

Deep Design for Ambient Intelligence

Toward Acceptable Appliances for Higher Quality of Life of the Elderly

David Zejda

Faculty of Informatics and Management
University of Hradec Králové
Hradec Králové, Czech Republic
e-mail: david.zejda@uhk.cz

Abstract—Deep design outlined in the paper is a new approach, where not only tasks, immediate emotions or habits and behaviours are considered. Deep design aims to identify sources of emotionally rich and strong experiences and feelings in order to augment them subsequently by means of smart technology. The most intrinsic needs of users, their deep needs, should be revealed and reflected in the process. Evaluation of a new technology is described as a successive process, starting with immediate decision, followed by short-term acceptance and finally long-term appropriation driven by the deep needs in a role of high order reinforcers. Deep design builds on various existing human-centric and emotion-driven approaches, but brings them further, or maybe rather deeper, bringing deep psycho-technical and socio-technical factors on the highest levels of importance. The idea of deep design is being introduced in a context of ambient technologies for elderlies, because actually there are certain dissonances in what do elderlies need and what many current intelligent technologies offer. As we show in the paper, our research in sources ranging from gerontology to ambient intelligence revealed four clusters of deep needs of elderlies - social touch, autonomy with anticipated support, feeling of being competent and feeling of helpfulness and self-worth.

Deep design; ambient intelligence; elderlies; old age; quality of life; acceptance; appropriation; human-centric design

I. THE ELDERLIES AND THEIR NEEDS

Proportion of elderly population grows steadily in developed countries. According to statistics published by Eurostat there were 15.1% of people over 65 in European Union in 1997, while in 2008 it was 17.0% [1]. That's a vital sign of achievements in extending life span. But, age is not the only criterion how to define elderlies. Ageing may be viewed as simply getting more years, as a biological process, or e.g. as a process of transition through certain life stages. Aged people themselves put distinction between normal ageing and what they call 'real old age'. Normal ageing is indicated by slowly progressing age-related diseases such as diabetes, arthritis, Alzheimer's disease and by gradual cognitive decline. By contrast the real old age brings sharp decline in both mental and physical abilities. [2] Because of negative connotations, elders only seldom perceive themselves as being old, rather they tend to view themselves as 'getting old' [3]. For the purpose of the article elderly people are those, who are likely retired, facing physical and mental decline, but able to live independently, only with partial or occasional care and

support. Some of those elderlies live in households of their families, others live alone, maintaining their own household, or take advantage of institutional care.

In retirement institutions usually there is the greatest level of assistance and care available. But, as described in the latter, the high level of care is not the main source of contentment for those who perceive the institutional setting as beneficial. Rather, users commend if the setting allows them to e.g. overcome their loneliness through meeting new people. On the other hand, elderlies often prefer ageing in place, in their well-known surrounding, near to family, despite the poorer tangible support there. They perceive the move to an institutional setting as a loss. As one cause of the negative feelings, professional care often mutates into control [4]. People do not wish to be controlled and elderlies are not an exemption. Further, previous heterogeneous social connections comprising people of all generations are often damaged, disturbed or even destroyed in retirement institutions [4], emphasizing the feeling of being really old and powerless.

People affected by age-related decline may benefit from various intelligent technologies, from simple appliances to greatly complex systems, such as whole aware, smart or intelligent homes. Some of the technologies allow elderlies to live in the home setting more independently, feel more capable, keep in contact with their close. But on the other hand, many projects tend to be more technology-centric than human-centric, neglecting the real wishes of elderlies. There are e.g. various sensoric monitoring systems aimed on fall or other crisis detection, various cognitive support systems such as reminders, pushing users to take medication timely. The systems have certain value, but they indeed focus on care-givers more than on care-receivers. [5] To deliver technologies perceived as beneficial by elderlies, the designers have to hold back of technology and adopt users' patterns of thinking [6]. Smart and potentially beneficial systems may be accepted reluctantly or even refused, if designers neglect the real needs. Reasons for refusal may be even quite trivial, such as placing or framing, non-suitable metaphor used, or some design detail, as shown e.g. in experiment with photo frames. [7]

