INTERACTIVE DIGITAL TV AS THE E-LEARNING PLATFORM
Towards Supportive Environments for Elderly

Vladimír Bureš, Daniela Ponce, Pavel Čech and Tereza Otčenášková
Faculty of Informatics and Management, University of Hradec Králové, Rokitanského 62, Hradec Králové, Czech Republic

Keywords: Ambient intelligence, Supportive space, Elderly, e-Learning, Cognition, Digital television, Vital Mind project, ELU project.

Abstract: Development of interactive digital television (iDTV) brings an opportunity to consider it as a certain type of e-learning platform especially appropriate for the elderly. The aging population suffers from many impairments that may worsen the rate of social exclusion. This unfavourable trend can be changed by the usage of interactive audio-visual applications enabling senior citizens to satisfy their specific needs and solve their particular problems. Moreover, it implies the opportunity to involve it in creation or improvement of supportive spaces with the aim to enhance the quality of life of elderly from the perspectives of the Ambient Intelligence vision. This paper presents an example of two iDTV applications focused on learning and cognitive training of elderly and it also outlines suggestions for further research in this field of study.

1 INTRODUCTION

E-learning has already been more or less successfully introduced in many institutions with diverse objectives (Poulová and Šimonová, 2010). From the technological perspective e-learning has variety of forms nowadays. There are several technologies that support its development - email, instant messaging, blogs, particular complex virtual learning environments, or recommendation systems (Čech and Bureš, 2007) to name a few. Television can be considered as a certain type of a social medium, which supports communication and interaction in the context of watching television, or related to TV content. For example, social television systems can integrate voice communication, text chat, presence and context awareness, TV recommendations, ratings, or video-conferencing with the TV set (Bloomberg, 2010). Nowadays, social television is a progressive field of research. However, the majority of existing social television systems is on a conceptual stage, or exist as lab prototypes, beta or pilot versions (Bloomberg, 2010). Regardless of the current state of research in this area, television has strong potential to support certain group of its users if used in an appropriate modification. The certain group is represented by elderly and the appropriate modification is e-learning. Increasing number of senior citizens in all economically developed countries have arisen the concerns related to active ageing. Active aging is the term adopted by the World Health Organization (WHO, 2002) to express the process of achieving a vision where aging, if it is to be a positive experience, needs to be accompanied by continuous opportunities for health, participation and security in order to enhance people's quality of life as they age. The word "active" refers to continuing participation in social, economic, cultural, spiritual and civic affairs, not just the ability to be physically active or to participate in the labour force (Giráldez and Casal, 2008). Moreover, the concept of Ambient Intelligence which is effectively employed within various realms while building better and helpful environments (Mikulecký, 2010) proves its advantages for discussed purposes as well. Therefore, this can be utilized to create natural and intuitive supportive spaces for elderly within the environments they live in. The paper focuses on the particular technology. It describes how digital television based on interactive digital technology can become e-learning medium for elderly; provides results and new knowledge about this domain, which were reached during the solution of the European projects Enhanced Learning Unlimited (ELU) and Vital Mind, and the national scientific project Smart

Bureš V., Ponce D., Čech P. and Otcenášková T..
INTERACTIVE DIGITAL TV AS THE E-LEARNING PLATFORM - Towards Supportive Environments for Elderly.
DOI: 10.5220/0003623701070113
In *Proceedings of the International Conference on Knowledge Management and Information Sharing* (KMIS-2011), pages 107-113
ISBN: 978-989-8425-81-2

Environments in Workplaces (SMEW); suggests further research activities, which can lead to full development of this platform as a basis for social interaction of individuals; and explains reasons that make this type of research necessary.

2 IDTV TECHNOLOGY AS A PLATFORM FOR LEARNING

Digital broadcasting becomes a reality in many European countries and also worldwide. After west and north parts of Europe in late 1990's, digitalisation has been introduced in countries in Central and Eastern Europe. Arrival of digital television has brought new opportunities for viewers who can interact with television by requesting and obtaining additional information, selecting different view angles of camera, playing games or accessing internet and e-mails. Enhanced possibilities of interactivity bring also a chance to exploit iDTV as a educational medium (Mikulecká et al., 2006). On the path leading to complete development of an appropriate content in a form of interactive audio-visual (iAV) applications and smooth realisation of learning processes, it is necessary to overcome many obstacles of different types, e.g. cultural, technological, psychological, social, or organisational ones (Atwere and Bates, 2003).

