On Dependability Issues of Home Assistive Technology for the Elderly and Physically Challenged People in Nigeria

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Abstract

It is a well-known fact that the elderly and physically challenged also want to feel safe, relaxed and comfortable in their homes. But, due to their fragile nature cause by old age, they are exposed to some risks, such as fire outbreak, inhaling hazardous gas, falling down etc. Most of them want to be independent and yet not completely alone. That is, if something goes wrong they can easily get help. To assist them maintain safe and independent life, we proposed a system which consist of a variety of commercially off the shelf components like: Fall detectors, video monitoring system, Health monitoring sensors, and Smoke detectors. This is to support them in maintaining their autonomous, private and dignified life, as well as to improve their quality of life and increase their safety. We presented some of the dependability issues that might arise such as: Availability, reliably, safety, security etc. because of their importance in this context. Finally, we proposed ways of dealing with the identified issues.

Keywords: Fall Detectors, Video Monitoring System, Health Monitoring Sensors, Smoke Detectors.

Introduction

Background

According to U.S. Department of Health and Human Services Administration on Aging (2003) as well as (Cowan and Turner-Smith, 1999; and Miskelly, 2001), an Assistive Technology for the elderly comprises of all equipment that can be acquired commercially, maintained and customised to allow an elderly person to perform action which he would otherwise not have the opportunity to perform on his own without such technology, or to improve the ease and safety with which they do the task.

Elderly are group of heterogeneous people with a lot of differences in their personalities and hence their needs. Physically Challenged Elderly are group of elderly people that have one form of physical disability or the other. In Nigeria, like other countries one can find this group of people in various part of the country. This group of people may be vulnerable and at risk of fall or some illness that
may require monitoring due to their nature, couple with old age. However, some of this group of people may lack family members to take care of them at that age.

Both the elderly and physically challenged people and their family are concern about the presence of someone that will respond to the old and disabled person in an emergency situation. To increase their safety and optimize their capabilities, we proposed a system that could support them in their homes using variety of assistive technology; such as Off – The shelf Sensors and Cameras like:

1. **A Fall Detector**: Like the Tunstall accelerometer and tilt meter – a small device to be worn around the wrist or upper chest will be used to detect when a user fall down. These two sensors are combined together to minimise false alarm. According to Trent Dementia Services Development Centre (2006) and Norfolk County Council (2007), the accelerometer detect when an impact greater than a preset threshold is made, while the tilt meter determine the orientation of the user. If it is horizontal, it gives a warning for about 25 seconds within which the alarm can be cancel by standing upright otherwise an alarm will be activated automatically to a call monitoring centre. The operator will then contact the user and when necessary initiate action of arranging for an appropriate person to be there as soon as possible. However, this device cannot be worn in bed (Dewsbury, *et al.* 2002; Edge, *et al.* 2000; and Miskelly, 2001).

2. **Video monitoring system**: Three (3) indoor Video Surveillance Cameras disguised as light bulbs, one each in bedroom, bathroom, and living room, and the RCA cable connected to a TV or VCR at the monitoring centre. However, the bath room camera will be set to capture only tilted image indicating only the person’s position. In case of emergency, alarm from one of the sensors will go ON at the monitoring centre for the operator to assess the situation and quickly provide the necessary help (Miskelly, 2001).

3. **Health Monitoring Sensor**: To be worn on user’s wrist to continuously read body temperature, pulse and movements to establish a pattern within first few days of usage. It generates an alarm when a deviation from the pattern is sensed. This sensor will detect faints, blackouts or collapse and send alarm via a radio link to a multi-link (a small device that fits in the community alarm centre to generate an emergency call). This sensor can also serve as a wandering detector by sending an alarm whenever the person moves out of the multi-link range (Miskelly, 2001).

4. **Smoke Detectors**: Two (2) to be install, one set each in the living room and bedroom to detect and activate an alarm to be sent to an operator who will view the situation through signals received from the video monitoring sensors. (Dewsbury, *et al.* 2002; Edge, *et al.* 2000; and Miskelly, 2001).

**The intended benefits of these technologies**

These technologies will support the physically challenged elderly people that stay at home for a longer period performing daily living activities rather than roam the street. As discussed in Embracing technology will help elderly’s independence (2007) as well as (Edge, *et al.* 2000; and Elliot, 1991) that
will be achieved by minimising their dependence on other family members. With the help of these
technologies a lot of elderly people with disabilities can do things for themselves; without which they
could not do. The provision of safety assurance devices has the benefit of alerting the caregiver or
monitoring centre when the elderly person need some help. According to Trent Dementia Services
Development Centre (2007) and Embracing technology will help elderly’s independence (2007) as
well as (Elliot, 1991; Edge, et al. 2000), that can be achieved by either sending an emergency call by
the person using the device or through sensors that will help in risk management by sending an
emergency call automatically when they detect something is wrong so that early help can be given
quickly; even if the elderly disabled person suddenly becomes unconscious someone will be there in
time to assist.