II. THE METHOD OF RESEARCH

In order to identify the key factors of acceptance we examined various sources ranging from ambient technologies for elderlies, through design and engineering methods to sociology, psychology and gerontology. Having heterogeneity

of the sources on mind, we decided for a free cognitive method of research:

1. take down both main conclusions and edge results and findings related to the area of interest
2. intuitively group the results to logical clusters
3. follow ideas in each cluster to conceptualize the key theme behind

The aim was to find a solid basis for what we finally called deep design approach, basis rooted in published statistics and other published data. Conclusions presented in the paper should be further evaluated by direct field-research, technology probes, or emphatic design.

III. HUMAN-CENTRIC DESIGN APPROACHES

In the centre of our approach there are humans and their feelings. The idea of human-centric design is not new, of course. E.g. Hartikainen [8] mentioned that effectiveness-focused usability as defined in ISO 9241-11 can not explain which technologies will be adopted by users. People are more complicated beings than physical and cognitive processors, able to carry out work. Jordan [9] pointed out, that task-centric approaches may be highly dehumanizing.

Emotions-driven Approaches

Norman [10] examined primary role of emotions in our ability to understand the world and to learn new things. Kano [11] has brought marketing technique used for measuring customer content, known as kano satisfaction model. Products should be designed to be joy to own and use them, the pleurability acts as a highly important prerequisite of acceptability [6]. Even appliance with usually negative appeal may be accepted if designed with emotions in mind, as shown in experiment with wheel-chair. [12]

Behaviours-centric Approaches

To get closer to humans, it may be advisable to move the design to users' everyday context, e.g. Kikin-Gil [13] recommended instead of focusing on tasks and functions to look on people and their behaviours. Hartikainen [8] favours human-centric in-place testing to lab experiments. Various methods and techniques have been developed for human-centric and mind-centric design, e.g. Vogiazou et al. [14] introduced 'design for emergence' where users are being observed in their daily activities to reveal unpredicted behaviours. Unexpected use cases may become fruitful source of ideas for iterative design. Similarly, technology probes bring high level of serendipity, possibly leading to breakthrough ideas. [15]

The Deep Design

Though much closer to human's needs, the ideas of both emotion-driven and behaviour-centric design are still not sufficient to hit the deep virtue of appropriation process. We have also relatively stable hopes and dreams, sorrows and fears, desires and aspirations, which drive or fuel both our emotions and behaviours. Actually, that make us human. Affinity towards a pleasurable appliance is typically derived, stemming from these deeper grounds. The things which people

usually like most are those with perceived psychological or social extent, either hidden or apparent. Elderlies do like souvenirs for the memories captured, they perceive communication devices as means to be in touch with their close, they appreciate the old grey photos for those who are depicted on them [7].

We wished to examine how to make ambient technologies more accepted by elderlies using some design, engineering or evaluation approach primarily aimed to target the deep needs. Some of the aforementioned approaches are getting relatively close to the idea and there are some more – e.g. Kikin-Gil's [13] proposed engineering approach take social structures into account, products are being designed in order to increase social effectiveness of users. Though various good ideas were examined already, we have not found any comprehensive design or engineering approach which would systematically lead designers to reveal and target deep needs of prospective users. The lack led us to start research on the approach which we called deep design.

Tab. 1 captures fundamental differences between approaches. The table is grouped by focus of the approaches and is ordered by closeness of the focus to the idea of deep design, from more mechanic and shallow to the deepest. Higher-level approaches either involve or imply results of lower-level approaches, such as that emotions-focused product has to be reasonably usable in parallel.