As the social interaction among people is strongly influenced by utilized technology, a brief introduction to iDTV technology and related interactive applications needs to be provided. The following paragraphs provide outline of key aspects of iDTV and depiction of digital television technology from the e-learning perspective.

From the technological point of view it is important to assure that beside the main audio visual (AV) signal, which represents the one-to-all interaction, all data necessary for launching iAV application, which serves for the one-to-many interaction, will be broadcasted. The process should be conducted as follows (see figure 1): the main signal containing for example movie (DVB stream) is broadcasted through space, received on the broadcasting channel by TV receiver or set-top box, and then processed and displayed on TV screen. Apart from broadcasting channel it is possible to use also return channel with some limitations (e.g. incomparably lower data limit).

In case of the global interactivity, i.e. when there is a feedback from the viewer to the broadcaster (in comparison to the local interactivity, in which there is only a loop between the user and his/her digital receiver with stored iAV application), the viewer can send data back to the broadcasting organisation. Nonetheless, the main broadcasting channel has its own limitations, too. Absolute majority of the communication capacity of the channel is occupied by the AV signal itself (i.e. by movie displayed on TV screen). It means that only a fraction of the channel capacity can be used for transfer of data related to iAV application. Leeway for iAV applications varies by individual broadcasters. This aspect of iDTV, posing requirements on size of iAV applications, has to be respected during their development.

In this vein, digitalisation leads to a qualitatively new TV environment. iDTV has potential to widen possibilities of social interactions from home environment. An important role is played by key elements of iDTV, such as (Bureš, Ponce and Čech, 2008):

- Availability – TV sets are currently more widespread in European households than PCs,
- Ease of use – relatively long history of TV usage has made the operation of TV equipment common for all generations, from youngsters to elderly,
- Interactivity – iDTV offers interaction at both local and global levels.

3 SPECIFICS OF ELDERLY PEOPLE

The number of elderly people is increasing all around the world. Particularly in Europe, the progressive ageing of society is already likely to become more noticeable over the next several decades. Its population is aging and more and more people encounter problems related to an old age (Melzer et al.1997).

Figure 2 depicts the projection of long-term care (LTC) expenditures as a percentage of Gross Domestic Product in England till 2031. While the first column represents the base case, the second and third columns in figure 2 show, respectively, the impact of using the high life expectancy and low life expectancy variants to the Government Actuary's Department principal population projections. The fourth column shows the results of assuming that the numbers of people aged 85 or more will grow 1% per year faster than projected by Government Actuary's Department. The fifth column shows the impact of a decline of 1% per year in the prevalence

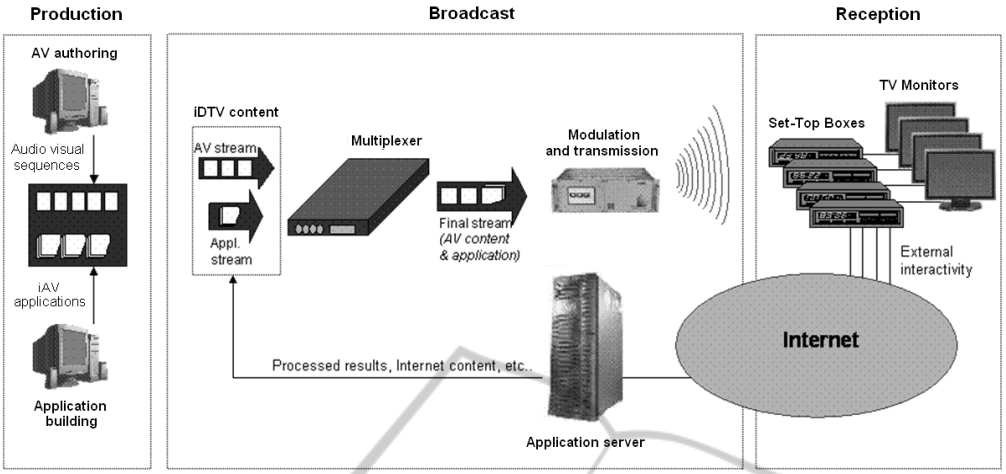

Figure 1: Process of the communication in the frame of iDTV (adopted from (Bureš, Ponce and Čech, 2008)).

