



social network and reducing the need of help with activities of daily living.

Loneliness, lack of emotional support and lack of companionship or social support can leave elderly men and women vulnerable to heart problems. The health effects of social isolation may be especially important among the elderly. Hawkey [11] in a study conducted at the Center for Cognitive and Social Neuroscience at the University of Chicago found that people over 50 and lonely could be adding 30 points to their blood pressure and raising significantly their chances of suffering from hypertension.

Under the psychological profile relationship between depression and a life style lacking social contacts is clear.

The analysis of the day to day life risks show a dangerous situation: distractions, reduced functional abilities typical for the aged age can generate tragedies in absence of a timely intervention: it is well known that elderly people are the main victims of domestic accidents. 20‰ accident refer to over 75 against the

14.7‰ of the whole population on the victim classification

Technology is expected to aid in solving the problems of growing group of senior citizens in need of assistance. The elderly has been considered to be a special group with special needs. Many solutions for smart housing, independent living and gerontechnology have been created to fulfil these expectations. To provide an environment within which the people can reside for as long as possible, whilst maintaining their quality of life and independence, is a widespread concern for all.

Information and Communication technology (ICT) in tandem with technological innovations in other fields offer opportunities to bring independent living in old age (and also in disability conditions).. Specifically designed ICT based assistive technologies can be of great benefit to older people that are increasingly at risk of having functional difficulties in areas such as mobility, vision, hearing and in some aspects of cognitive performance. Smart home and consumer electronic developments can make management of the home and everyday living a lot easier for older people. ICT can give human support helpful for both user and caregiver through domotic systems.

The intelligent houses for the old people should consider the following class of functions:

- a) **safety and security** prevention from accidents – which quite often happen to old people ; protection of persons and goods from fire, floods, burglary etc.
- b) **environment comfort:** monitoring of the environment parameters correlated to the well-being of the old people (temperature, humidity, ventilation, heating etc.).

c) **sanitary surveillance:** monitoring of the main vital parameters of the old person.

These activities are carried out with respect to the security, the safety and the privacy of the user.

It is well recognized that assistive technology often is not accepted by old users. This may be because the technology was incorrectly prescribed or imposes too great a burden in use. Often, however, the stigma attached to an assistive product could be an important reason for the rejection.

The level of acceptance of new technologies strongly depends from their level of intrusiveness. The aid shouldn't stigmatize the old person, it shouldn't define him/her as different/particular. Elderly people usually are not familiar with new technologies and above all they hate loneliness: carer and nurses, relatives and neighbors, sellers and messengers are human contact opportunities.

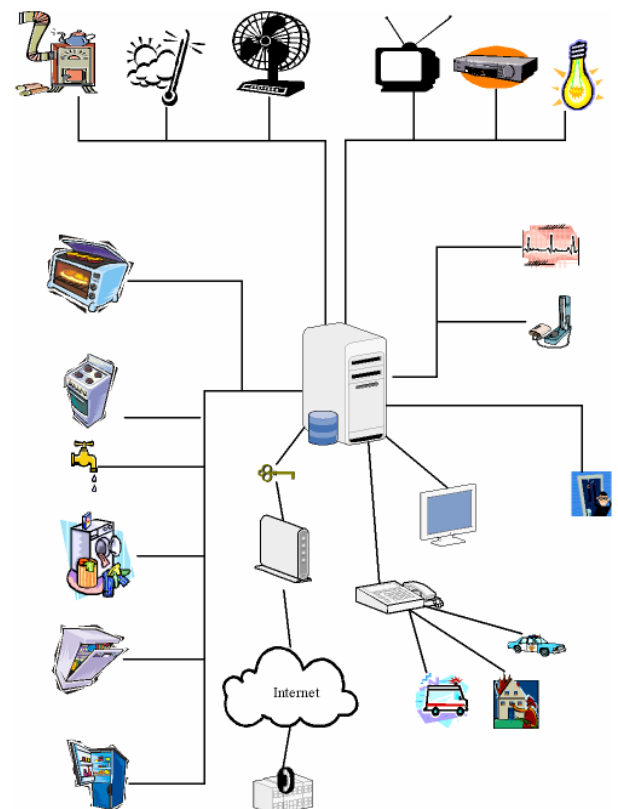
The automation of an house shouldn't risk to take away the few social contacts user still have with human being

## 2 The Architecture

In this paper we propose an architecture that allows the maximum help to old people, but that respect their needs.