TABLE I. VARIOUS TECHNOLOGY DESIGN APPROACHES

focus	methods	target
task	use cases, goals, scenarios, ...	effectiveness, efficiency,
human	usability testing, prototyping, ...	usability, utility, accessibility
emotions	kano model, emotion-driven design, affective computing, ...	immediate emotional benefit, pleasure
behaviours	technology probes, design for emergence, emphatic design, ...	unspoken, tacit behavioural patterns,
deep needs	deep design	harmony, long-term acceptance, perceived quality of life

The table shows design approaches grouped by focus and ordered from shallow to deepest.

IV. ACCEPTANCE AND APPROPRIATION

People are economy beings and they do what makes sense to them and what brings highest possible utility. Of course, elderlies are not an exception. The rational evaluation applies step-by-step in all phases of the acceptance process, from immediate decision-taking to long-term getting-familiarized-with, continuously comparing utility with costs in terms of both price and also e.g. anticipated effort necessary to master complex interface. People usually do not like to change themselves. Apparently, the perceived benefit of evaluated technology has to significantly outweigh the costs. But besides this, it has to succeed in competition with the best time-spending alternative available, maybe some habitually rooted and immediately convenient, some which does not require effort to learn or change anything. The idea of competing activities has been examined e.g. by Pujol et al. [16] in a study

on love-promoting technology. Also Becker [17] applied models known from economics on various human behaviours, resulting in a whole rational choice theory.

The process of evaluation could be split into consequential phases:

1. immediate decision taking
2. short-term evaluation
3. long-term appropriation

Successful product has to pass all these phases. Reversely, refusal in any phase results in product failure.

1. Immediate Decision Taking

First, a technology has to succeed in immediate evaluation, when a prospective user decides, whether to give it a try or not. Various immediate emotions take place in the phase, such as anxiety of the unknown, lack of concentration on one hand and excited curiosity or wish to adhere to positive recommendation on the other hand. According to Vastenburg et al. [18], for elderlies the direct anticipated short-term emotional benefit of a technology must be strong and immediately clear to outweigh anticipated short-term cost in terms of both price and also e.g. effort necessary to master complex interface.

2. Short-term Evaluation

If benefits are clear and strong, resulting enthusiasm (euphoria) positively bursts also following short-term evaluation. But, even a technology keenly accepted first may fail soon, if it does not bring anticipated benefits sufficiently quickly. Time frame available is determined by level of initial euphoria. Symptoms of the described acceptance process arisen in various studies. For example, in experiment aimed to increase social connectedness among patients, family, and care-givers in spinal cord lesion rehabilitation centre by photo sharing, amount of photos shared gradually decreased. [19]

3. Long-term Appropriation

Compared with technology adaptation or adoption, the idea of appropriation [20] is more focused on the strengths which causes, that certain technology is getting used in daily habitual manner. In the process of appropriation lasting aspirations of user, his desires, valued social relations or other deep needs have to be hit by the technology and the user have to either clearly or subconsciously but above all perpetually perceive, that they have been hit.

V. THE APPROPRIATION MODEL

Carroll et al. [21] provided insight into minds of young people and the strengths behind evaluation of novel technologies by them. The model has been built upon questionnaires, scrap books, observation and online diaries. The authors focused on youngsters. We selected some core ideas of their appropriation model to refine them for scenario of elderlies evaluating intelligent technologies.

The appropriation model defines attractors, repellents and appropriation criteria, sets of forces which together act their respective roles during the process. Attractors and repellents

take effect in the initial evaluation. Prospective user is positively motivated if a product is cheap, convenient, seems to be controllable, usable, fashionable, familiar, “our stuff” and dissuaded if it is costly, inconvenient, controlled, frivolous, unfashionable, unfamiliar, “their stuff”. Repellents and attractors keep certain role in following phases, but some more permanent sets of forces, appropriation and dis-appropriation criteria, start to influence the user. User keeps in using the technology if it support what's important for him – his social life, leisure, management of information and when the technology e.g. brings safety and security. Critical mass of usage has to be reached timely. User on the other hand turns away if he finds out, that there is a hidden cost in using the technology, if the technology negatively affects his life, if it is somehow unusable or non-learnable. Finally, yet another forces called higher order positive or negative reinforcers turn the scale. While attractors and repellents are immediate factors, higher order reinforcers stem from deep needs.