of mild cognitive impairment, and the last column shows the impact of a decline of 1% per year in the prevalence of moderate to severe cognitive impairment (Comas-Herrera et al., 2003). Moreover, age related problems such as cognitive, sensory and physical impairments occur even in case of healthy elderly and they are accompanied by an accumulation of mild but progressive loss of efficiency in all senses and organs. Elderly live often in social exclusion, i.e. without family or friends, lacking of social contact, with lower incomes, or insufficiently involved in pleasurable social activities (Miotto et al., 2008). The social exclusion can be even reinforced by progressing impairments (CI).

To compensate the problems and the lack of social contact as well as to support the needs of elderly in active aging, supporting tools are needed. Several studies have analyzed the relationship between the elderly and new technology in general. Various factors such as attitudes toward technology, perceived usefulness and acceptance of that technology were explored. Results showed that elderly population would show a strong tendency to reject new products which had apparently been designed to cater to some kind of "special need", as many elderly people do not want to be considered as being distinct from the rest of the population (Miotto et al., 2008).

Information and communication technologies (ICT) can potentially enable the elderly to remain socially linked to networks of relatives, caregivers and friends. Virtual communities that have grown up around disease support groups are an example of such an effect (Giráldez and Casal, 2008).

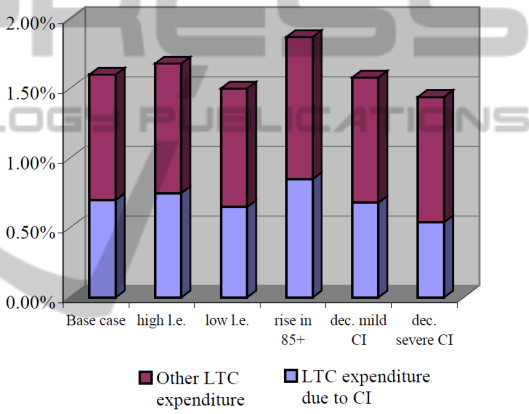

Figure 2: Projected LTC expenditures as a % of GDP, England 2031, (Commas-Herrera et al., 2003).

Unfortunately, many elderly have limited computer skills and are more or less computer illiterate. Therefore, they cannot benefit from the growing number of computer programs designed to preserve cognitive abilities. Nevertheless, senior citizens are familiar with one specific technology - television. TV creates a specific environment that is characterized by several unique attributes in comparison to other environments created, for instance, by ICT. These are lean-back attitude (in comparison to lean-forward attitude), or lazy-interactivity (in comparison to active interactivity (Jensen, 2005)) to name the most significant ones. In addition, watching television is traditionally perceived as a way of relaxation mixed with entertainment. TV is also a source of information and has been utilized as a learning medium for many decades. Moreover, in relation to the above mentioned problem, elderly represent the largest

proportion of the television viewing public: evidence of the fact that elderly people spend more time watching television than other age segments are presented both in past and recent research ((Miotto, 2008), (Eggermont and Vandebosch, 2001)).

In the following section we present two iDTV applications that can support learning of elderly.

4 ILLUSTRATIVE IDTV APPLICATIONS FOR LEARNING

Many elderly seek actively ways how to keep pace with changing society they are part of. For example, courses specially designed and offered to elderly by universities are becoming more and more popular. By attending such courses the elderly not only learn what they did not have previous opportunity to learn or what is the latest achievement of the science and technology but they also interact socially with similarly interested and minded people. When physical impairments make personal attendance difficult or impossible, an alternative way of delivery of the course and realisation of the presence and communication of the attendee can be helpful, for example in the form of an iDTV course with full interactivity. Development of such courses was researched in the framework of the European project Enhanced learning unlimited (ELU) and details are given in the section 4.1.

