in Santa Ana, California, USA. While Mrs. Valenzuela is preparing breakfast, the display in the kitchen shows an announcement to notify her that there are family news that may be interesting for her. She approaches the display and notices that in the Cooking section there are new messages. As the "5 de Mayo" (May 5) Mexican day is coming, her daughters are organizing a dinner at the neighborhood and have published a list of potential Mexican dishes they would like to prepare for the occasion as illustrated in Figure 1.



Figure 1. Family Newspaper – Cooking section.

Mrs. Valenzuela realizes that she has the recipes of some of them and decides to go for her cooking book to send them to her daughters. While Mrs. Valenzuela goes for the book, Mr. Valenzuela quickly pulls the display and reads the family newspaper while he is taking breakfast. He selects the Sports section because he is sure his son Mario has written a review of the latest soccer game of the Mexican league. As Mr. Valenzuela realizes that his son would like to read interviews to some of the players that were published in yesterday's local newspaper, he scans the note and attaches it to the review. At that moment Mrs. Valenzuela is back with a bunch of old cooking books and

asks her husband: "Do you think that they will find Tejocotes fruit for the tea in Santa Ana?."

Scenario 2. Mrs. Diana is a 72 years old woman who lives alone in Tijuana, Mexico. She likes to play with the memory game included in the Entertainment section of her family newspaper. When she selects the memory game to start to play, a set of pictures of her family residing in the USA and other places of Mexico is presented on the screen as illustrated in Figure 2. As she misses her grandson Jose, she decides to play this session with him. For this, she selects the photograph of Jose and the virtual Jose appears saying hello and the memory game, which includes only images of the latest events related to her grandson. When Diana matches a first pair of cards, the virtual Jose, explains a little bit of the event in the picture. While Mrs. Diana and the virtual Jose are playing, her grandson is making his homework in his computer. He realizes his grandmother is playing and decides to join the game. The grandmother is happy to play with her grandson.



Figure 2. Elder accessing the Memory Game

Evaluation of the System Prototype

The goal of the evaluation was to explore the feasibility of our solution as well as its appropriateness for the context of elders and their families. A functional prototype was evaluated by a total of 8 persons, including elders and members of their family. It was expected that participants, while facing the prototype, would raise more specific issues that would serve to refine our solution and, in general, our understanding of the challenges they face in their lives. Each evaluation lasted about an hour and was based on three major phases:

- 1) A brief interview to discuss their patterns of communications, tools used, circumstances leading to contact each other, and their feelings of isolation resulting from being separated.

2) A presentation of the two scenarios, presented previously, to illustrate the context and usage of the system. We asked the participants their impressions about the scenarios and how well those scenarios described the situations that they typically face.

3) Finally, we gave to each participant a tour through the functionality incorporated in the prototype to explore its interfaces and the way that information was organized.

Based on an analysis of the data collected during the evaluation we identified results both with respect to the system and with respect to situation of being separated from their families. Related to the system we found these major design issues to be addressed by our system:

The system was perceived as a complementary communication tool. Participants indicated that they see this system as a complement for their current communication tools (e.g. phone). They pointed out that it would provide new ways to share information among them. Furthermore, we found that although their family members use tools such as email and instant messaging to communicate among them, most elders lose the opportunity to maintain these bonds due to the complexity of these tools. When evaluating the system, elders expressed that the electronic family newspaper would let them integrate themselves into those networks and keep in touch with their families.

Elders need easy way to access the system. Elders expressed that it was easy to understand but they were concerned with not having a direct and easy way to launch it. To facilitate the access, we are planning to provide a very simple mechanism for elders to open and start using the system. They emphasized that as long as the system was not complex they would use it. For our design, we are considering to include figures depicting the sequences of steps to be performed to use the main functions. Such figures would be useful if they are attached to the device or are easily placed on a wall near the device.

Willing to maintain and increase communication. Family members are very concerned about the well-being of their parents and in particular they feel that as their parents become older, they would need to increase their communication with them. In the other hand, we found that elders indicated that their experience is that at the beginning of the separation (i.e. when their children left their home and went abroad), their relatives used to communicate with some frequency. However, as time passed by, the communication was less and less frequent and sometimes was reduced to special occasions. To address this issue, we extended the functionality of the system to incorporate a reminder mechanism that enables elders and their families to maintain communication as described in the following scenario.