Emotion-driven design approaches focus on immediate factors, which is not enough. According to Carroll et al., designers need new design techniques, more sensitive to the lasting psychological and sociological nature of the appropriation criteria and reinforcers. In a latter work [22] they offer scenario-based participatory design technique. This and other behaviour-focused approaches target the forces driving the short-term evaluation stage and eventually may lead to higher acceptance even in long-term. Tab. 2 shows possible forces driving particular phases of evaluation. Next section of the paper presents results of our search for long-term appropriation forces driving elderlies.

TABLE II. PHASES OF TECHNOLOGY EVALUATION

phase	positive forces	negative forces
immediate decision taking	appeal, excited curiosity, wish to adhere to positive recommendation, apparent short-term benefit, low price, ...	anxiety of the unknown, lack of concentration, anticipated usability issues, high price, ...
short-term evaluation	enthusiasm, euphoria, truly perceived benefit, joy and pride for managing the interface, ...	usability issues, disillusion, negative side effects, hidden cost, ...
long-term appropriation	dignity, self-worth, social needs, ...	deep needs not satisfied or deep needs affected

The table shows which forces drive consequential phases of product evaluation.

VI. DEEP NEEDS OF ELDERLIES

Youngsters' reinforcers consist of e.g. power, identity or fragmentation. [21] To reveal deep needs of elderlies, which act as a source of their high order reinforcers in the model, we have to ask the correct questions. We should not ask what others think the elderlies wish and need, but rather what do *the elderlies* need and what they *really* need, what they think or even better what they *feel* they need. So, what they need? To be cared? Not so. To be monitored? Of course not! Our explorative research as shown below resulted into four interrelated clusters of deep needs of elderlies:

- A. social touch
- B. autonomy with anticipated support

- C. feeling of being competent
- D. feeling of helpfulness and self-worth

In each section we are presenting the raw findings first, and turning them into basic general guidelines for ambient technologies consequently.

A. Social Touch

The most apparent desire of elderlies in most of the papers examined was to keep their social connections alive and healthy. How to capture the essence of the need as precisely as possible? There were many terms invented to capture various modalities of social relationships, such as a ‘social presence’, ‘the ability of a communication medium to emulate face-to-face presence through its capacity to carry interpersonal communication cues; different media or systems can be directly evaluated with respect to how close they emulate the experience of face-to-face interaction between humans’ [23] or ‘social connectedness’, ‘a positive emotional appraisal, characterized by a feeling of staying in touch communication medium, in the context of social and within ongoing social relationships’ [24]. Though the second term is quite close, we should abstract from technology to reveal the most inner needs.

Elderlies particularly appreciate deep relationships with strong positive emotional content and prefer them to wide but shallow relations. They wish to stay in touch with their close and with family members in particular. They wish to look in lives of their close but do not wish to be looked upon. [3] The mixture consists of

1. awareness of daily life, ‘daily contact between family members, as opposed to the lack of an alarm’ [4] (focus on information),
2. feeling of closeness, ambient intimacy, ‘being able to keep in touch with people with a level of regularity and intimacy that you wouldn’t usually have access to, because time and space conspire to make it impossible’ [25]. (focus on persistence)
3. affective awareness, ‘the general sense of being in touch with someone’s friends and family’ [26] (just the ambiguous sense)

Summarizing these modalities, elderlies yearn after closeness, they wish to perceive that they have a valuable social role, they wish to be updated with ongoings of their close. This is something what we call the social touch. Keeping in social touch brings comfort and peace of mind [4] and lowers a pain of cognitive decline. [27]