It is organized in two logical networks:

- o a Daily Support Network (DSN) composed by an Home Health Network (H2N) and a Virtual Call Center (VC2)
- o and a Village Network (VN).



### Figure 2 Home Health Network (H2N)

This architecture includes a domotic part with sensors that should be not invasive and an intelligent audio/video interface that connect the home with a Virtual Call Centre and to the Village Network.

## 2.1 The Daily Support Network. (DSN)

The Home and Health Network (H2N) is a local intelligent domotic system network that acquires data from sensors of different types distributed in the house and that adequately drives controllers. This net is always active (the user is continuously being monitored) and will therefore supply the data necessary to the system so that through proper protocols, it identifies the interaction level (normal, attention, call, emergency).

An example of H2N is shown in figure 2; it is embedded in the house and it consists of:

- sensors and actuators (interface with the physical variables to measure or with the device to activate),
- the interfaces for sensors and actuators from/to the home
- a gateway
- the necessary applications for the intelligent management of the collected data.

The two main functionalities of the H2N are the house monitoring/driving through devices typical of domotics (e.g. sensors for smoke, gas escapes, losses of water, temperature, control of the refrigerator door, of the gas in the kitchen, turning on of the television set etc., and actuators of the heating, air condition, ventilation, etc). and the collection information on the health of the user: Sensors can be wired or wireless (Bluetooth, wifi, etc) connected.

The Virtual call Centre (VC2) is a communication system which provides several functions responding to different levels of needs. Home and Health Network (H2N) is will contact VC2 through electronic equipment with audio and video connection (i.e. video-telephone, a palm phone, palm top, home computer with a web cam etc.) The VC2 is shown in figure 2.

It should carry out the following functions:

- audio-video communicates with the user every days
- gives a daily care support (if necessary)
- facilitates the access to useful information on what is going on in the community, if the old men/women is able to go outside (shows, activities etc.)
- distributes information, proposals and suggestions for services, animation, lessons, meeting, shows etc. ;

- facilitate the socialization among elderly people, through notification of the presence of other users connected and reachable in Village Network.

All these activities are tailored as much as possible to the user needs and abilities. Since the solitude is one of the most dramatic problems for the elderly condition, it is necessary to preserve the few occasions of human contact that usually remain. For these reasons the contact provided through the connection with a "Virtual Call Centre" (VC2) should be carried out through audio-video equipments.

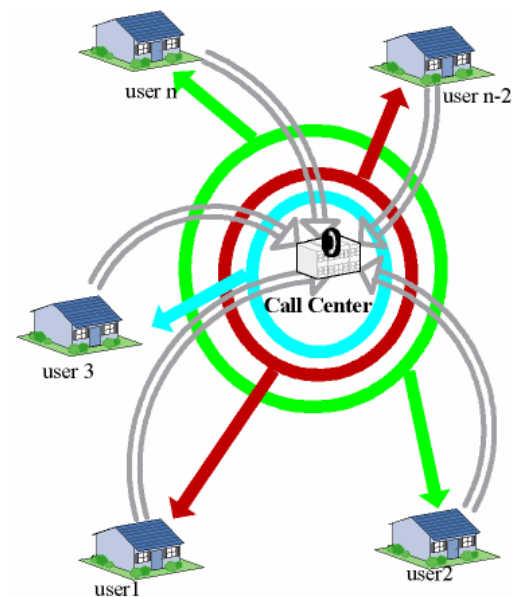


Figure 3 The Virtual Call Center receive information from users and satisfy different functions for each of them.

A fundamental characteristic of the VC2 is its "Virtuality". Operators are not supposed to reside in a specific geographic place; vice versa they can operate in various centers, or even while they are traveling, through e.g. the aid of video-telephones or palmtops etc. The operativeness, in such a way, is simplified (an operator can take care in the house of an old person and contemporary he/she can help other users via data transmission). For the user the operator will appear and speak from a video. We can assume that some users of the system (old people still mentally strongly active, disabled persons unable to move etc.) can rise to the role of operator after some training, in a sort of "mutual voluntary service", being paid for it.