Scenario with Extended Functionality

Scenario 3. Mrs. Lopez lives alone in Puebla, Mexico and her daughter Ana migrated to Houston, Texas, USA many

years ago. She has a son Daniel who studies a bachelor degree. He got a scholarship and is studying away from home in California. Daniel usually accesses the electronic family newspaper to read the news from his mom, grandma and other members of his family at the beginning of each week, either on Sunday's night or on Mondays. However, in the last two weeks, Daniel spent most of his time studying for his final exams at the school's library with little time to check the newspaper. While Daniel is working in his computer, the electronic family newspaper, which is aware of this situation, reminds him to keep in touch with his family and automatically opens a window from which he can post any message to the family newspaper, as illustrated in Figure 3. Daniel takes a digital photo of him and his friends working in the computing lab, and then writes a short message to let his mother know that he almost finishes his courses. The next day, Mrs. Lopez notices that Daniel has posted a picture to Ana and feels happy to know that his grandson is doing fine.

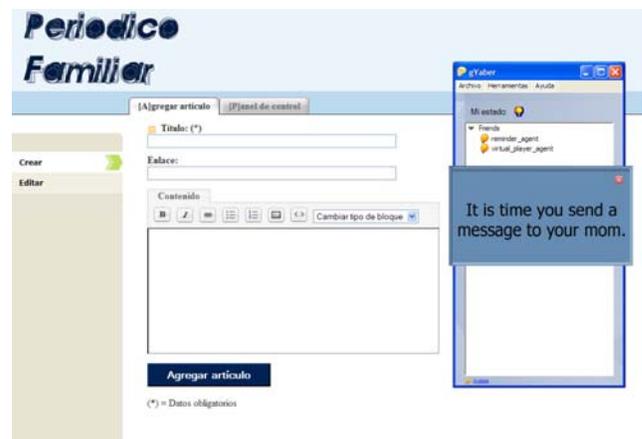


Figure 3. The system reminder to the elder's son.

System design

In order to achieve the system functionality we are proposing to provide an interface for elders and another interface for family members. To serve the needs of elders and facilitate information capture, the system is based on Tablet PC technology. By using a pen elders can access the functionality and input information. In addition, Family members can use the system through any other device with a web browser. This would help the seamless adoption of the system. The following sections describe the system architecture which is based on agent technology.

System Architecture

As illustrated in Figure 4, the architecture of the electronic family newspaper consists of several layers.

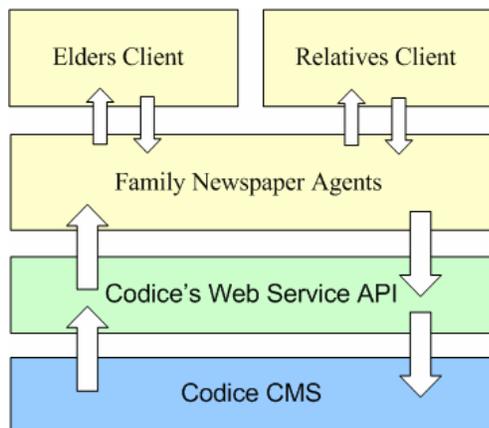


Figure 4. Electronic Family Newspaper architecture.

Codice CMS. The system includes a Weblog Content Management System named Codice in which a weblog is created by the family members to load the information they want to publish in the family newspaper through the Codice Web Service's APIs. The use of weblogs is gaining momentum with the introduction of tools that facilitate the publishing process and to improve the user experience and usability; Codice was built on AJAX (Asynchronous JavaScript + XML) which incorporates standards-based presentation (XHTML and CSS), dynamic display and interaction (Document Object Model), data interchange and manipulation (XML and XSLT), asynchronous data retrieval (XMLHttpRequest) and JavaScript binding everything together (Garrett, 2005). The Ajax engine, allows the user's interaction with Codice to happen asynchronously.

Codice Web service's API. To implement our system we are using the Service-Oriented Computing (SOC) paradigm that utilizes Web services as fundamental elements for developing applications (Papazoglou, 2003). A Web service is characterized as an application that exposes its functionality through an API, and it is also a Web resource designed to be consumed by software rather than by a human using a browser (Manes, 2003). Thus, our architecture is based on a Web service API layer that enables users to interact with Codice CMS from a wide

range of computing devices (such as Tablet PCs, PDAs, cellular telephones, or appliances) and software platforms (e.g., LINUX or Windows). Thus, elders' relatives can load information to the family newspaper from any computing device.