Design guidelines: Designers should focus on relationships which already exist first rather than building new [3]. Vastenburger et al. [18] recommend to leverage relations instead of supplanting them and similarly Neustaedter et al. [28] suggest to not replace existing awareness-gathering techniques, but augment them. Sadly, elderlies often have unmet their communication needs [15]. Technology should provide ‘mediated awareness’. It should surrogate or re-establish natural social structures disrupted by distance, current pace of life, or by dehumanizing technology. [4]

B. Autonomy with Anticipated Support

Family and other caregivers should be at hand, willing to offer assistance when it is required, but ‘ageing well’ means, that the support is actually nearly never drawn. [29] Elderlies in general desire to feel autonomous and independent. [30] They wish to stay in touch with childrens’ lives, but imposing no intrusions to them. Children should avoid overprotectiveness, which brings stigmatizing and a loss of perceived independence. [3] Krause [31] brings interesting insight in the deep feelings behind various types of support provided to improve quality of life of elderlies. He distinguishes four fundamentally different types of support - emotional support, tangible support (e.g. cleaning, cooking), informational support (providing information), and anticipated support, the confidence that help will be provided if necessary. Both emotional and anticipated support improved perceived quality of life. Informational support had no clear effect. Most interestingly, tangible support caused decrease in perceived quality of life. According to Krause, inability to reciprocate tangible support results in sense of dependency, or implies incompetence.

Design guidelines: According to the findings, supportive technologies managed by relatives could be perceived negatively, increasing feeling of dependence. On the other hand, intelligent supportive technologies mainly or fully managed by elderlies themselves, lowering need of tangible support from relatives or others, could be accepted much more. Positively perceived emotional and anticipated support could be increased by easy-to-use pervasive communication devices.

C. Feeling of Being Competent

Besides the most valued relations (typically family relations), social links within a local community are desired too. [32] Particularly elderlies in an early phase of cognitive and physical decline appreciate diversity in relations and extensiveness of relations besides relation deepness. While asymmetry in relations with close family is desired – elderlies prefer to watch instead of being watched – with social peers (contemporaries, various people in a local community) they wish to feel competent, equal. [3] For the relations it is vital if elderlies are acknowledged with their own impairments and if they do not strive too much to hide them. Rather than if they are pretending competence, they are likely to feel happy if they may exploit most of the remaining abilities. [27] On the other hand, the acknowledgement should not overgrow into feeling of incompetence.

Design guidelines: The desire to feel competent in both relations and life in general could be reflected in technologies augmenting or extending social network of their users. Intelligent technologies could be used to provide convenient interfaces to social networking sites for those who are not able to manage graphical user interfaces based on metaphors not close to elderlies, such as menus, windows, dialogues etc. Feeling of competence could be further supported by higher adaptability and customization, while keeping it as simple and usable as possible.

D. Feeling of Helpfulness and Self-worth

Reciprocity in relations is not always necessary, or even desirable by elderlies, especially when dealing with children.

We already mentioned positively perceived asymmetry in communication patterns (look at but not being looked at). Desire to keep similar pattern in field of support and care has been observed too. [3] In general, elderlies do not wish only to stay autonomous, but they wish to influence others [27], to be and to feel helpful and important for their close. They wish to feel that they are indeed perceived as helpful and important by those who receive their support. The virtue of pleasurable giving is further supported by cultural and religious heritage (e.g. [33] Acts 20:35) which makes the giver feel even more dignified.

Design guidelines: In the case of those whose opportunities to help and influence others have been limited by their impairments we should focus to support renegotiation of roles of importance. [29] Hofmeester et al. [34] show how, by thinking of older people as active participants in society rather than as needy and dependent, innovative designs have been developed for systems that help elderly people remain vital part of the community. These elderlies, supported by appropriate technology, may use their memories, experience and time to take various valuable roles. They may act as a living memory of the community, as a guide, commentator, or a valuable family member, of course.