By giving control back to the disabled elderly people it will minimise the conflicts between the elderly
and physically challenged people and their carers; which is sometimes cause by the carers directing
them on what to do all the time. According to Trent Dementia Services Development Centre (2007),
the technologies will enable family members to be rest assured that the elder is safe, while
maintaining an independent life, and to know if there is problem so that they can be there in time to
offer necessary help.

The technology will support the caregivers in remotely monitoring the person they are caring for
from their own location without physically being with the person at all times so that they can only
offer assistance when they are needed (Edge, et al. 2000; and Stephen, et al. 2008). Similarly, these
devices can assist in reducing stress usually encountered by some caregivers (family members who
are either minors or old themselves and over 65 years, that have to cut back their own social lives,
providing service that sometimes make them sick also) by taking the pressure off them (Elliot, 1991).

**Dependability issues in Assistive technologies**

Domestic Assistive Technology System is a Socio- Technical system comprising of the installed
assistive technology (device), user, and the home environment. And the dependability of this system
may be affected by the way the user uses such system and the home environment. (Dewsbury, et
al.2004).

To help us identify the dependability issues that might arise in this research, we have looked similar
research projects conducted in this area in Europe. Some of them are summarised in this section.

i. **INHOME** – is a project whose goal is to provide means of improving quality of life for the
elderly people at home by developing generic technologies for domestic and ambient
environment management with the aim of increasing their autonomy and safety.

ii. **MPower** – A Project with the goal of defining and implementing platform to support
integration of ‘Smart House’ and sensor technology, partners will promote interoperability
standardisation between profession and institution systems as well as secure and safe
information management through European Association of Homes and Services for the
Ageing (EAHSA). The general aim is to simplify and speed up developing and deploying services for elderly and people with cognitive disabilities.

iii. **UUTE** – A project aimed at technological expertise integration among the Finnish and international research consortium in order to exploit that to form new platforms for wellness, healthcare and security service. It is a subproject that is part of a lager international project called ITALH whose general emphasis is on assisted and independent living. Provision of support for groups of selected patients to manage their diseases or improve rehabilitation is the special emphasis of the Finnish ITAH UUTA subproject which focus on new novel sensors integration, wireless communication, and service platforms with minimum installation costs, so that actual real-time continuous or on-demand measurements, data transfer and quick safety or clinical support and service can be given.

iv. **NETCARITY**: A new integrated paradigm to support engagement and independence of elderly people living alone at home has been proposed by NETCARITY. The focus here is development of light technological infrastructure to be integrated in elderly people’s home at reduced costs. That allows the assurance of everyday activities basic support, critical health situations detection, and social and psychological engagement that will help in maintaining well-being, dignity and quality of life enhancement.

In general the overall goal of the research projects is to design the next generation systems for ambient assisted living in Europe to meet users/family carers/ care providers’ requirements at affordable cost. In addition to set up visible demonstrations of innovative ALL systems to show their viability in European markets. Likewise to adapt and extend state-of-the art Experience and Applications research methods, design-for-all components integration, provision of tools to create new consistent user centred design methodology.

Most of the above projects are looking at safety of old and disable people living alone at home because of its importance since most of these people’s quality of life depends on these technologies; therefore it is important to deliver technologies that are safe and secure.

Potential safety issues could be that the sensors install may be faulty as a result of poor integration of components – FAULT and therefore it will not send emergency call to the monitoring centre when the user is in need of help – ERROR as shown in Figure 2.1.

![Figure 2.1 Potential Safety issue due to faulty sensor](image)

Or user that doesn’t know or the user who as result of cognitive problem forget the significance of particular equipment in the house may switch off or unplug the equipment – FAULT, and in that case
the device will not be of help even if the user is in need of emergency help – ERROR in line with Trent Dementia Services Development Centre (2007) and Anderson, et al. (2003) as shown in Figure 2.1.

Similarly if the user is confused or distressed by alarm sound or recorded message may switch it off and stop using it; FAULT and sensors cannot transmit emergency call – ERROR. In line with Trent Dementia Services Development Centre (2007) and Anderson, et al. (2003).

In all three scenarios, the fact that sensors are not transmitting emergency call will expose the user to more harm than when he has not started using the system. For example, if the person fall down and become unconscious, the monitory unit and family members will not intervene because their assumption will be that all is well since there is no emergency call. Furthermore, if there are insufficient carers to respond to an alert – emergency alert will be received – ERROR, and it will not be responded to – FAILURE as in Trent Dementia Services Development Centre (2007) and Anderson, et al. (2003).