Elder's Client. This layer is the subsystem that enables elders to create and interact with the electronic family newspaper. The main components of this layer were identified as autonomous agents who proactively help elders interact with the system. For instance, they enable elders to publish information on the newspaper by using the scanner. We proposed that autonomous agents represent the users living abroad, thus the elder can chose to play the memory game with an agent representing one of his relatives. The elder may play with the real relative and interact with him through instant messaging. Other agents act as proxies to the system's devices (such as Tablet PC, digital cameras or scanners) by facilitating the interaction of the elders with these devices. The elder's client is based on a pen-based computing system, such as Tablet PC, through which elders can navigate the electronic family newspaper and introduce some commands. The system also displays a keyboard in order for seniors to easily introduce some text, such as to provide a brief description of a picture. Thus, at the elder's home the Tablet PC can be located in any place where they would like to read the family newspaper. The Tablet PC acts as a server for the system's agents that enable elders to visualize the family newspaper or update it.

Relative's Client. The main components of this layer are: an agent that notifies the relative when the elder is playing the memory game and enables them to communicate by IM; and a web browser from which the user can access the family newspaper and load information trough its weblog.

Family Newspaper Agents. This layer consists of several autonomous agents that wrap complex system functionalities. These agents compose dynamically the different sections of the family newspaper. Thus, agents turn the systems Web services into proactive entities working as peers to serve elders and their relatives. The following section describes the functionality provided by these agents.

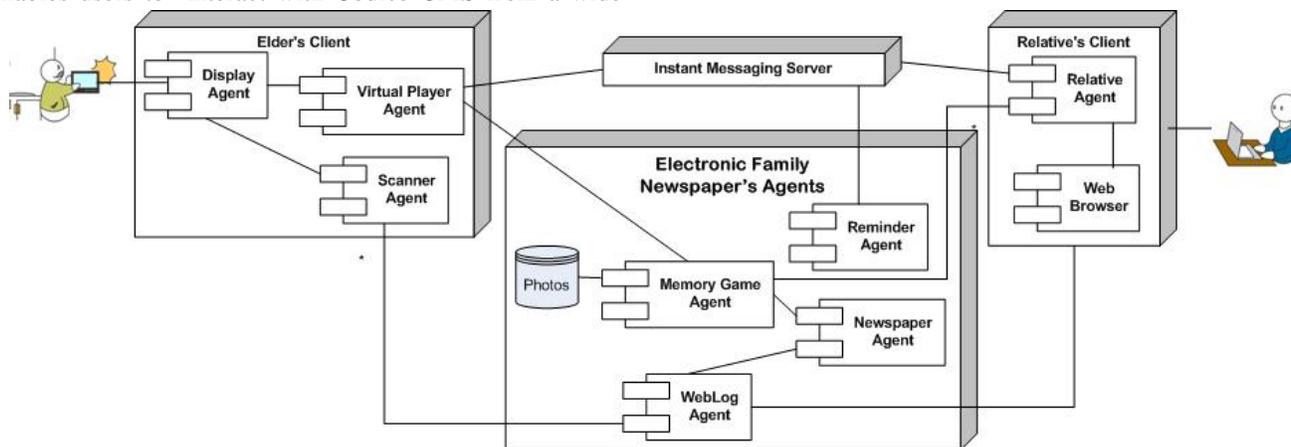


Figure 5. Autonomous agents as main components of the system

System Agents

Envisioning our technological solution as a multi-agent system enabled us to implement a scalable and loosely-coupled system in which by means of autonomous agents we can add new functionality to the system (i.e. new games), integrate new devices (i.e. video cameras) and other people with whom the user may want to be connected, such as close family friends. As illustrated in Figure 5, the main system's agents are the following:

The Newspaper Agent. This agent is aware of new entries in the Codice weblog to build or update the newspaper. To monitor and collect the weblog changes, the newspaper agent was built as a content syndication reader powered by the RSS (RDF Site Summary – formerly called Rich Site Summary) standard which is an application of the eXtensible Markup Language (XML) that adheres to the World Wide Web Consortium's Resource Description Framework (RDF) and is a method for describing news or other Web content that is available for syndication or distribution from an online publisher (Çelikbas 2004), in this case is accessible through the Codice APIs, which generate an XML when a change occurs in the family newspaper.