VII. DISCUSSION ON FEASIBILITY

Development of ambient environments is a complex task, because their features and functions can neither be comprehensively predefined nor anticipated because of various emergent or synergic effects. [35] Further, Dix [36] argues that it is virtually impossible to design directly for long-term appropriation, because, as he says, appropriation is something unexpected or even unexpectable. Designing for appropriation truly may look as oxymoron. But the product which reflects deep needs of people will likely become not only enthusiastically accepted, but also adopted and gradually appropriated. So, if we sufficiently understand the process of appropriation and especially if we manage to identify the correct high order reinforces, we *may* intentionally design for appropriation. And that's what deep design is all about - reveal deep needs as a source of the reinforces and reflect them in product. Deep design approach recommends to ask questions from the other side - while designers aware of human needs usually ask "how the product reflects users' needs?", deep designer asks "which product would reflect the deep users' needs most closely?"

Other argument could target the fact, that we assumed elderlies as a relatively homogeneous group, characterized by certain impairments caused by age and by similar values, habits and patterns of thinking. We agree, this presumption brings arbitrary simplification, because elderlies are *not* a homogeneous group, actually individuals differ greatly in all the aspects and in many more. Each member of the group has his own personality. His values have been formed by range of forces during the whole life. Social setting, health state, religion, cultural heritage, country of residence, wealth or social status, hobbies, previous experiences, all these factors play their role in the appropriation process. It makes the design and engineering more complicated, emphasizing importance of adaptability and customization. Sometimes it could be useful to stratify elderlies according to additional criteria and focus on deep needs of the sub-group. But, despite

the complications, we are still convinced, that the revealed deep needs have sense for design, at least as a starting point.

VIII. CONCLUSIONS

There are dissonances in what elderlies really need and what many technologies indeed offer. To get ambient intelligence closer to elderlies and to improve the quality of their lives in very deed we have to focus on their deep needs first. Elderlies do not wish to be monitored, but they wish to keep their independence, they wish to live in their home, stay in touch with their close, feel competent and helpful and dignified. If the feelings are not being considered enough, elderlies do not adopt new technologies quickly or even refuse them. Proposed deep design approach brings researchers' and designers' attention to subtle psycho-technical and socio-technical questions, emphasizing deep needs of prospective users rather than product or a technology behind.

Process of user's technology evaluation may be described as series of successive steps, from immediate decision taking, short-term evaluation, up to long-term appropriation. Successful products have to pass all these phases – attract attention first and from short-term evaluation break into habitual usage later. Failure in any of the steps moves the product away from the scope of user's interest, which effectively means its refusal. In early phases some shallow emotions such as visual appeal, curiosity or euphoria drive the process. To increase the chance of acceptance there are two possible ways. If we increase initial euphoria, it may give us more time for the following phase; if we make the product easier to use, benefits may sooner positively outweigh the effort necessary. Successful product has to match neatly with user's living patterns and in particular it must target his deep needs. The deep needs, turned into high order reinforcements keep the product in use in the long-term.

Despite the amazing scientific and technological progress we probably do not live happier lives than our forefathers. Our lives in the age of unprecedented prosperity are fast and hurried. Many current technologies promote only shallow relations or even they are putting people apart. Will future intelligent appliances *indeed* improve our lives? Who knows?

ACKNOWLEDGMENT

Author wishes to thank Josef Zelenka and Peter Mikulecký for their valuable advices. The research was supported by grants:

GAČR no. 403/10/1310 – “SMEW - Smart Environments at Workplaces”

UHK FIM specific research no. 2110 – “Intelligent Social Technologies for Quality Life of Elderlies”

REFERENCES

- [1] Eurostat, “Proportion of population aged 65 and over.”
- [2] C. Degnen, “Minding the gap: The construction of old age and oldness amongst peers,” *Journal of Aging Studies*, vol. 21, Led. 2007, s. 69-80.
- [3] S.E. Lindley, R. Harper, a A. Sellen, “Designing for elders: exploring the complexity of relationships in later life,” *Proceedings of the 22nd British HCI Group Annual Conference on HCI 2008: People and Computers XXII: Culture, Creativity,*

Interaction - Volume 1, Liverpool, United Kingdom: British Computer Society, 2008, s. 77-86.