**Potential Dependability issues of Assistive Technologies for the elderly disabled**

In this section, potential Dependability issues of Assistive Technologies for the elderly disabled are discussed. In order to look at safety in this type of technologies we looked at availability and reliability because in most cases safety issues of these home technologies arises as a result of the two issues already stated.

1. **Availability:** This is one of the critical attributes of a system. It is the ability of a system to provide correct service when required. As discussed in Trent Dementia Services Development Centre (2007), the system is expected to proactively offer service when required. This is because there is need for the system to automatically act in situations where the user cannot
issue command to the device in order to seek for help, for example when he is unconscious. From this example, a faulty sensor will not send emergency alert even when the user fall and become unconscious. Similarly a user may switched off or unplug an alarm if he forget its essence due to cognitive problem, or even when he is confused or distress by it sound which lead to unavailability of the system (Dewsbury, et al. 2003).

ii. **Reliability:** This has to do with the continuity of correctness of service offered by the system. The system must be fault tolerant. Because a system that cannot anticipate or notice the occurrence of error, or one that cannot even handle an error will not be relied upon. If the quality of life of users (the elderly disable people) of such systems depends on these devices then failure of these devices could have serious effect on them. It is a fact that an unavailable system cannot send alert even in emergency situation, in that case it will be unreliable because it is not producing a continuous correct service. (Anderson, et al. 2003; Dewsbury, et al. 2003; Maciuszek, et al. 2004).

iii. **Safety:** This is a very crucial attribute of home assistive technologies. Most of the technologies have low power and are in conformity with electrical safety standards which minimises the risk of the device causing injury to the user or other people that live nearby. However, due to the inherent dangerous nature of houses especially to the elderly disabled which can be more risk prone than using the device, detailed safety analysis involving high cost may not be necessary, though it is important to install devices that will not cause injury to their users or damage to the environment. It is imperative to ensure that the installed devices do not assess situations incorrectly or produce false alert which may cause the user to stop using it. From the above example, also if the system cannot send emergency alert it means users safety could be threaten. This is because users can exposed to a higher risk due to the absence of the alert from the sensors which may elude others to think all is well even when it is not so. (Anderson, et al. 2003; Dewsbury, et al. 2003; and Maciuszek, et al. 2004).

iv. **Security:** The services that these technologies offered to a user and the personal information obtain from using these systems must be made confidential; access to such information must be restricted to only authorised person; because unauthorised disclosure of such information may have serious effect on the user. This is a well-known fact that users value their privacy, and they wish to maintain the confidentiality of their information. They may wish to dispose the information about their everyday life only when necessary to an authorised person. Therefore, trade-off has to be made between user’s need of maintaining personal information privacy which imposes some restrictions on the type of monitoring to adopt, and minimising the speed of intervention and consequently the general safety of the system. (Anderson, et al. 2003; Dewsbury, et al. 2003; Maciuszek, et al. 2004; Steyaert, 1998).
Methodology
In this section, we present various ways of addressing the dependability issues identified.

Ways of addressing the dependability issues
Some ways of addressing dependability issues of assistive technologies for the physically challenged elderly people include:

i. To improve the quality of implementation of the assistive technology. This will increase the number of adoption and quality usage of the technology. The implication of adopting this suggestion is that it may require retraining and or recruitment of more qualified developers, as well as increment of other resources such as; the sensors and cameras which will incur additional cost for the government or organisation providing the service.

ii. The problem of lack of information, technical support or maintenance of the technology purchased by the user/relatives/ service providers can be address by increasing awareness about these technologies. There is need for demonstrating their capabilities to the general public. However, that may require additional budget.

iii. When a bus line is used for inter device communication it can serve as a safety valve of the system, but a Bus line is more expensive to install than its alternative and again this is better in the sense that it last longer. So the initial cost can be seen as a benefit over a long period of time when the other cheaper installations have been replaced, while it does not need to. Another cost associated with this is obtaining highly skilled individuals that know the technology well enough to design systems that will meet user’s need.

iv. Instead of relying on the manufacturers’ specifications and standardisations for the availability, reliability and safety of the components used in these technologies, actual test analysis can be perform to ascertain these facts.

v. Security can be improved by decentralising computation and making the user in control of his/her information. Thereby restricting access to the information gathered by these sensors to only authorised people regardless of whether such information is stored or transmitted to the control unit or relatives. (Hansen, 2005).

Conclusion
In conclusion, Assistive technology can support the elderly disabled people in Nigeria to live safely and securely at home maintaining their independence. Although there are a number of issues worth considering when deciding to adapt and use such technologies such as dependability and ethics; we have realised that some dependability issues lead to others. For instance a system or component that is unavailable cannot be relied upon and an unreliable system / component can lead to safety issue. Likewise an unsecure system / component may not provide continuous correct service and may sometimes bring safety concerns.
References