That contact with the VC2 is also the minimal human contact that the elder person can have every day.

The Daily Support Network services requires an appropriate and secure network infrastructure. The basic assumption is using Internet (eventually GSM network)

as transfer infrastructure. Securing data exchange is possible by VPN IPsec connection between every H2N and VC2. Identification of users and operators can be solved by digital certificates (CA, PKI) and/or other strong authentication methods.

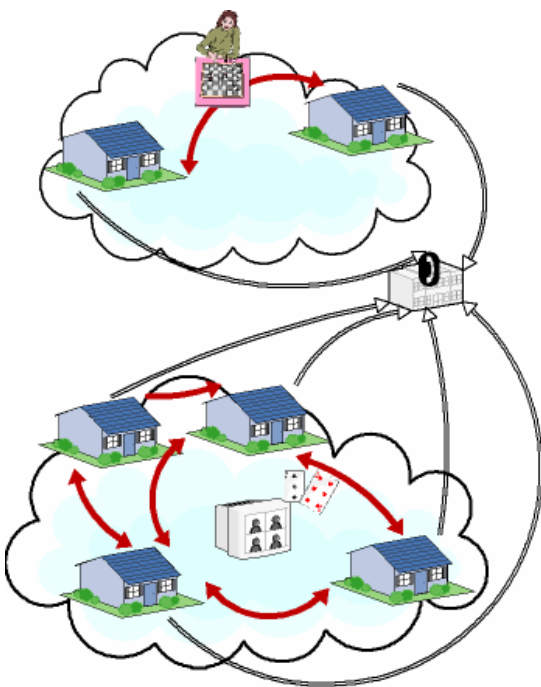
## 2.2 The Village Network (VN).

In the villages of the past a network of personal relationship allowed old lonely people to be integrated in the area where they were living taking advantage of different kindness and communications from familiar and friend environment.

A village network can help reducing the feelings of loneliness. It shall allow the elderly to practice their mind and overall it allows a reciprocal control that is similar to what happened in the villages in the past centuries.

The Village Network facilitate the communication with family members and friends, and allows the creation of virtual communities.

This network is an effective way of forming self help groups for older people and carers alike. The use of computers to provide entertainment already fights back loneliness.



*Figure 4 Village Network: old people connected together on their interest basis build a network of personal relationships fundamental to face up their loneliness.*

Through this net the elder users of the system can put themselves in contact with each other (facilitated by the VC2 proposals) and they can play, chat, entertain themselves giving a mutual support-monitoring as

happened many years ago in the villages. This net is a distributed virtual presence system.

Since this type of net is mainly destined to be used as a point of experience interchange and as an opportunity for meetings, the characteristics of guarantee and quality of the service should be stressed. The VN will be a privileged 'place' where to meet old friends and where to find new ones: so far anyone who desires will be allowed to access the VN, using weak methods of authentication. The system will notify through opportune marks the elder user if the person that is speaking with, is known to the network management or is an external element. This is to try to protect elderly people from cheaters and bunch of crooks

This type of network infrastructure does not require the security level as that of the Daily Support Network. The character of providing services enables the usage of Internet as transport medium without the need of secure VPN tunnels and other security protocols. On this network it is necessary to validate user by authentication. This is a protected network VPN of voluntary connection between the houses of the elder people and the VC2.

The old person can join this network of services when he/she is still a self-sufficient person. In this phase the system help is limited to daily audio-video contact with proposal of activities, occasions of socialization, exchanges with other persons of different ages. Subsequently, when the conditions of the old person changes, the operator will be able to activate more services. The reference idea is to have a kind of club for independent users who can tele-meet people or watch and discuss a movie or tele-participate to a conference or to a lesson according to their tastes and their health status.