Elderly are often concerned with their decreasing cognitive abilities. Many mental activities they naturally perform may have positive effect on cognitive capabilities. As stated by (Breznitz, 2009), certain kind of games can serve as appropriate tools for sharpening one's wits. Nevertheless, every game has its own limitations in sense of narrow band of cognitive skills that it exercises. For instance, chess require and train visual perception, long term focusing of attention, and memory for similar positions, while the game Bridge trains short-term memory and some basic combinatorial skills, or crossword puzzles exercise almost exclusively retrieval from lexicon, and are often repetitious.

A scientifically grounded and specially designed cognitive training program focused on exercising the weakest cognitive abilities such as visual short-term memory, divided attention, time estimation, or visual scanning, on contrary to mostly strong cognitive abilities such as naming, spatial perception, inhibition, or awareness (Cognifit, 2009) can have much wider and deeper effect. Producing such a program with use of iDTV technology enables to incorporate interactivity which opens door to social inclusion. Development of such cognitive training program has been researched in the framework of the European project Vital Mind and details are given in the section 4.2.

Resulting applications of both projects have successfully undergone tests. Easy use of iDTV applications demonstrated that iDTV technology can serve development and support of virtual learning communities of elderly. Nevertheless, some

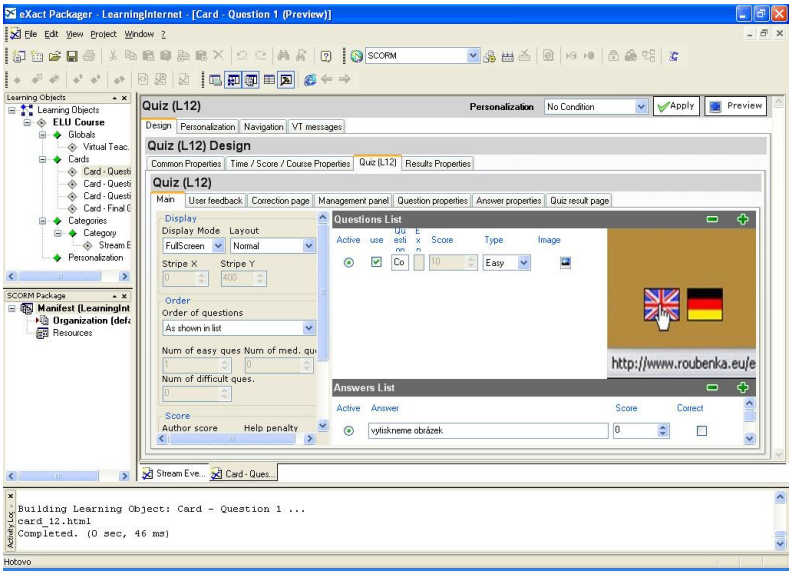

Figure 3: Authoring Tool for iDTV application development.

Figure 4: Cognitive Training of Seniors.

minor technical problems were detected as well.

4.1 Life-long Learning

The ELU project was focused on investigation of ways to increase the use of television for t-learning activities and it researched, developed and implemented pedagogical scenarios for the use of iDTV in t-learning at home, universities and schools (ELU, 2011). Project objectives included:

- Study of the pedagogical and technological aspects of using iDTV as the medium for t-learning,
- Development of new tools for creating content for t-learning to be used on iDTV.

The project developed a methodology for t-learning system production. The t-learning system used an open platform Multimedia Home Platform (MHP). The technology required to enhance the MHP to function as t-learning middleware was also designed and implemented. In order to demonstrate ways of t-learning on an iDTV platform and to test the effectiveness of iDTV, several specific contents were also developed with the help of the designed authoring tool (see screenshot at figure 3). The content was SCORM-compatible. T-learning content material was delivered to users in a manner that was generated to meet the user's learning context in terms of the users' learning preferences, the selected pedagogic strategy, monitored skills & competencies and the interaction capabilities of the means of delivery. The research proved that the iDTV technology can be used as a learning platform. However, several drawbacks and thus research challenges were identified. Further details related to created courses or used technology can be found in (ELU, 2011).