Weblog agent. It acts as a proxy to the Codice's APIs by enabling users to post information into the Weblog. This agent receives information directly from the elder's relatives or from the agents that help elders to contribute to the family newspaper (see figure 5), such as the Scanner Agent.

Display agent. It is a proxy to the display. It has control of what and when the information is presented in the Tablet PC. For instance, when the display agent is notified that a

new entry in the newspaper is available, it automatically opens the family newspaper application.

Scanner Agent. The images and text provided by the elder can be loaded through a scanner. For this, the system provides an agent acting as proxy to these devices. When the elder scans a document or picture, the Scanner Agent sends the image to the WebLog Agent in order to be post on the weblog and then added to the family newspaper.

Memory Game Agent. When the elder joins the Entertainment section, he is presented with several activities, such as the Memory Game. The Memory Game Agent is a server application that monitors the movements of the players, and validates them. It also maintains a database with images and a brief story describing them. If the elder chooses to play, this agent will generate a set of cards with the images posted in the weblog, as illustrated in Figure 2.

Virtual Player Agent. This is a companionship agent. If the elder chooses to play the memory game with one of his relatives, the memory game agent will generate a set of cards containing images related with that particular person. Both, the elder and the virtual player agent will make alternate movements. When a pair of cards is matched, the Virtual Player Agent will display a brief story related with that card's image. This agent is visually represented by a relative's photograph as illustrated in Figure 2. When this agent perceives that the person it represents is connected, it invites him to join the game. Thus, the relative realizes that the elder is thinking about him. If the relative decides to join to the game, the virtual player agent will cede the control to him, and the photograph of the relative will be emphasized to indicate that the real relative is playing the game.

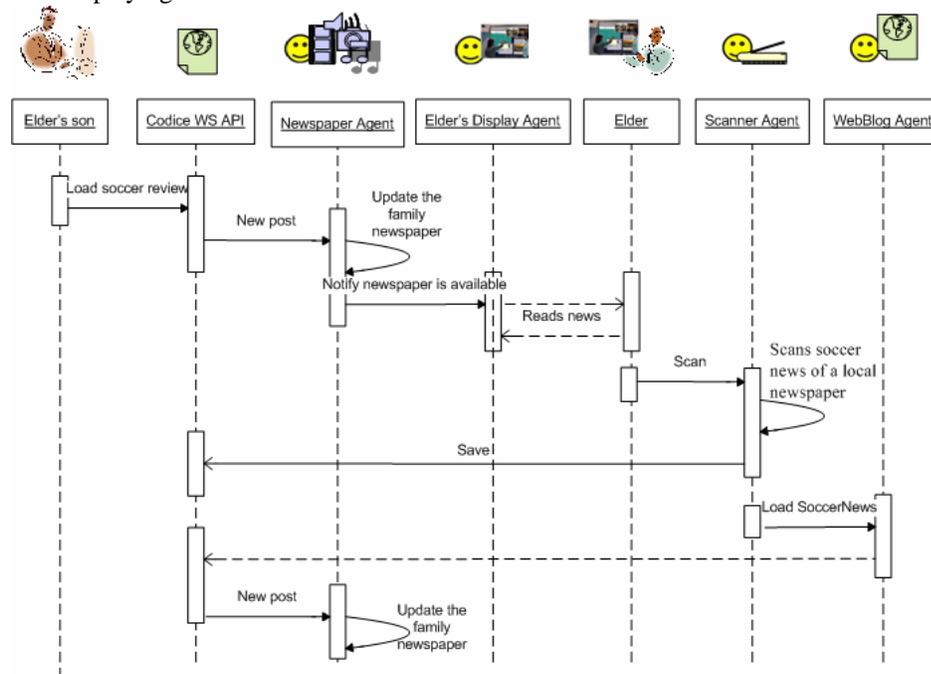


Figure 6. Interaction of the system components

Real Player Agent. If a relative decides to join a game of memory with the elder, the Real Player Agent is started. Then, it is connected to the Memory Game Agent which acts as the game server. The Real Player Agent has an IM client through which the user can maintain contact with the elder while they are playing.