- [4] E.D. Mynatt, J. Rowan, S. Craighill, a A. Jacobs, "Digital family portraits: supporting peace of mind for extended family members," *Proceedings of the SIGCHI conference on Human factors in computing systems*, Seattle, Washington, United States: ACM, 2001, s. 333-340.
- [5] A. Miyajima, Y. Itoh, M. Itoh, a T. Watanabe, "'Tsunagari-kan' Communication: Design of a New Telecommunication Environment and a Field Test with Family Members Living Apart," *International Journal of Human-Computer Interaction*, vol. 19, 2005, s. 253.
- [6] E.R. Veldhoven, M.H. Vastenburger, a D.V. Keyson, "Designing an Interactive Messaging and Reminder Display for Elderly," *Proceedings of the European Conference on Ambient Intelligence*, Nuremberg, Germany: Springer-Verlag, 2008, s. 126-140.
- [7] L. Swan a A.S. Taylor, "Photo displays in the home," *Proceedings of the 7th ACM conference on Designing interactive systems*, Cape Town, South Africa: ACM, 2008, s. 261-270.
- [8] P. Hartikainen, "Usability of Social Ubiquitous Computing," (draft).
- [9] P.W. Jordan, *Designing Pleasurable Products*, CRC Press, 2002.
- [10] D.A. Norman, *Emotional Design: Why We Love (or Hate) Everyday Things*, Basic Books, 2003.
- [11] &. Kano, "Attractive quality and must-be quality," *Journal of the Japanese Society for Quality Control*, vol. 14, Dub. 1984, s. 39-48.
- [12] P. Desmet a E. Dijkhuis, "A wheelchair can be fun: a case of emotion-driven design," *Proceedings of the 2003 international conference on Designing pleasurable products and interfaces*, Pittsburgh, PA, USA: ACM, 2003, s. 22-27.
- [13] R. Kikin-Gil, "Affective is effective: how information appliances can mediate relationships within communities and increase one's social effectiveness," *Personal Ubiquitous Comput.*, vol. 10, 2006, s. 77-83.
- [14] Y. Vogiazou, J. Reid, B. Raijmakers, a M. Eisenstadt, "A research process for designing ubiquitous social experiences," *Proceedings of the 4th Nordic conference on Human-computer interaction: changing roles*, Oslo, Norway: ACM, 2006, s. 86-95.
- [15] H. Hutchinson, W. Mackay, B. Westerlund, B.B. Bederson, A. Druin, C. Plaisant, M. Beaudouin-Lafon, S. Conversy, H. Evans, H. Hansen, N. Roussel, a B. Eiderbäck, "Technology probes: inspiring design for and with families," *Proceedings of the SIGCHI conference on Human factors in computing systems*, Ft. Lauderdale, Florida, USA: ACM, 2003, s. 17-24.
- [16] R.S. Pujol a H. Umemuro, "Productive love: a new approach for designing affective technology," *Proceedings of the 27th international conference extended abstracts on Human factors in computing systems*, Boston, MA, USA: ACM, 2009, s. 2469-2478.
- [17] G.S. Becker, *The economic approach to human behavior*, University of Chicago Press, 1976.
- [18] M.H. Vastenburger, T. Visser, M. Vermaas, a D.V. Keyson, "Designing Acceptable Assisted Living Services for Elderly Users," *Proceedings of the European Conference on Ambient Intelligence*, Nuremberg, Germany: Springer-Verlag, 2008, s. 1-12.
- [19] M. Biemans, B.V. Dijk, P. Dadlani, a A.V. Halteren, "Let's stay in touch: sharing photos for restoring social connectedness between rehabilitants, friends and family," *Proceedings of the 11th international ACM SIGACCESS conference on Computers and accessibility*, Pittsburgh, Pennsylvania, USA: ACM, 2009, s. 179-186.
- [20] B. Magnus a K.M. Higgins, *The Cambridge companion to Nietzsche*, Cambridge University Press, 1996.