4.2 Cognitive Training

The Vital Mind project is focused on design and development of cognitive activities to enhance the basic elements of cognition and to improve quality of life for senior citizens, and development of new methods for user control by detection of hand movements using vision and/or gyro and of non-voice vocal commands (VitalMind, 2011). The project uses a combination of cognitive psychology, the television medium and advanced interactive ICT to enable the elderly to actively participate in mind fitness exercises while they are sitting in front of their TV set (see figure 5). The main objectives of the project include:

- Design and development of cognitive activities to enhance the basic elements of cognition and to improve quality of life for senior citizens,
- Development of new methods for user control by detection of hand movements using vision and/or gyro and of non-voice vocal commands.

The main benefits of the Vital Mind project is the fact that the project provides the elderly and disabled viewers with new cognitive-based exercises and it also improves the user interface to overcome the difficulties encountered by elderly people in their attempts to use a range of services made available through an advanced interactive television system. Vital Mind project strives to transform the passive television viewing into dynamic activities of mental preservation and intellectual enhancement. Such

cerebral stimulation in a mentally rich environment is crucial for healthy aging. This should be ensured by a tool that would be easily integrated in the homes of handicapped individuals to speed the rehabilitation process. While technology is currently in use, the effect of congnitive training is still in the stage of data analysis. Description of achieved results can be found at (VitalMind, 2011).

5 IDTV AS A E-LEARNING PLATFORM: FUTURE RESEARCH

From the research perspective it is apparent that the communication process described at figure 1 has to work within several environments. Unfortunately, these are mostly explored independently. Although each environment uses different tools or methods together they enable the whole communication and interaction process to be completed. These environments are:

- Broadcasting environment at broadcaster side,
- Receiving environment at end-user's home (e.g. set-top boxes),
- iAV application development environment and content authoring tool,
- Simulation and testing environment.

Therefore, in future research results achieved in particular areas, e.g. human-television interaction, or development of enhanced STB features, need to be interrelated.

Moreover, the extent in which particular environments are investigated differs. There is still lack of activities focused on creation of iAV tools and applications that would enable end users to work with the content (log writing, publishing, downloading, sharing or modifying existing content). For example, with no user identity management system it is hardly possible to foster content sharing within a community. In this vein, the existing broadcaster-to-user (one-to-all or one-to-many) interaction could be extended by user-to-user or user-to-broadcaster (one-to-one) interaction. To do so, both possibilities of currently available infrastructure and related business models need to be investigated. Thus, iDTV could become full e-learning medium.

6 CONCLUSIONS

Basically, there are two general changes supporting the establishment of iDTV as a e-learning medium. Firstly, the digital TV broadcasting is being fully introduced in many countries continuously. Thanks to unique characteristics of the TV environment such as lean-back attitude or lazy-interactivity the iDTV technology can take advantage of its basic features and use them as a platform for learning of particular user groups. Secondly, there is the aging society accompanied by growing quantity of age related impairments. Therefore, elderly people can serve as an appropriate example of the abovementioned user group. Moreover, for elderly TV represents a well-known and friendly environment. For this reason two interactive applications were developed in the framework of two European research projects. While the first one deals with education possibilities in the iDTV environment, the second one is focused on cognitive training. In this way senior citizens can become members of two purposefully created social communities which try to assist them with their needs (education) and problems (cognitive impairments). Developed applications were successfully tested in practice. It was proved that due to availability or easiness of its use the iDTV environment is an appropriate technology for development and support of virtual learning communities of elderly. However, these tests also revealed problems that need to be solved. For instance, how the technology can be further modified to support development of the concept "smart workplace" (Mikulecký, 2009) focused primarily on elderly and their living environments.

ACKNOWLEDGEMENTS

This paper was created with the support of the of the GAČR project SMEW, project num. 403/10/1310 and the Vital Mind project - 7th EU Framework Programme project num. 215387. Authors would like to thank to all consortium members and the coordinator.