Reminder Agent. To preserve the elder's relationship with their relatives living abroad, the system provides a context-aware agent that reminds relatives to communicate with the elders. This agent is aware when a user that usually transfers information to the newspaper (i.e. at the beginning of the week), breaks his interaction pattern with the system, then the agent sends a message to the user to remind him to communicate to the elder. For this, the agent is aware of: who accesses the family newspaper, when users access the system, and what activities the users performed (read or post information). By sensing this information, the agent infers which user has lost contact with the elder, and the next time it detects the user's presence, the agent not only reminds him to communicate, but encourages him to post information to the family newspaper by opening a window requesting information to be published. The reminder agent posts this information to the weblog on behalf of the user.

Sample application

Through a sample application, we describe how the system's components interact to support emotional and social ties of elders and their family. For this, we first revisit Scenario 1. Figure 6 illustrates how the system's components interact to support this scenario: While Mario is at his school, he loads in the weblog a review he wrote for his father of the latest soccer game of the Mexican league. The Newspaper Agent is aware that a change was made to the weblog, and updates the family newspaper. Then, it notifies the family Display Agent that the newspaper is available. The Display agent sounds an alarm to advertise that the newspaper has news. Thus, while Mr. Valenzuela is taking his breakfast, he approaches the display and selects the Sports section. As Mr. Valenzuela realizes that his son would like to read some comments from some of the players published in yesterday's newspaper, he scans the note. For this, he touches some buttons in the system to address the scanner system. Then, Mr. Valenzuela chooses to load the note. The order is interpreted by the WebLog Agent that posts the note. Finally, the Newspaper Agent realizes of the new change in the weblog, and then, modifies the newspaper.

Related Work

Some design concepts and products have intended to create emotional connections over a distance by applying theories of affective computing combined with ubiquitous computing technology. The Gust of Presence system provides a suitable carrier for affective communication by enabling a two-way notification of presence (Bassuk et al,

1999). This system lets parents and children who live apart inform each other when they have arrived home. It uses a bowl, which senses when the user throws something into it, such as money or keys, which may indicate he has arrived at his home. Then, the bowl takes a picture from the inside and sends this information to another identical bowl located in the parent's home. The Lovelet (McCracken, 1988) is a wearable communication tool for intimate people by naturally and timely conveying affection. This consists of a thermosensor that always senses air temperature surrounding a user, the temperature data is transmitted to another user and depending on the temperature, a full color LED (Light Emitting Diode) illuminates in different color to indicate an emotional state. The above mentioned projects enable users to communicate their feelings to the persons they loved. However, these technological proposals do not enable users to share their personal reminiscences with others, which we consider can ameliorate the isolation of old people. Several projects have focused on providing mechanisms to help users to capture and maintain the family's memories. The Living Memory Box (Keller et al, 2004) is a device that assists families in preserving memories in a variety of media forms, such as photos, video and audio. The Living Memory Box appliance can be seen as both an archival and narrative device, allowing families to bring together artifacts and then tell stories about those particular items. The digital storytelling (Fujita and Nishimoto, 2004) is a device that enables digital photos to be used in a manner similar to print photos for sharing personal stories. A portable device combined with a novel interface supports local sharing like a conventional photo album, as well as recording of stories that can be sent to distant friends and relatives. Finally, the FotoFile system (Stevens et al, 2003) provides a unified interface for annotation and search, using categories such as people, places, and events that are commonly used for labeling photographs.

The above presented systems and our own findings motivated us to propose a system to help Mexican elders to ameliorate their isolation by means of digital photos and narrations of the stories around them.

Discussion

While elders expressed they need to feel more connected with their families, and stated that the communication was more frequent when their relatives migrated, the families living abroad face a very complex trade-off as they wish to be aware of the well being of their parents but cannot always afford the means to be in close contact. This might cause some tension and dissatisfaction of the relationships with them. These situations may also affect elders emotionally and their health. We created an electronic family newspaper with the aim to help elders to maintain emotional closeness with their beloved ones. For this, the system enables elders and their relatives share personal information which is presented in sections such as, Sports,

Entertainment, and Health, in which the family may publish digital images, videos and text describing a family event.