- [21] J. Carroll, S. Howard, F. Vetere, J. Peck, a J. Murphy, "Just What Do the Youth of Today Want? Technology Appropriation by Young People," *Proceedings of the 35th Annual Hawaii International Conference on System Sciences (HICSS'02)-Volume 5 - Volume 5*, IEEE Computer Society, 2002, s. 131.2.
- [22] S. Howard, J. Carroll, J. Murphy, a J. Peck, "Using 'endowed props' in scenario-based design," *Proceedings of the second Nordic conference on Human-computer interaction*, Aarhus, Denmark: ACM, 2002, s. 1-10.
- [23] John Short, *The social psychology of telecommunications*, (London, New York): .
- [24] N. Romero, P. Markopoulos, J. Baren, B. Ruyter, W. Ijsselstein, a B. Farshchian, "Connecting the family with awareness systems," *Personal Ubiquitous Comput.*, vol. 11, 2007, s. 299-312.
- [25] A. Java, X. Song, T. Finin, a B. Tseng, "Why We Twitter: An Analysis of a Microblogging Community," *Advances in Web Mining and Web Usage Analysis*, 2009, s. 138, 118.
- [26] O. Liechti a T. Ichikawa, "A Digital Photography Framework Supporting Social Interaction and Affective Awareness," *Proceedings of the 1st international symposium on Handheld and Ubiquitous Computing*, Karlsruhe, Germany: Springer-Verlag, 1999, s. 186-192.
- [27] M. Morris, J. Lundell, a E. Dishman, "Catalyzing social interaction with ubiquitous computing: a needs assessment of elders coping with cognitive decline," *CHI '04 extended abstracts on Human factors in computing systems*, Vienna, Austria: ACM, 2004, s. 1151-1154.
- [28] C. Neustaedter, K. Elliot, a S. Greenberg, "Interpersonal awareness in the domestic realm," *Proceedings of the 18th Australia conference on Computer-Human Interaction: Design: Activities, Artefacts and Environments*, Sydney, Australia: ACM, 2006, s. 15-22.
- [29] R.G. Adams a R. Blieszner, "Aging Well With Friends and Family," *American Behavioral Scientist*, vol. 39, 1995, s. 209-224.
- [30] T. Kawamura, K. Umezu, a A. Ohsuga, "Mobile Navigation System for the Elderly --- Preliminary Experiment and Evaluation," *Proceedings of the 5th international conference on Ubiquitous Intelligence and Computing*, Oslo, Norway: Springer-Verlag, 2008, s. 578-590.
- [31] N. Krause, "Longitudinal study of social support and meaning in life," *Psychology and Aging*, vol. 22, Zář. 2007, s. 456-469.
- [32] W. Gaver a A. Dunne, "Projected realities: conceptual design for cultural effect," *Proceedings of the SIGCHI conference on Human factors in computing systems: the CHI is the limit*, Pittsburgh, Pennsylvania, United States: ACM, 1999, s. 600-607.
- [33] Bible, *Holy Bible, Giant Print Presentation Edition: King James Version*, Oxford University Press, USA, 2000.
- [34] K. Hofmeester, A. Dunne, B. Gaver, M. Susani, a E. Pacenti, "A modern role for the village elders," *CHI '99 extended abstracts on Human factors in computing systems*, Pittsburgh, Pennsylvania: ACM, 1999, s. 43-44.
- [35] K. Olsevicova a P. Mikulecky, "Learning management systems as an ambient intelligence playground," *Int. J. Web Based Communities*, vol. 4, 2008, s. 348-358.
- [36] A. Dix, "Designing for appropriation," *Proceedings of the 21st British HCI Group Annual Conference on HCI 2008: People and Computers XXI: HCI...but not as we know it - Volume 2*, University of Lancaster, United Kingdom: British Computer Society, 2007, s. 27-30.