## 2.3 Security and safety

Safety is an essential attribute of any technological service responsible for the well being of human beings. Every time we have a network communication there is a possibility of tapping, with the consequence of information robbery. Another completely different problem is authentication, at all levels implemented. Therefore it is necessary to choose the appropriate mechanism for data authentication and protection; these important features are to be granted always (sensor to gateway communication, home gateway to call centre, peer to peer communication among elder people etc.).

As for safety, a key aspect is enhancing the trustworthiness of the systems such that in no case the users be jeopardized. Moreover security should take into account other parameters of the system, like scalability, costs, bandwidth available and power (both in terms of cpu power and battery power of wireless devices, for example). This objective can be pursued by introducing a technology that allows the usage of procedures of

secure identification and safe access to the resources (opening of the doors, turn on of several monitoring devices and/or other facilities) by means of the concession of the necessary privileges to caregiver (authorization). Note that these requirement cannot currently be satisfied by using the usual methodologies (i.e. to make a copy of the house keys), because in such a way the control of ‘who has made what’ becomes impossible (problem of the copies). Instead it is important to guarantee the access to the resources only at some times, maintaining a log of each single transaction, shrinking or increasing the authorizations following specific events (unexpected diseases, out of order events to the house systems, ordinary maintenance etc.). For all these reasons we suggest the usage of digital certificates coupled with hardware devices to support the users (i.e. touch or wireless smart card).

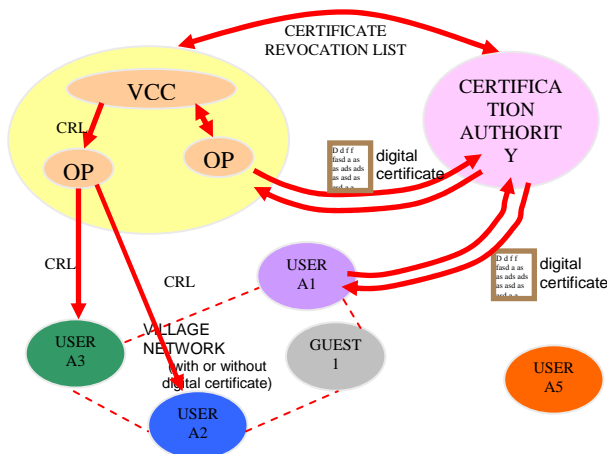


Figure 5 Certificate attribution process

Technologies for secure identification, and consequent resource access to caregivers: door locking and unlocking, start-up and shutdown of monitoring devices and various facilities, privilege attribution.

### 3.3.1 Certificate attribution

Each single position will communicate with an authorization centre with the authority to validate the identity of the single operator and its position. After the validation a digital certificate could be released. This certificate is valid for a slot of time as asked by the circumstances. It has the scope to make the operator recognizable and traceable (both for monitoring the carried out operations, for guarantying the possibility to reconstruct the modality of a single participation and for allowing the access to the resources). Similarly in the elder person home a site will be predisposed. It will be integrated in the domestic furnishing.

During the installation phase, a link between the home site and the Authorization Centre (AC) will be set up and will create/ save a digital certificate. Such a digital certificate (eventually completed with biometrical data

for the identification of the elder person who approaches the system) is used in the phase of logon to the Grandfather system. All the exchanged traffic, i.e.: data between AC and VC2, between AC and domestic sites, and VC2 and domestic sites will be protected by source coding and authentication.

## 3 Conclusion

The automation of a domotic house shouldn't risk to take away the few social contacts an old user still has with human beings. A Virtual Call Centre (VC2) and a Village Network can give human support helpful for both user and caregiver. This system will be tailored for the target audience, i.e., elder people, trying to make use of terminals and concepts that are well known and accepted by them.

Assistive technology is not just to enable an older person to live alone, but to maintain autonomy and relationship not only with his or her family or caregiver, but also with other people. We proposed an architecture that allows the elder person to live at home as long as possible maintaining an acceptable independence state, a good quality of life and a sufficient level of social communications.

The focus of the architecture proposed in this paper is based on human aspects of the elderly people needs. to improve the quality of life of elderly people and their caregivers. The final goal is facilitating an independent and not isolated, social life, inside one's home as long as possible. Contextually this architecture tries to facilitate the job of the caregivers allowing the communication with the elders and supplying the attendance with a smaller workload

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