From the system's evaluation we found that participants perceived that the family newspaper would be a complement to their current communication tools (e.g. phone) as it would provide richer ways to share information. Participants highlighted that by using the system they could share pictures and other information that currently cannot be transferred using the phone they have. In particular, family members thought that the system could provide a way to transfer interesting contents found in the Internet to their parents who were not able to access those resources in their own. Although other barriers can exist for using it, Mexico, and other Central American countries, are rapidly deploying telecommunication networks. In the near future new forms of networks (e.g. 3G) will provide the means to establish richer forms of communication. Consequently, we believe that opportunities exist to create not just devices that can be used to communicate individuals (e.g. cell phones), but to develop platforms that let whole families to share pictures, information, messages, and other digital artifacts. The stated above makes us think that the system can be well accepted and used by elders and their families.

The system was designed to provide an easy to use interface for elders. For this, the presentation of the information has the format of a newspaper, which is a concept already known by any user. For facilitating the elders' interaction with the family newspaper we propose they access it through a Tablet-PC with a touch screen.

The main system's components were identified as agents since they have attributes that enabled us to cope with the desirable system's features. Such as, agents are aware of changes in the weblog, and act based on them (*reactivity*), agents decide to send a reminding message when the users' interaction pattern breaks (*autonomy*); and finally agents seamlessly collaborate with the elder in the same work environment (Maes, 1994). In this case, autonomous agents help elders to perform difficult tasks, such as using the scanner to publish information on the newspaper.

Thus, we used autonomous agents as the main design constructors of the system. In our approach we proposed that autonomous agents assist elders in their interactions with the system; act as proxies to devices (such as Tablet PC, digital cameras or scanners); hide complex system's functionality (such as the Newspaper agent); and represent users (such as the Virtual Player Agent). The use of autonomous agents facilitated to add new functionality to the system in order to address the design aspects resulted from the system's evaluation. In regard with this aspect, we have already modified the system design to add a context-aware agent that provides "reminders" to users. Currently, we are working on the implementation of this agent and we plan to evaluate this system functionality.

References

- Bassuk, S. S., T. A. Glass, et al. (1999). *Social Disengagement and Incident Cognitive Decline in Community-Dwelling Elderly Persons*. *Ann Intern Med* 131(3): 165-173.
- Carroll, J. M. (2000). *Making Use: Scenario-Based Design of Human-Computer Interactions*, MIT Press.
- Çelikbas, Z. (2004). *What is RSS and how can it serve libraries?* Info To Go Navigating the Internet. 11.
- CONAPO (2004). *There are in Mexico 7.9 millions of elders*.
- Fujita, H. and K. Nishimoto (2004). *Lovelet: a heartwarming communication tool for intimate people by constantly conveying situation data*. CHI '04 extended abstracts on Human factors in computing systems, Vienna, Austria, ACM Press.
- Garrett, J. J. (2005). *Ajax: A New Approach to Web Applications* available at <http://www.adaptivepath.com/>.
- Keller, I., W. van der Hoog, et al. (2004). *Gust of me: reconnecting mother and son*. *Pervasive Computing, IEEE* 3(1): 22-27.
- Maes, P. (1994). *Agents that reduce work and information overload*. *Commun. ACM* 37 (7): 30-40
- Manes, A. T. (2003). *Web Services Basics*. *Web Services: A Manager's Guide*, Addison-Wesley Professional: 27-45.
- McCracken, G. (1988). *The long interview*. Newbury Park, CA, USA, SAGE Publications.
- Morris, M., J. Lundell, et al. (2003). *New Perspectives on Ubiquitous Computing from Ethnographic Study of Elders with Cognitive Decline*. *Lecture Notes in Computer Science* 2864: 227-242.
- Papazoglou, M. P. (2003). *Service -Oriented Computing: Concepts, Characteristics and Directions*. *Proceedings of the Fourth International Conference on Web Information Systems Engineering*, IEEE Computer Society: 3.
- Santana, P. C., M. D. Rodríguez, et al. (2005). *Supporting emotional ties among mexican elders and their families living abroad*. CHI '05 extended abstracts on Human factors in computing systems, Portland, OR, USA, ACM Press.
- Stevens, M. M., G. D. Abowd, et al. (2003). *Getting into the Living Memory Box: Family archives & holistic design*. *Personal Ubiquitous Comput.* 7(3-4): 210-216.