REFERENCES

Atwere, D. and Bates, P., 2003. *Interactive TV: a Learning Platform with Potential*, London: Learning and Skills Development Agency.

Bloomberg, L. P., 2010. *Social Television*. [online] Available at: <http://bx.businessweek.com/social-television/news/> Accessed [21 March 2011].

Breznitz, S., 2009. *CogniFit Training: The key to cognitive vitality*. [online] Available at:

<http://www.cognifit.com/science/cogtraining> [Accessed 21 March 2011].

Bureš, V., Ponce, D. and Čech, P., 2008. Digitalization of Europe: a New Challenge for Education. *Problems of Education in 21st Century* 2008(5), pp. 43-54.

Čech, P. and Bureš, V., 2007. Recommendation of web resources for academics - Architecture and components. *WEBIST 2007: Proceedings of the Third International Conference on Web Information Systems and Technologies, Vol WIA - WEB INTERFACES AND APPLICATIONS*. Spain: Barcelona, pp. 437-440.

CogniFit Personal Coach Demo, 2009. [online] Available at: <http://www.cognifit.com/science> [Accessed 21 March 2011].

Comas-Herrera, A. et al., 2003. *Cognitive Impairment in Older People: its Implications for Future Demand for Services and Costs*. PSSRU Discussion Paper, 1728/2. [online] Available at: <http://www.pssru.ac.uk/pdf/dp1728.pdf> [Accessed 20 March 2011].

Eggermont, S. and Vandebosch, H., 2001. Television as a Substitute: Loneliness, Need Intensity, Mobility, Life-Satisfaction and the Elderly Television Viewer. *Communicatio South African Journal for Communication Theory and Research* 27(2), pp. 10-18.

Enhanced Learning Unlimited (ELU), official project web site, 2011. [online] Available at: <http://elu-project.com/> [Accessed 20 March 2011].

Giráldez, M. C. and Casal, C. R., 2008. The Role of Ambient Intelligence in the Social Integration of the Elderly. In: G. Riva et al., eds., 2008. *Ambient Intelligence: The Evolution of Technology, Communication and Cognition Towards the Future of Human-Computer Interaction*. Amsterdam: IOS Press.

Jensen, J. F., 2005. Interactive Television: New Genres, New Format, New Content. *Proceedings of the Second Australasian Conference on Interactive Entertainment*. Australia, Sydney, pp. 89 – 96.

Melzer, D., Ely, M. and Brayne, C., 1997. Cognitive impairment in elderly people: population based estimate of the future in England, Scotland, and Wales. *British Medical Journal* 315(7106), pp. 462.

Mikulecká, J., Rohrová, H., Belotti, F., Napoletano, L., 2006, Designing a constructionistic framework for T-learning. *Lecture Notes in Computer Science* 4227, pp. 549-554.

Mikulecký, P., 2009. Remarks on Ubiquitous Intelligent Supportive Spaces. *Proceedings of the 15th American Conference on Applied Mathematics/International Conference on Computational and Information Science*. USA, TX, Houston, pp. 523-528.

Mikulecký, P., 2010. Large-scale Ambient Intelligence. *DNCOCO´10 Proceedings of the 9th WSEAS international conference on Data networks, communications, computers*. Porto, Portugal, p. 12.

Miotto, A. et al., 2008. *Elderly Needs and Use Cases,* Vital Mind Project Deliverable 2.1. [online] Available at: <http://www.vitalmind-project.eu> [Accessed 20 March 2011].

Poulová, P., Šimonová, I., 2010. eLearning at Czech Universities in 1999-2010. *Proceedings of the 9th European Conference on e-Learning*. Portugal, Porto, pp. 488-496.

Vital Mind, official project web site, 2011. [online] Available at: <http://www.vitalmind-project.eu/> [Accessed 20 March 2011].

World Health Organization (WHO), 2002. *Active Ageing: a Policy Framework*, Second United Nations World Assembly on Ageing. Spain: Madrid. [online] Available at: <http://whqlibdoc.who.int/hq/2002/WHO_NMH_NPH_02.8.pdf> [Accessed 20 March 2011].